Technical Memorandum

To: Jeff Lerud, NDOT

Date: July 31, 2020

From: Jack Sjostrom, CA Group

Subject: I-15 from Flamingo to Sahara: Ultimate Ideas Review Memorandum – Revision 1

Copies: I-15 from Flamingo to Sahara Technical Advisory Committee (TAC)

Introduction

Interstate 15 (I-15) is the primary transportation corridor in southern Nevada connecting to California and Arizona. Over the past three decades, the Nevada Department of Transportation (NDOT) has been making investments in improvements to I-15 to keep up with the growth in the Las Vegas area. The section of I-15 between Flamingo Road and Sahara Avenue is the last section to be upgraded adjacent to the resort corridor (Las Vegas Strip). Recently completed projects include NDOT's I-15 South Design-Build Project (Silverado Ranch Boulevard to Tropicana Avenue) to the south and NDOT's Project NEON (Sahara Avenue to I-15/US95/I-515 Interchange) to the north.

The I-15 from Flamingo to Sahara Feasibility Study was initiated by NDOT to develop and evaluate alternatives primarily focusing on improving I-15 safety and traffic operations, and to identify right-of-way needs to accommodate future traffic demands.

The Feasibility Study is prepared based on the Federal Highway Administration's (FHWA) guidance for Planning and Environmental Linkages (PEL) so that the study can be used as the basis for subsequent project development under the National Environmental Policy Act (NEPA) and its implementing regulations as contained in 23 CFR 771 and 40 CFR. These regulations require that the NEPA process explores and evaluates all reasonable ideas to the proposed action.

The purpose of this Ultimate Ideas Review Memorandum is to document the ultimate ideas developed during the alternatives workshop that are compatible with the project's purpose and need. This memorandum also identifies which ultimate ideas should be carried forward for further development screening.

Project Study Area

The Feasibility Study covers an area of approximately 4.5 miles on I-15, as shown in Figure 1. The northern limit is Sahara Avenue (the southern end of NDOT's Project NEON) and the southern limit is I-15/I-215/CC-215 system interchange. These endpoints form the logical termini of this study, allowing for the development of a project that can be constructed alone, serves a meaningful purpose, and addresses environmental impacts on a sufficient scale. The project study area includes six interchanges with I-15: Sahara Avenue, Spring Mountain Road, Flamingo Road, Tropicana Avenue, Russell Road, and I-15/I-215/CC-215 system interchange. Additionally, seven grade separations exist within the corridor; Desert Inn Road (over I-15), Union Pacific Railroad (UPRR) (under I-15), Dean Martin Drive (under I-15), Twain Avenue (under I-15), Harmon Avenue (over I-15), Hacienda Avenue (over I-15), and Sunset Road (over I-15).

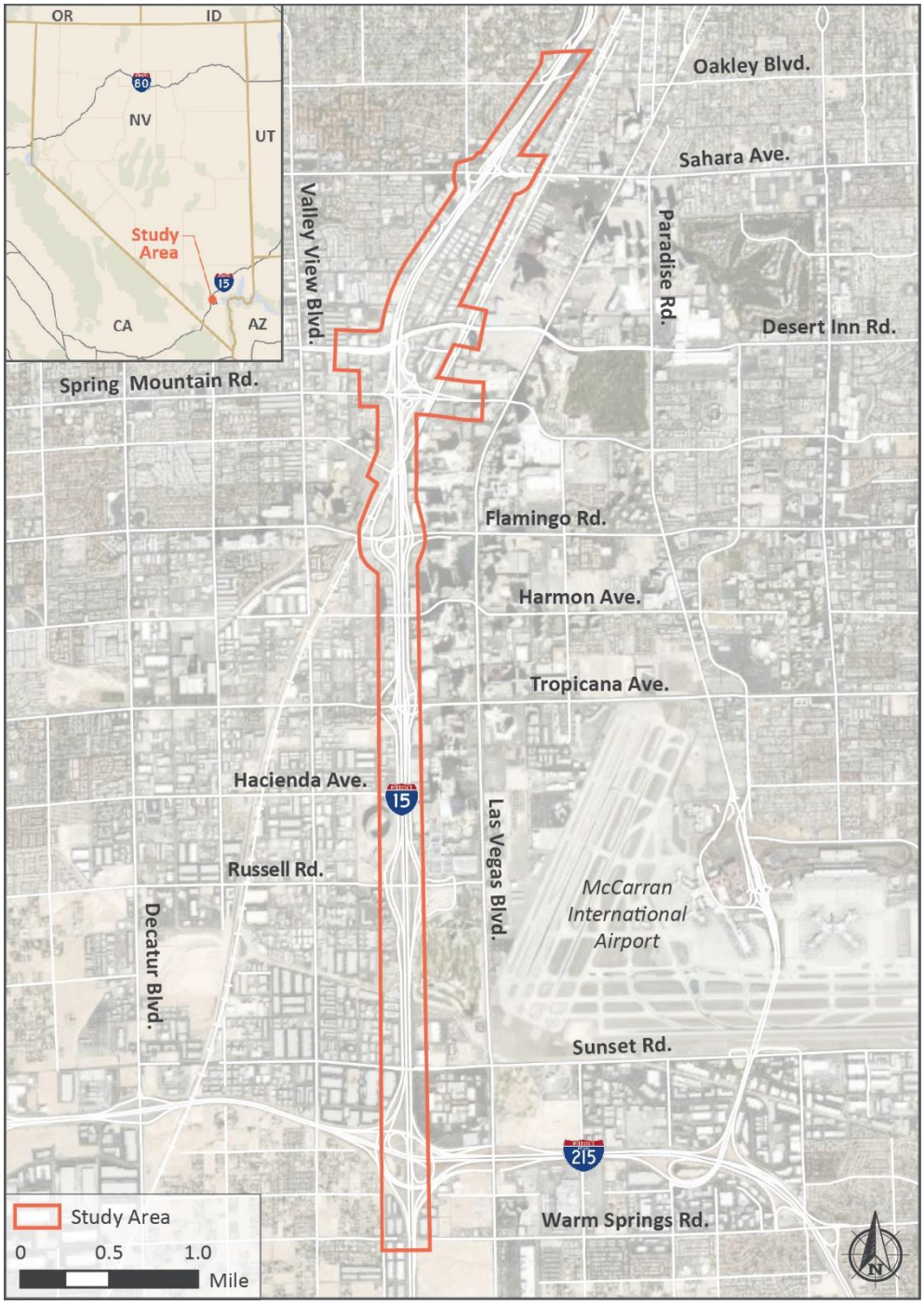


Figure 1. Study Area and Logical Termini

Study Process

The first step in the study process was to define the project's purpose and need, three levels of alternatives development and screening were held as part of this Feasibility Study. Level 1 is an evaluation to eliminate ideas that have fatal flaws. Level 2 is a comparative screening of ideas based primarily on qualitative criteria to identify and rank ideas that could satisfy the purpose and need. Level 3 is a detailed screening and refinement of conceptual alternatives to determine which conceptual alternative or alternatives could best meet the purpose and need for the project. Figure 2 shows the screening process.

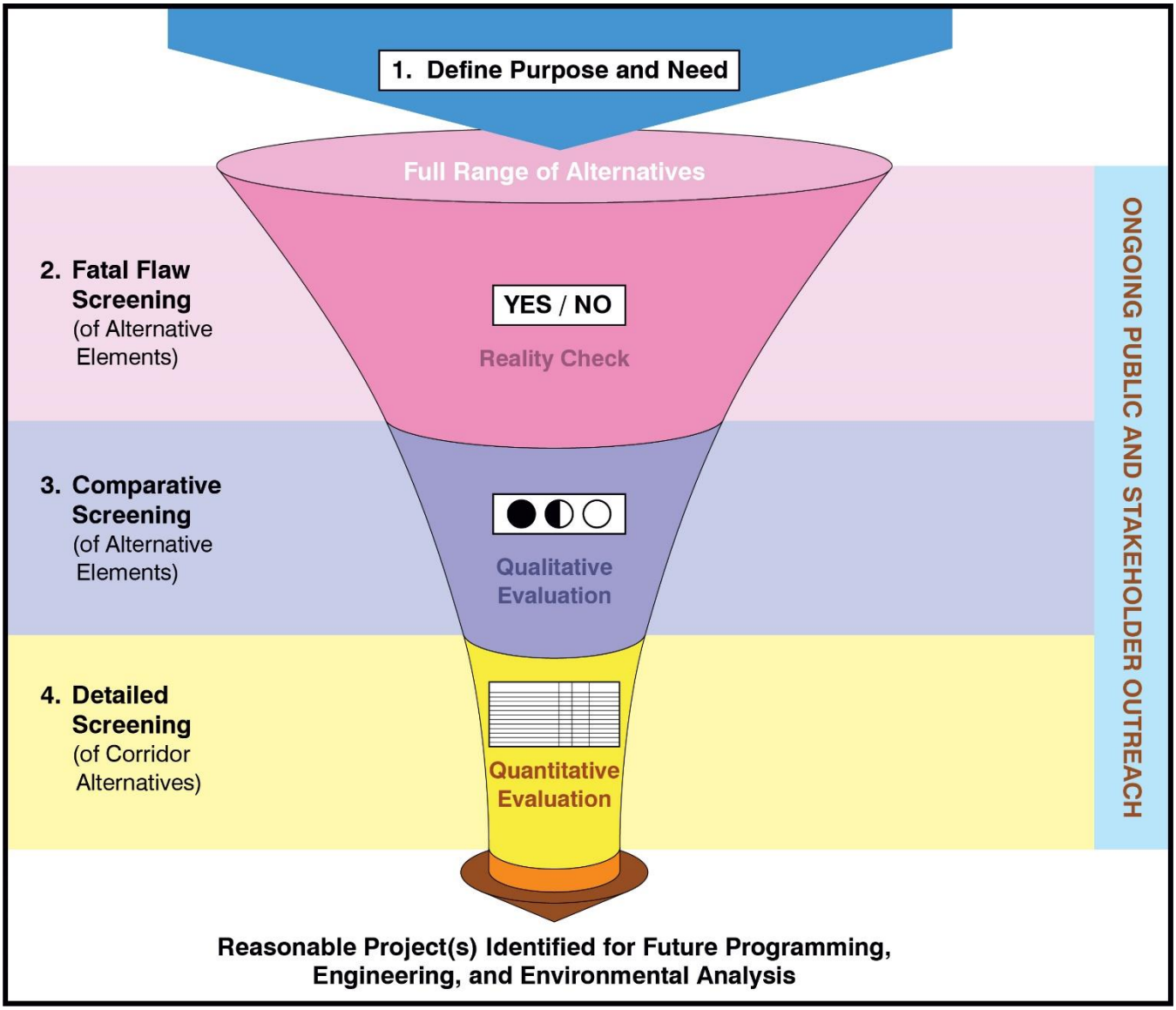


Figure 2. Alternatives Development Screening Process

Project Purpose and Need

The purpose and need of a project provides the basis for identifying, evaluation, and screening alternatives, leading to alternatives recommended for further study. At the onset of this Feasibility Study, the transportation needs of the study area were identified and analyzed. From this effort, a purpose and need statement was developed. A more detailed and refined purpose and need statement will be developed following completion of the Feasibility Study, as the project is further developed in the NEPA process.

Congestion within the I-15 corridor creates delay for all users. Additional traffic demand generated by the added capacity improvements to the north and south (Project NEON and I-15 South Design-Build) creates a pinch point in the study corridor without adequate capacity. The purpose of the proposed project is to:

- Resolve existing roadway deficiencies
- Provide transportation improvements to serve existing and future growth areas
- Accommodate regional and local plans

Alternatives Development and Evaluation

A wide range of ideas were developed that included feasible improvements on the freeway, its interchanges, and adjacent local streets, including concepts on both existing and new alignments. The process of developing and screening ideas considered the following:

- Reasonableness of an idea
- Meets the purpose and need for the project
- Ability to avoid or minimize environmental impacts
- Regional planning context
- Stakeholder input
- State and federal requirements

A four-step alternatives development and screening process was carried out to identify the candidate ideas to be studied in detail in the Feasibility Study, supporting PEL checklist, and subsequent NEPA document, as shown in Figure 2. The four steps include:

1. Develop preliminary ideas based on purpose and need
2. Conduct screening based on fatal flaws (Level 1)
3. Conduct screening based on preliminary comparative analysis (Level 2)
4. Conduct detailed screening based on comparative analysis (Level 3)

Alternatives Development Workshop

The Alternatives Development Workshop was held early in the study process to create improvement ideas that served the overall project need and NDOT's desire to identify future right-of-way needs. The workshop was held on June 24 through 26, 2019 and participants included NDOT staff, representatives from City of Las Vegas, Clark County, and RTC, national experts with specific experience in constrained urban interstate corridor development from other major cities, and local (Las Vegas) consultant staff.

The workshop resulted in a total of 80 concepts being prepared for screening. Each idea is a discreet

improvement, such as a ramp modification or addition of a new auxiliary lane, with the overall intent to package feasible ideas into conceptual alternatives .The workshop identified many ideas to be considered, either individually, or in combination, as possible solutions to current or anticipated problems in the I-15 corridor within the study area. On July 3, 2019, the complete list of the ideas developed at the workshop was circulated among the workshop attendees for concurrence on the ideas listed and their descriptions. On July 29, 2019, a team comprised of NDOT and CA Group convened to review the alternatives workshop ideas and to conduct an initial pass/fail screening.

The workshop used a collaborative decision-making process to develop a consensus among the attendees, including NDOT and FHWA, on the elements of the ideas. At this point, the collaborative decision-making process approved ideas to be further developed and evaluated during the next phase of alternatives development and screening.

Screening Criteria

Workshop participants identified criteria for qualitative and quantitative evaluation of transportation improvement ideas as:

- **Safety:** considers whether the idea could meet design criteria without need for design exceptions and improve safety for users. Ideas that meet design criteria would score higher, e.g., free-flow directional movements would be considered superior to a signalized intersection.
- **Mobility:** considers whether the idea could provide opportunities for users to efficiently move from their origin to their destination and minimize delay. An idea that connects motorists to their destination would score higher than an idea that requires them to travel out of their way.
- **Accessibility:** considers whether the idea could maintain existing connections or add access points between the local road network and the interstate highway system.
- **Compatible with other Plans/Studies:** considers the impacts to future improvements within the I-15 Resort Corridor. These include, but are not limited to, the I-15 South Design-Build, the I-15 Tropicana Interchange preliminary design, and Project NEON.
- **Implementability:** considers relative construction costs of the idea, ease of construction, potential right-of-way impacts, and whether the idea would likely be accepted by the public. This includes assumptions of magnitudes for any (if needed) right-of-way acquisitions or easements. Detailed estimates of construction costs are not available for each of the ideas because they have not been fully developed, but engineering judgement has been applied to compare order of magnitude costs. Higher comparative cost would result in a lower score, but high cost is not considered to be a fatal flaw.
- **Environmental Impacts:** considers whether the idea could result in substantial impacts to the environment such as potential residential or business relocations, environmental justice populations, or encounter existing hazardous waste or materials.
- **Schedule Impact:** considers whether the idea would result in need for additional right-of-way, UPRR impacts, or utility relocations that could lead to delays in implementation.

Scoring Criteria

The scoring criteria is summarized in Table 1, feasible ideas are scored subjectively and qualitatively ranking them against each criterion on a scale of 0-4. A low score of zero or one is not considered to be a fatal flaw. Ideas determined to contain fatal flaws are not scored. Each criterion carries equal weight. The average of the seven scores is used to compare one idea to others.

TABLE 1 - SCORING CRITERIA FOR COMPARATIVE DIFFERENCES BETWEEN IDEAS

CRITERIA	0 (POOR)	1 (NEUTRAL)	2 (GOOD)	3 (BETTER)	4 (BEST)
SAFETY	Worse than existing, several design exceptions	Comparable to existing with similar number of design exceptions	Slightly better than existing with fewer design exceptions	Better than existing	Much better than existing, no design exceptions needed
MOBILITY	Out of direction travel	Comparable to existing	Slightly better than existing	Better than existing	Much better than existing
ACCESSIBILITY	Existing movements not retained	Comparable to existing	Slightly better than existing	Better than existing	Much better than existing
COMPATIBLE WITH OTHER PLANS/STUDIES	Major Impacts	Moderate impacts	Modest impacts	Minimal impacts	No impacts
IMPLEMENTABILITY	High relative cost and low public acceptance	High relative cost or expected low public acceptance	Moderate cost and expected moderate public acceptance	Low relative cost or expected general public acceptance	Low relative cost and expected high public acceptance
ENVIRONMENTAL IMPACTS	Major impacts that NDOT will not consider (i.e. acquisition of hotel/casino, residential tower, or shopping mall)	Potential impacts could be considered significant even with mitigation	Potential impacts could be mitigated to be not significant	There are some potential impacts, but they are considered minimal	There no potential impacts
SCHEDULE	R/W relocations; UPRR impacts; major utility relocations	R/W relocations; or UPRR impacts; major utility relocations	R/W without need for relocations; moderate utility impacts	Minimal R/W needed; modest utility impacts	No new R/W; No major UPRR or utility impacts

Level 1 Screening (Fatal Flaw Screening)

Alternatives workshop participants identified 80 ideas for transportation improvements within the study area. The Level 1 screening evaluation was intended to eliminate ideas that have fatal flaws. The following criteria were applied to screen unfeasible ideas from further consideration:

- does not preserve or is not related to preserving the I-15 right-of-way to align with future and ongoing projects,
- is outside the project's planning study limits,
- would require revision to an adjacent project with an approved NEPA decision
- would require reconfiguration of the entire I-15 corridor beyond the project's planning study limits, or
- was found not to be geometrically feasible and was therefore eliminated as having fatal flaws.

Twenty-three of the workshop's 80 ideas were eliminated based on the criteria listed above. The elimination of these ideas from further consideration was presented to workshop attendees via email. No objections were made on these pass/fail results.

Level 2 Screening – Ultimate Ideas

The comparative screening process reviewed the 53 ultimate ideas (and 4 interim ideas) for compatibility with each other and other improvements within the study area. A cutoff was established for evaluating ultimate ideas, requiring a total idea score of 2.00 or greater for ultimate ideas to advance to the detailed screening process. Lower scoring ultimate ideas (in whole or in part) could be added back for consideration in subsequent phases of alternatives development if it is determined that ultimate ideas initially thought to be superior are determined by subsequent analysis to not be as effective as anticipated. Using this cutoff score, 23 ultimate ideas were advanced for quantitative evaluation. The ultimate ideas are also summarized by rank in Table 2.

The following is a summary of each of the ultimate ideas, the score, and the design development team's recommendation to NDOT for implementation. The ideas are discussed in order of highest to lowest scores.

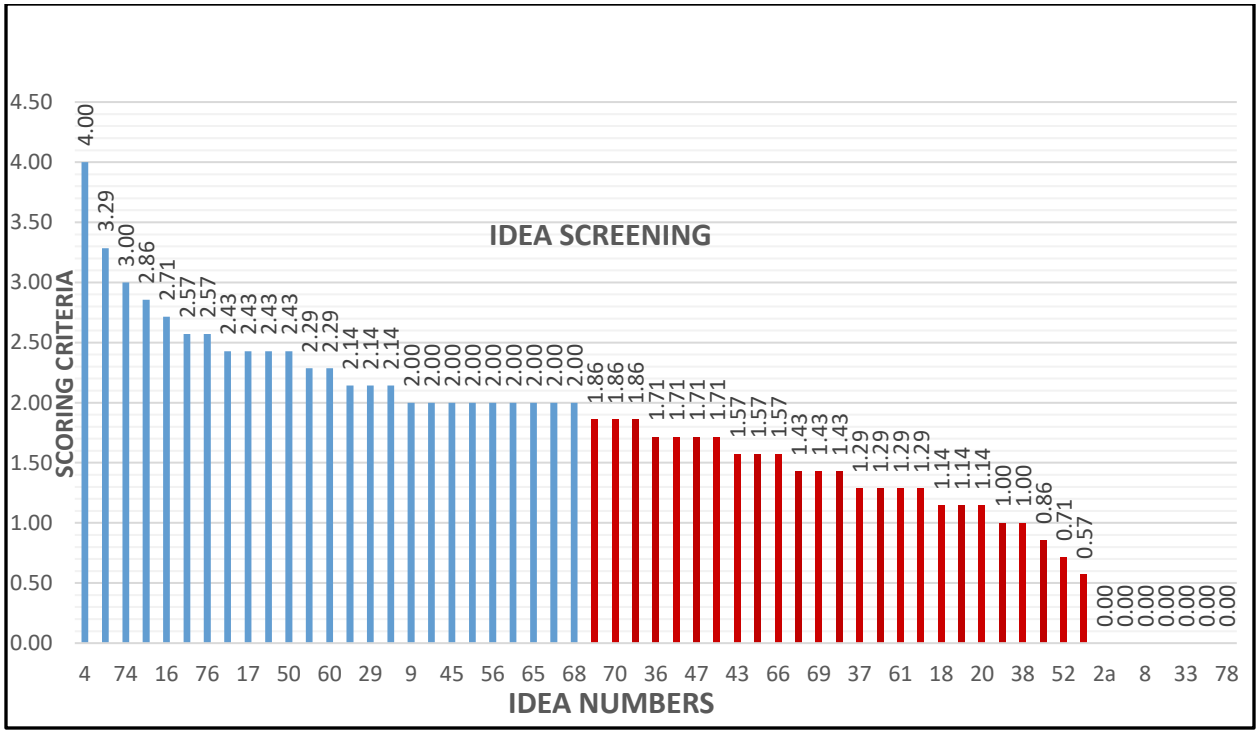


Table 2. Idea Screening Results

Ultimate Ideas

Idea No. 14 (Score - 3.29)

Idea No. 14 proposes to convert the existing I-15/Flamingo Road interchange to a typical diverging diamond interchange (DDI) and to eliminate the I-15 southbound (SB) to Flamingo Road eastbound (EB) loop ramp. There is potential to move the SB ramps terminal intersection closer to the I-15 mainline. This idea minimizes impacts on the rest of the interchange.

It is feasible to convert the existing I-15/Flamingo Road interchange to a typical DDI. Traffic analysis would be required to evaluate the DDI configuration.

This idea would remove the SB to EB loop ramp and the existing pedestrian bridge at Flamingo Road.

Idea No. 74 (Score - 3.0)

Idea No. 74 proposes to add one lane to I-15 in each direction to provide 2-HOV lanes plus 4-GP lanes from the I-15 South Design-Build to Project NEON.

It is recommended to make 4-GP lanes the base condition for both northbound (NB) and SB I-15. This would add 1-GP lane on I-15 from Flamingo Road to Sahara Avenue. It is also recommended that 1-HOV lane be provided SB between the I-15 South Design-Build Project (I-215) limits and approximately Harmon Avenue, widening to 2-HOV lanes from Harmon Avenue to Project NEON's (Sahara Avenue) 2-HOV lanes. Between the I-15 South Design-Build Project limits and approximately Twain Avenue, 1-HOV

lane would be provided NB, widening to 2-HOV lanes from Twain Avenue to Project NEON's (Sahara Avenue) dual HOV lanes.

Idea No. 13 (Score - 2.86)

Idea No. 13 proposes to convert the existing I-15/Flamingo Road interchange to a modified DDI and maintain the I-15 SB to Flamingo Road EB loop ramp with a separate roadway outside of the DDI.

It is feasible to convert the existing I-15/Flamingo Road interchange to a typical DDI. Traffic analysis would be required to evaluate DDI configuration.

Idea 13 is similar to Idea No. 14, except the SB I-15 to EB Flamingo Road loop ramp would remain.

It is not geometrically feasible to maintain the SB to EB loop ramp and construct the separate roadway over I-15. This idea also would remove the existing pedestrian bridge.

Idea No. 16 (Score - 2.71)

Idea No. 16 proposes to reconstruct the I-15/Spring Mountain Road interchange to a typical DDI.

It is feasible to reconstruct the interchange to a modified DDI with the I-15 SB to EB Spring Mountain Road flyover ramp. It is recommended to modify the existing I-15 SB to EB Spring Mountain Road flyover ramp to accommodate 2-HOV, 4-GP and 1-auxiliary lanes on I-15 SB and to retain the existing I-15 NB to Highland Drive direct access ramp. Traffic analysis would be required to evaluate DDI and the existing configurations.

In order for the I-15/Spring Mountain Road DDI to operate efficiently, it would be necessary to relocate the existing access to the property on the southwest corner of Spring Mountain Road and I-15 from Spring Mountain Road to Polaris Avenue.

Idea No. 12 (Score - 2.57)

Idea No. 12 proposes to braid the I-15 NB on-ramp from Tropicana Avenue with I-15 NB off-ramp to Flamingo Road.

It is feasible to braid the Tropicana Avenue NB on-ramp and Flamingo Road NB off-ramp.

During the concept evaluation, it was determined that due to the proximity of Frank Sinatra Drive and NB I-15 between Tropicana Avenue and Flamingo Road, the existing right-of-way could not accommodate the 1-HOV and 6-GP lanes on NB I-15, HOV ramps to Harmon Avenue, and a NB CD road to Flamingo Road lane configuration. It is recommended to acquire additional right-of-way and to restripe the SB Frank Sinatra Drive between Park Avenue and Harmon Avenue (see Figure 3).

Figure 3 – Idea No. 12 – Frank Sinatra Drive restripe

Idea No. 76 (Score - 2.57)

Idea No. 76 proposes to braid all ramps.

It is feasible to braid the Russell Road NB on- ramp with the NB CD road to Tropicana Avenue; the Tropicana Avenue NB on-ramp with the Flamingo Road NB off-ramp; the Flamingo Road SB on-ramp with the Tropicana Avenue SB off-ramp; and the Spring Mountain Road SB on-ramp with the Flamingo Road SB off-ramp.

It is not feasible to braid the NB Spring Mountain Road on-ramp with the Sahara Avenue NB off-ramp. The distance between westbound (WB) Spring Mountain Road to NB I-15 on-ramp and Sahara NB off-ramp painted gore is over 4800 feet. It is recommended to retain the existing NB Spring Mountain Road off-ramp and the NB Flamingo Road on-ramp cross over.

Idea No. 1 (Score - 2.43)

Idea No. 1 proposes to provide full HOV access at Harmon Avenue and Meade Avenue and develop improved through street along Meade Avenue for continuous east-west access.

The I-15/Harmon Avenue full interchange was dismissed by Southern Nevada HOV Update but would provide HOV access from Harmon Avenue to SB I-15 and from NB I-15 to Harmon Avenue.

It is recommended to provide enough right-of-way with I-15 NB re-alignment to the east to accommodate full HOV access at Meade Avenue and for continuous east-west access and to accommodate the City of Las Vegas Martin Luther King Boulevard extension project.

Idea No. 17 (Score - 2.43)

Idea No. 17 proposes to reconstruct the I-15/Spring Mountain Road interchange to include roundabouts while maintaining the existing flyovers if needed for traffic capacity.

It is not feasible to reconstruct the I-15/Spring Mountain Road interchange to roundabouts. The roundabout on the west side of I-15 would require a substantial right-of-way acquisition, as shown in Figure 4. This idea also not feasible because of high traffic volumes and roundabouts may not operate efficiently with high traffic volumes. The traffic volumes are based on the design year (2040). Idea No. 17 is not recommended for further analysis.

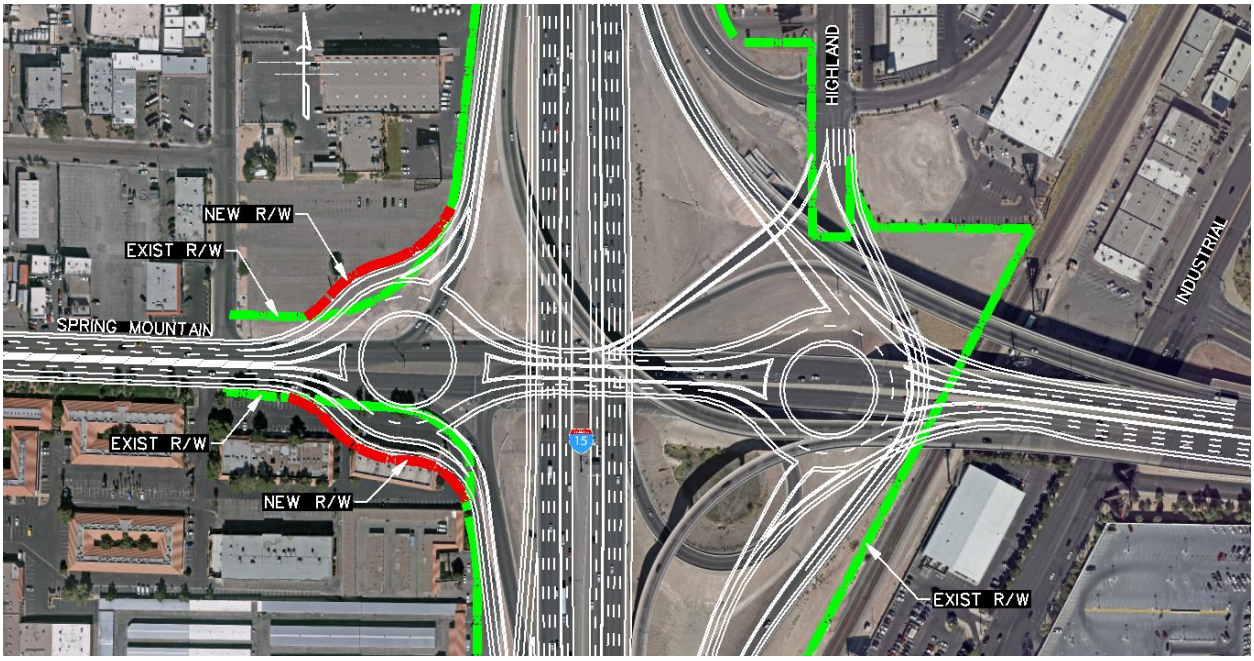


Figure 4 – Idea No. 17 - Roundabout Interchange Configuration at Spring Mountain Road

Idea No. 34 (Score - 2.43)

Idea No. 34 proposes to modify the I-15/Flamingo Road interchange to a DDI or a Single Point Diamond Interchange (SPDI).

Idea 34 is similar to Idea Nos. 13 and 14.

It is recommended that all interchange configurations in the study area should be evaluated for the optimal operation. FHWA guidance states that adjacent interchanges should not have wildly differing configurations in order to maintain driver expectations. The appropriate interchange type should be selected depending upon the most efficient operations for all locations within the study area.

Idea No. 50 (Score - 2.43)

Idea No. 50 proposes to reconstruct the Tropicana Avenue SB off-ramp further north and braid with the Flamingo Road SB on-ramp. It would remove I-15 SB to Flamingo Road EB loop ramp and combine it with the WB off-ramp. A flyover would be constructed for the Flamingo Road EB off-ramp. The Flamingo Road SB on-ramp would be relocated to increase vehicle entry speed, but the current location could work for braided ramps.

It is feasible to reconstruct the Tropicana Avenue SB off-ramp just south of Flamingo Road and braid Tropicana Avenue SB off-ramp with the Flamingo Road SB on-ramp. This idea would remove I-15 SB to Flamingo Road EB loop ramp and combine it with the WB off-ramp.

During the concept evaluation, it was found that due to the proximity between Dean Martin Drive and SB I-15 between Tropicana Avenue and Flamingo Road, the existing right-of-way could not accommodate the 1-HOV and 5-GP lanes on SB I-15, HOV ramps from Harmon Avenue, and a SB CD

road to Tropicana Avenue lane configuration. It is recommended to acquire additional right-of-way and to restripe Dean Martin Drive between Flamingo Road and Tompkins Avenue (see Figure 5).

Figure 5 – Idea No. 50 – Tropicana Avenue SB off-ramp and Flamingo Road SB on-ramp

Idea No. 28 (Score - 2.29)

Idea No. 28 proposes to add a SB to EB flyover ramp to the Flamingo Road interchange similar to the existing Tropicana Avenue or Spring Mountain Road interchanges and remove the SB to EB loop ramp. This would provide pedestrian access on the south side of the I-15/Flamingo Road structure, which could provide improved multimodal opportunities on Flamingo Road and improved access to Dean Martin Drive.

Geometrically, the proposed Flamingo Road EB off-ramp flyover is feasible. But it is recommended to consider and change the flyover concept to a SPDI or DDI at Flamingo Road.

The SPDI concept would require widening the existing Flamingo Road bridge over I-15 and would remove the existing pedestrian bridge.

Traffic analysis would be required to evaluate these configuration alternatives.

Idea No. 27 (Score - 2.14)

Idea No. 27 proposes to extend the Tropicana Avenue NB on-ramp and braid with the Flamingo Road off-ramp (north of Harmon Avenue); and combine the Tropicana Avenue NB on-ramp with Flamingo Road NB on-ramp (creating a CD road) on the existing Spring Mountain Road bridge.

It is not feasible for a third level CD road over Flamingo Road. It is not feasible to braid Flamingo Road NB off-ramp north of Harmon Avenue with Tropicana Avenue NB on-ramp which would require right-of-way acquisition along Frank Sinatra Drive and a re-alignment of Frank Sinatra Drive further to the east. Idea No. 27 is not recommended for further analysis.

Idea No. 29 (Score - 2.14)

Idea No. 29 proposes to construct a connection between Highland Drive and Sammy Davis Jr Drive/Frank Sinatra Drive/Industrial Road either over or under the UPRR tracks; and construct a conventional I-15 interchange. Idea No. 29 would remove the EB Spring Mountain Road to NB I-15 loop on-ramp; and replace with WB to NB high-speed on-ramp.

It is not feasible to add a third level over or under Spring Mountain Road and Idea No. 29 is not recommended for further analysis.

It is feasible to convert the existing I-15/Spring Mountain Road interchange to a typical DDI or SPDI. Traffic analysis would be required to evaluate if the existing I-15/Spring Mountain Road interchange, or a typical DDI, or typical SPDI configuration would perform better.

Idea No. 54 (Score - 2.14)

Idea No. 54 proposes to construct parallel one-way frontage roads from south of Spring Mountain Road to Sahara Avenue to complement a simplified interstate system that meets driver expectations.

It is recommended to braid the SB Spring Mountain Road exit with the Sahara Avenue on-ramp and create a CD road for the Flamingo Avenue and Tropicana Avenue exits the CD road exit would be braided with the Spring Mountain Road on-ramp to I-15.

On I-15 NB, braid the Flamingo Road off-ramp and Tropicana Avenue on-ramp, maintain the existing braided condition of the Spring Mountain Road off-ramp and Flamingo Road on-ramp.

Idea No. 9 (Score - 2.0)

Idea No. 9 proposes to use a CD road and braided ramps. This idea limits access between adjacent cross streets and reduces friction on the I-15 mainline.

Idea 9 is similar to Idea Nos. 54 and 76.

It is recommended to braid the SB Spring Mountain Road exit with the Sahara Avenue on-ramp and create a CD road for the Flamingo Avenue and Tropicana Avenue exits. The CD road exit would be braided with the Spring Mountain Road on-ramp to I-15.

On I-15 NB, braid the Flamingo Road off-ramp and Tropicana Avenue on-ramp, maintain the existing braided condition of the Spring Mountain Road off-ramp and Flamingo Road on-ramp.

It is also recommended to replace the Harmon Avenue bridge pier to accommodate the NB CD road.

Idea No. 26A (Score - 2.0)

Idea No. 26A proposes to reconfigure the Tropicana Avenue, Flamingo Road, and possibly Spring Mountain Road exits into a SB CD road.

(Idea No. 26 - Combine Tropicana SB off-ramp with Spring Mountain SB on-ramp onto a CD road. Braid with Flamingo SB off-ramp, allowing Spring Mountain SB on-ramp to enter I-15 immediately after then, Flamingo SB on-ramp enters mainline I-15 further downstream.)

Idea 26A is similar to Idea No. 76.

The SB Spring Mountain Road off-ramp would be braided with the SB Sahara Avenue on-ramp in the future phase of Project NEON. It is recommended to maintain the braided condition. It is also recommended to braid the SB Flamingo Road off-ramp with the SB Spring Mountain Road on-ramp and to braid Tropicana Avenue SB off-ramp with the Flamingo Road SB on-ramp.

Idea No. 45 (Score - 2.0)

Idea No. 45 proposes to braid the Tropicana Avenue NB off-ramp with Russell Road NB on-ramp. This would pull the NB I-15 mainline traffic further south allowing for greater weaving distance between the

Flamingo Road NB off-ramp and Spring Mountain Road NB off-ramp.

It is recommended to merge CC-215 EB to I-15 NB with a slip-ramp at Sunset Road as seen in Figure 6. The Tropicana Avenue and Russell Road off-ramps from NB I-15, I-215 EB and CC-215 EB would be combined through the NB CD road. The NB CD road would then be braided with the Russell Road NB on-ramp. Shift and maintain the second Tropicana Avenue off-ramp located south of Russell Road by a 1000 ft to the north. This would allow a greater weaving distance between WB I-215 to NB I-15 and Tropicana NB off-ramp.

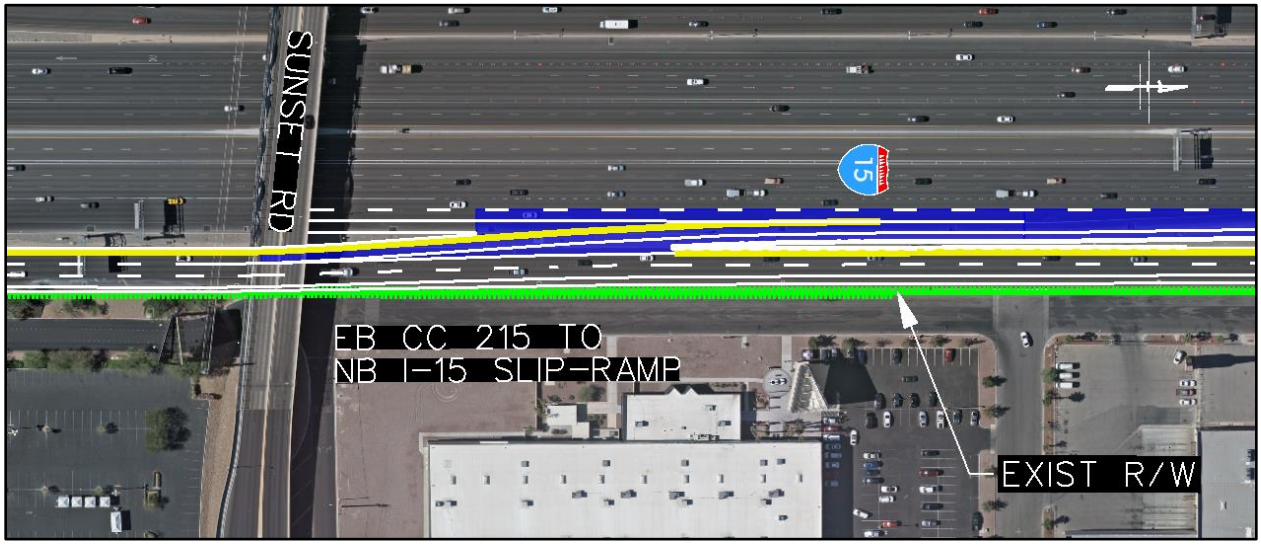


Figure 6 – Slip-Ramp from EB CC 215 to NB I-15

Idea No. 46 (Score - 2.0)

Idea No. 46 proposes to combine the Tropicana Avenue NB on-ramp with the Flamingo Road NB on-ramp to braid together under the Spring Mountain Road NB off-ramp. This would allow for more free flow movements off to Flamingo and Spring Mountain roads. This idea works with Idea No. 45.

It is not feasible to add a third level CD road over Flamingo Road and this idea is not recommended for further analysis. This idea requires right-of-way acquisition and a re-alignment of Frank Sinatra Drive further to the east.

Idea No. 56 (Score - 2.0)

Idea No. 56 proposes to move the CC-215 WB off-ramp (SB CD Road on-ramp) further south to reduce backup and conflicts with the Tropicana Avenue SB on-ramp, then braid the Flamingo Road SB on-ramp and Tropicana Avenue SB off-ramp.

It is not recommended to move the CC-215 WB off-ramp (SB CD Road on-ramp) further south. Existing distance between the painted gores of SB Russell Road off-ramp and SB Tropicana Avenue on-ramp is almost 1600 feet. Moving the off ramp to the south will exacerbate the weaving distance between the SB Tropicana on-ramp and the SB Russell Road off-ramp and the SB CD road split.

It is feasible and recommended to braid the Flamingo Road SB on-ramp and Tropicana Avenue SB off-ramp.

Idea No. 57 (Score - 2.0)

Idea No. 57 proposes to remove the existing Flamingo Road SB to EB loop ramp and combine with the extended SB to EB off-ramp and reconstruct existing Spring Mountain Road SB on-ramp and braid with reconstructed Flamingo Road SB off-ramp. This could be accomplished with a braid of the Spring Mountain Road SB on-ramp.

It is not feasible to install an additional signal on Flamingo Road between the two ramp termini existing signals for SB to EB movement only.

It is recommended and feasible to braid the SB I-15 off-ramp to Flamingo Road with Spring Mountain Road SB on-ramp. It is also recommended to change the Flamingo Road interchange to DDI or SPDI.

Idea No. 65 (Score - 2.0)

Idea No. 65 proposes to construct a DDI at Spring Mountain Road with the eastern crossover grade-separated. A traffic signal would be installed for the Western Avenue crossover where traffic volume is much lower. The south end of Highland Drive would be connected to Aldebaran Avenue.

It is feasible to construct a modified DDI at Spring Mountain Road with the eastern crossover grade-separated and with the western typical crossover with a traffic signal at the crossover.

The existing access to the property on the southwest corner of Spring Mountain Road and I-15 would be relocated from Spring Mountain Road to Polaris Avenue for the DDI configuration to operate efficiently (see Figure 7).

It is not feasible geometrically to connect Highland Drive to Aldebaran Avenue over I-15 and the Spring Mountain Road ramps and is not recommended for further analysis.

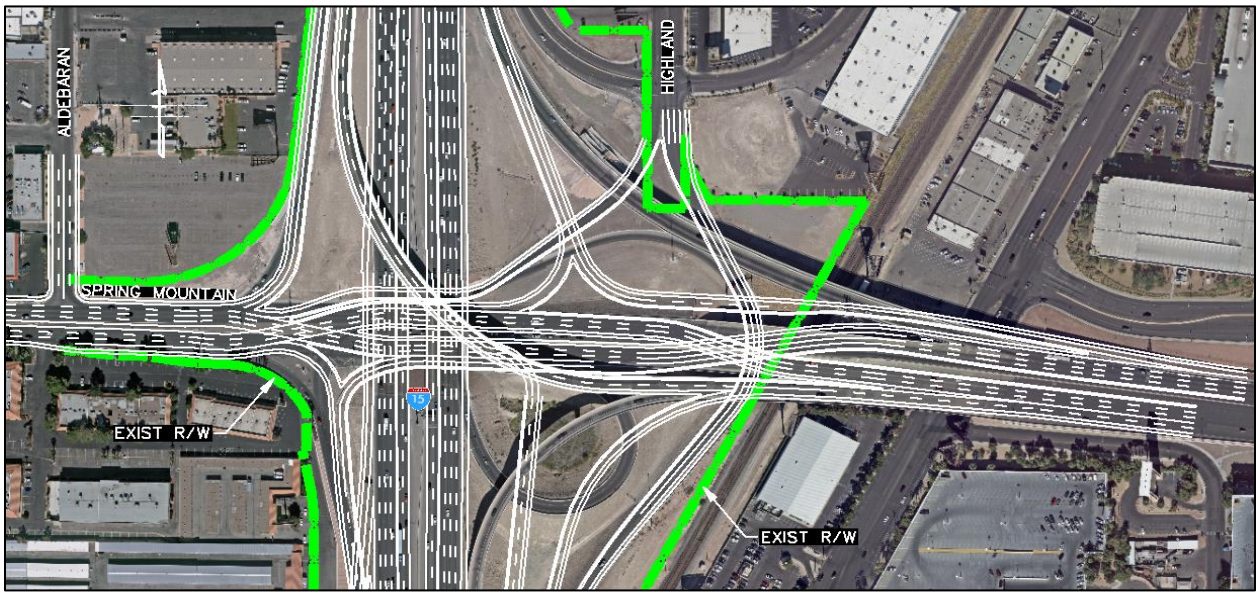


Figure 7 – Idea No. 65 – DDI Configuration at Spring Mountain Road – Grade Separated and Conventional Cross-over

Idea No. 67 (Score - 2.0)

Idea No. 67 proposes to construct a NB elevated CD road, Tropicana Avenue on-ramp to Spring Mountain Road off-ramp. This would require that the CD road merge earlier to the south (i.e., at Russell Road). The CD road would be constructed over Frank Sinatra Drive as needed. Harmon Avenue and Flamingo Road would have to be grade-separated with NB CD road. This idea may require the relocation of the power substation located in the NE corner of the I-15/Tropicana Avenue interchange.

It is not feasible to add a third level CD road and it is undesirable to relocate the power substation.

This idea would require major reconfiguration of I-15 NB CD on-ramp location to I-15. The elevated CD road would require substantial structures. This idea is not recommended for further analysis.

Idea No. 68 (Score - 2.0)

Idea No. 68 is the same as Idea No. 67, except the Tropicana Avenue on-ramp is braided over the CD road to I-15.

It is not feasible to add a third level CD road and it is undesirable to relocate the substation as described in Idea No. 67.

This idea would require a major reconfiguration of I-15 NB CD on-ramp location to I-15. The elevated CD road would require significant structures. This idea is not recommended for further analysis.

CONCLUSION

Out of the 53 ultimate ideas that were developed, 23 ultimate ideas scored greater than 2.00 and were considered for further evaluation. Seven of the ultimate ideas scored greater than 2.00 but are not recommended for further consideration. The remaining ultimate ideas are carried forward for further development and analysis as documented in the Alternatives Screening Report.

To: Jeff Lerud, NDOT
Date: February 3, 2020

From: Jack Sjostrom, CA Group

Subject: I-15 from Flamingo to Sahara: Interim Ideas Memorandum – Revision 1

Copies: Jeff Lerud, Dean Morton, Kevin Maxwell, Casey Sylvester, Eric MacGill, Casey Smith, NDOT; Ben Sprague, Atkins; Vinay Virupaksha, Project File, CA Group

INTRODUCTION

I-15 is a major corridor in southern Nevada connecting California to Utah. For the past three decades, Nevada Department of Transportation (NDOT) has been making significant investments on I-15 improvements to keep up with the growth in the Las Vegas area.

I-15 from Flamingo to Sahara Feasibility Study was initiated by NDOT to develop and evaluate alternatives primarily focusing on improving traffic operations, safety, and to accommodate future demand on I-15 and adjacent streets.

The purpose of this memorandum is to summarize some of the ideas developed during the alternatives workshop that are not necessarily compatible with the ultimate I-15 vision, but that might offer enhanced operations if implemented between now and when the feasibility study alternative is constructed – "interim" ideas. The Feasibility Study process is currently evaluating, screening, and combing the ideas from "I-15 from Flamingo Rd to Sahara Ave.: Screening of ideas" and developing alternatives for I-15 between Russell and Sahara.

There are four interim ideas, two of which passed the initial pass/fail screening. The following is a summary of each of the interim ideas and the design development team's recommendation to NDOT for implementation.

1. INTERIM IDEAS

1.1 Idea #4 (Overall Performance Average during Screening 4.0)

Use technology (smart signs) to manage truck/heavy vehicle traffic - signing specific lanes for truck use only through the corridor. Left or right most lanes (GP) can be mixed traffic.

*Note if less than 12' lanes are needed, recommend not using truck restricted lanes.

Idea conclusion

Enhanced ITS facilities have been implemented in the corridor by Project NEON. Truck management and lane designation should be part of the ATM (Active Traffic Management) plan. All projects should perpetuate ATM and allow enhancements as desired by NDOT during project development. This can happen with the installed ATM signs. Considered an interim improvement.

Review Comments:

An ATM strategy must be defined to deploy the system and for the system to enhance operations and function of I-15 throughout the corridor. It is understood that NDOT has a plan for the ATM system and will consider all use options.

Design considerations, requirements and elements for ATM could be found: FHWA ATM Publication

The most appropriate location for a truck lane, would be to bypass the weave areas between interchanges.

The concerns with this technology for purposes of this study area are:

- The system will only be successful when ATM directions are actively enforced
- The system is not valley-wide and could create confusion or be ignored
- A "trucks only" lane (or lanes) could create long trains of trucks, preventing normal vehicles from crossing or weaving to and from their entrance/exit ramps. This could also conflict with the center running HOV lanes and their access.

Recommendation:

It is recommended that NDOT consider implementing "truck lanes" during applicable hours, but consider the challenge with weaving, specifically with HOVs at service interchange access locations. Additional traffic analysis and congestion modeling should be performed to determine the performance of "truck only" lanes.

1.2 Idea #60 (Overall Performance Average during Screening 2.29)

Reconstruct Spring Mountain Rd SB on-ramp with a smaller pork chop island, decreased ramp entry angle, and increased right turn lane storage on EB Spring Mountain Road. This should reduce vehicle speeds on the EB approach to the on-ramp to be more comparable to WB entry speeds and reduce potential vehicle conflicts. This will also increase capacity/storage on EB Spring Mountain Rd.

Idea conclusion:

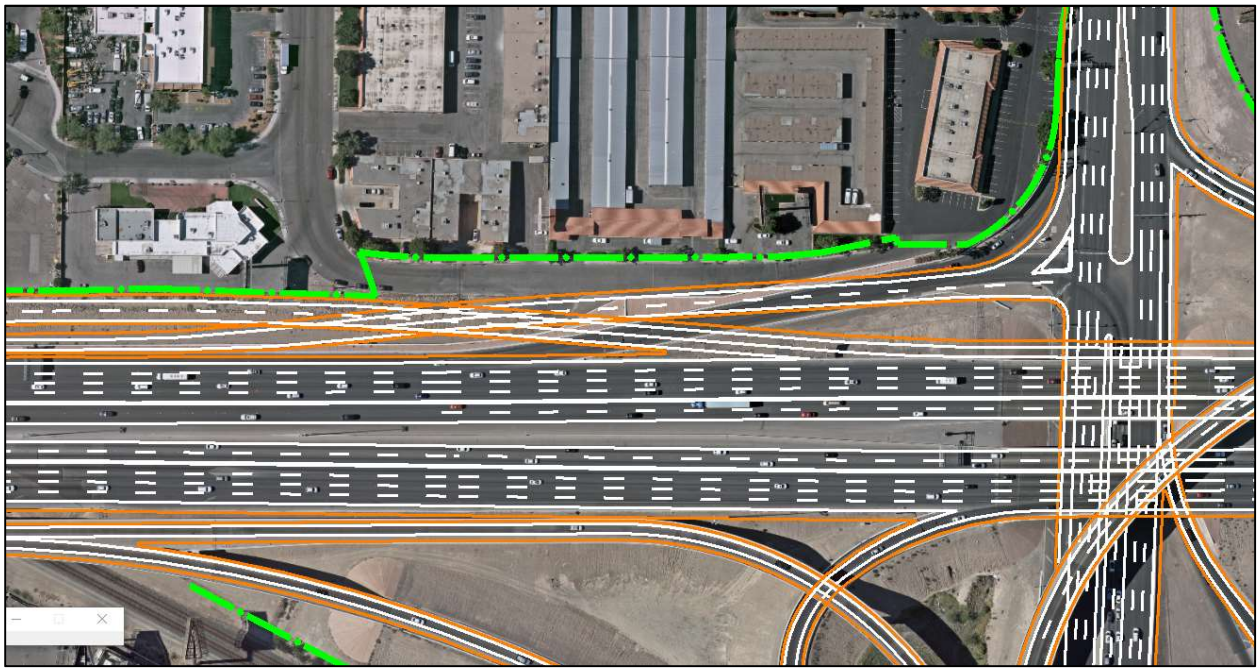
This idea may not align with other interchange ideas that would offer more benefit to the entire system. Consider it as an interim option.

Review Comments:

- The EB storage length could be increased by approximately 200' (need Traffic Operation Analysis to warrant the storage length)
- The ramp entry angle is decreased with a 20' lane at the island. The turning radius allows traversal by a WB-67.
- The painted gore to painted gore spacing between the Spring Mountain entrance and Flamingo WB exit on SB I-15 is approximately 1570 feet. The Spring Mountain ramp entrance and Flamingo WB exist ramp could be adjusted and extend the two-lane storage from the ramp meter stop bar.
- The existing on-ramp could also be widened to the inside to provide a 3 lane on-ramp up to the meter location,

Recommendation:

It is recommended that NDOT consider implementing a modified geometry and added ramp meter lane at the SB ramp entrance to increase storage for the EB to SB turn lane and expand the ramp meter storage in the interim. The existing geometry does not provide adequate storage, and ramp metering operation develops queues into Spring Mountain.



SB On-Ramp at Spring Mountain

1.3 Idea #58 (Overall Performance Average during Screening 1.71)

Reconstruct the Spring Mountain Rd interchange with I-15 as a Diverging Diamond Interchange (DDI) and eliminate direct access to Highland Dr.

Idea conclusion:

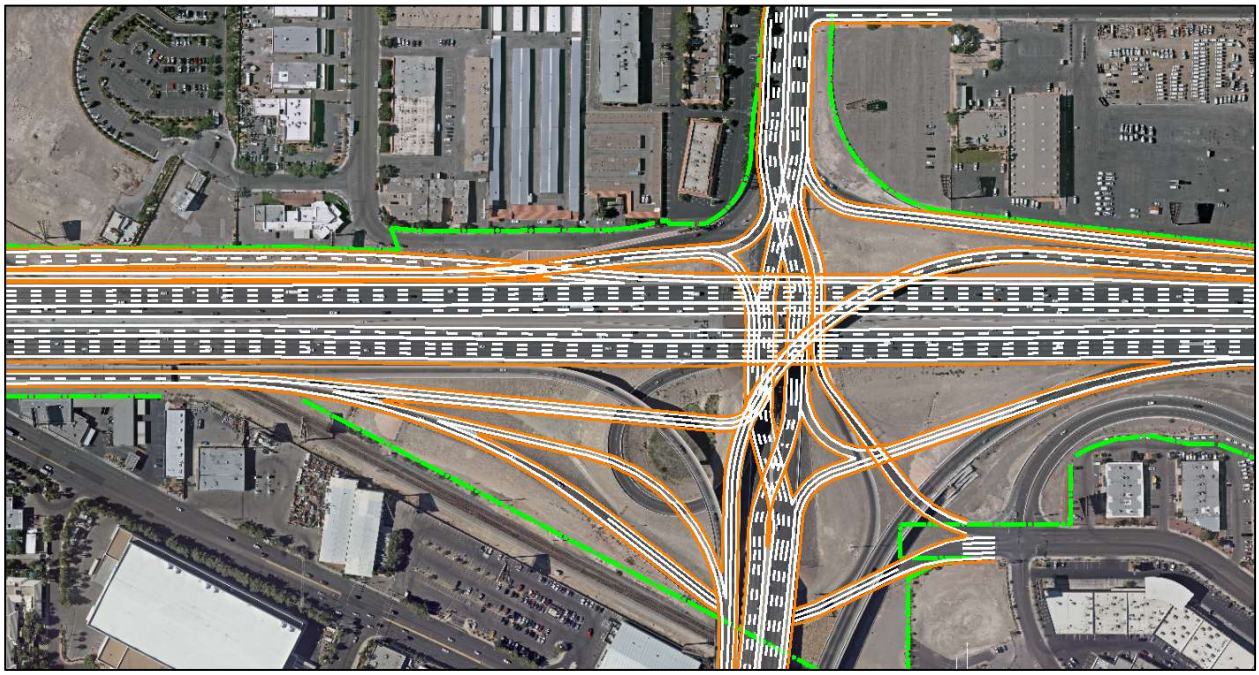
Elimination of access to Highland Dr. could be politically problematic. Removing the access to Highland Dr could be separate from converting Spring Mountain Rd to a DDI, which is already documented in another idea. The idea to remove direct access to Highland Drive without reconstructing the interchange will be considered as an interim improvement.

Review Comments:

- This idea, as an interim improvement, would be to remove the Highland access from the existing interchange movements. Reconfiguration of the interchange to a DDI, or a modified DDI will be evaluated as an ultimate concept.
- The removal of access may slightly enhance the operation of the interchange, but it will adversely impact local access, causing traffic to have adverse effects to adjacent interchanges and the intermediate roadway network.

Recommendation:

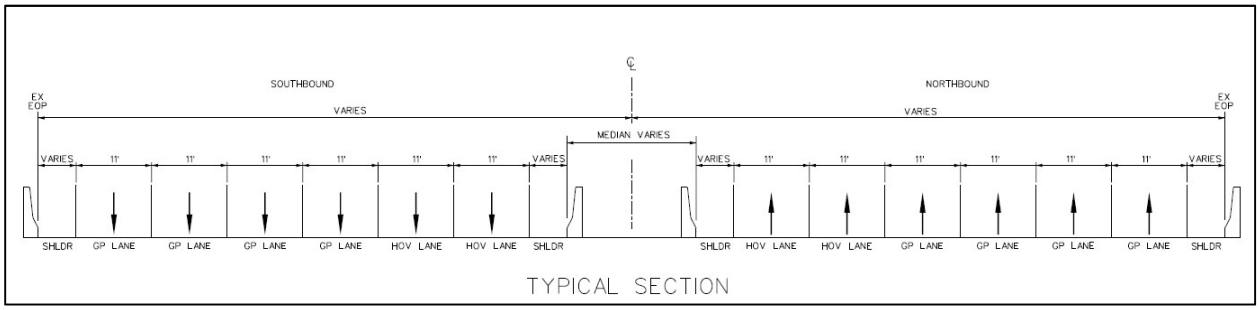
It is recommended that NDOT not consider removal of access to Highland as an interim improvement.



Modified SB On-Ramp at Spring Mountain

1.4 Idea #6 (Overall Performance Average during Screening 0)

Use of 11' lanes may allow an extra 10'-15' of space or allow room for an additional lane. The sketch below shows the approximate width needed between Tropicana Ave and Flamingo Rd - exclusive of the space needed for on-/off-ramps (if there are any in the final configuration). There will be many other constrained areas in the corridor. Eleven-foot lanes are commonly used in Seattle area and are not considered a "deviation". AASHTO allows for 11' lanes except in high truck volume areas.



Idea conclusion:

NDOT to consider 11' lanes for all projects to maximize ROW utilization, this can happen without any other improvements. Considered an interim improvement. Need to provide a continuous lane or not valuable. Defer to idea development.

Review Comments:

- Per AASHTO 4.3 and 7.3.3.2 "…Lane widths also affect roadway level of service. Narrow lanes force drivers to operate their vehicles closer to each other laterally than they would normally desire. Restricted clearances have a similar effect. In a capacity sense, the effective width of traveled way is reduced by adjacent obstructions such as retaining walls, bridge trusses or headwalls, and parked cars that restrict the lateral clearance…."

  "…Lane widths less 12' may be used in more constrained areas where truck and bus volumes are relatively low and speeds are less than 35 mph…"

  "…The 12' lane widths are desirable, where practical, on high-speed, free-flowing, principal arterials…"

- Decreasing the lane width will not improve traffic operations between Flamingo and Sahara.

There are constrained areas between Tropicana and Sahara on NB/SB I-15 which do not have the pavement width to accommodate a total of six 11' lanes (2-11' HOV and 4-11' GP lanes) along with minimum inside and outside shoulders. Currently, these locations have substandard inside and outside shoulder widths. The pictures below show the locations between Tropicana and Sahara on NB/SB I-15 where lane-width reductions will not allow the addition of another lane.

0' to 2' inside and outside shoulders with six 11' lanes (2-11' HOV and 4-11' GP lanes)

Retaining Wall at Spring Mountain Off-ramp and Flamingo on-ramp, NB I-15 – looking north

0’ to 2’ inside and outside shoulder with six 11’ lanes (2-11’ HOV and 4-11’ GP lanes)

SB I-15 Bridge over Spring Mountain – Looking north

0’ to 2’ inside and outside shoulders with six 11’ lanes (2-11’ HOV and 4-11’ GP lanes)

SB I-15 off-ramp to EB Spring Mountain ramp Pier at EB Spring Mountain over SB I-15 – looking north

Not enough bridge width for six 11' lanes (2-11' HOV and 4-11' GP lanes)

SB I-15 Bridge at Sahara – Looking south

Recommendation:

It is recommended that NDOT consider lane width reductions as an interim improvement *only if there are significant needs for capacity* prior to implementing an ultimate concept. In the interim, the intent would be to add another lane without widening the existing I-15 pavement between Tropicana and just south of Sahara SB on-ramp. There are multiple pinch points along the corridor that do not provide adequate room for the six-lane configuration (five existing lanes, assuming adding one more 11-foot lane) outside the existing shoulder edge, resulting in substandard or zero shoulder areas. This will result in reduced safety along the corridor and potentially increase the time for responding to and clearing incidents.

Technical Memorandum

To: Jeff Lerud, NDOT

Date: July 31, 2020

From: Jack Sjostrom, CA Group

Subject: I-15 from Flamingo to Sahara: Alternatives Screening Report

1. Introduction

Interstate 15 (I-15) is the primary transportation corridor in southern Nevada connecting to California and Arizona. Over the past three decades, the Nevada Department of Transportation (NDOT) has been making investments in improvements to I-15 to keep up with the growth in the Las Vegas area. The section of I-15 between Flamingo Road and Sahara Avenue is the last section to be upgraded adjacent to the resort corridor (Las Vegas Strip). Recently completed projects include NDOT's I-15 South Design-Build Project (Silverado Ranch Boulevard to Tropicana Avenue) to the south and NDOT's Project NEON (Sahara Avenue to I-15/US95/I-515 interchange) to the north.

The I-15 from Flamingo to Sahara Feasibility Study was initiated by NDOT to develop and evaluate alternatives primarily focusing on improving I-15 safety and traffic operations, and to identify right-of-way needs to accommodate future traffic demands.

This study is based on the Federal Highway Administration's (FHWA) guidance for Planning and Environmental Linkages (PEL), so that the Feasibility Study can be used as the basis for subsequent project development under the National Environmental Policy Act (NEPA) and its implementing regulations as contained in 23 Code of Federal Regulations (CFR) 771 and 40 CFR. These regulations require that the NEPA process rigorously explores and objectively evaluates all reasonable alternatives to the proposed action. Reasonable alternatives are those that are practical or feasible from a technical and economic standpoint, achieve the purpose and need for the project, and do not create unacceptable environmental impacts when compared to other alternatives.

This Alternatives Screening Report summarizes the full range of ideas for transportation improvements considered for the study and the process used to develop and evaluate ideas. It also describes how ideas were combined to create Conceptual Alternatives for further evaluation in detailed screening, and further refinement of alternatives for advancement to the NEPA process.

2. Project Study Area

The study area covers an area of approximately 4.5 miles on I-15, as shown in Figure 1. The northern limit is Sahara Avenue (the southern end of NDOT's Project NEON) and the southern limit is I-15/I-215/CC-215 system interchange. These endpoints form the logical termini of this study, allowing for the development of a project that can be constructed alone, serves a meaningful purpose, and addresses environmental impacts on a sufficient scale. The project study area includes six interchanges with I-15: Sahara Avenue, Spring Mountain Road, Flamingo Road, Tropicana Avenue, Russell Road, and I-15/I-215/CC-215 system

interchange. Additionally, seven grade separations exist within the corridor; Desert Inn Road (over I-15), Union Pacific Railroad (UPRR) (under I-15), Dean Martin Drive (under I-15), Twain Avenue (under I-15), Harmon Avenue (over I-15), Hacienda Avenue (over I-15), and Sunset Road (over I-15).

Figure 1. Study Area and Logical Termini

3. Study Process

The first step in the study process was to define the project's purpose and need, three levels of alternatives development and screening were held as part of this Feasibility Study. Level 1 is an evaluation to eliminate ideas that have fatal flaws. Level 2 is a comparative screening of ideas based primarily on qualitative criteria to identify and rank ideas that could satisfy the purpose and need. Level 3 is a detailed screening and refinement of conceptual alternatives to determine which conceptual alternative or alternatives could best meet the purpose and need for the project. Figure 2 shows the screening process.

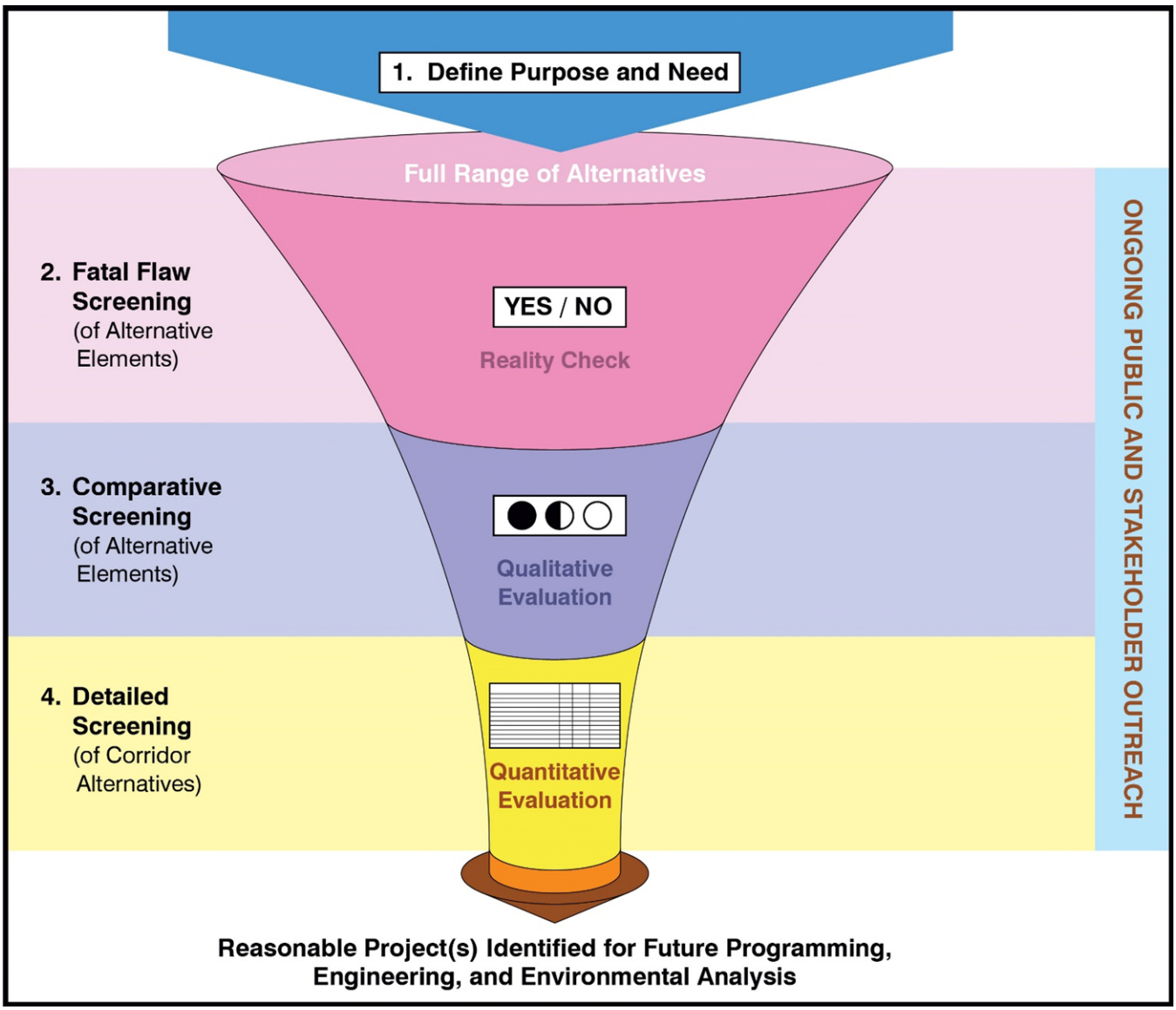


Figure 2. Alternatives Development Screening Process

4. Project Purpose and Need

The purpose and need of a project provides the basis for identifying, evaluation, and screening alternatives, leading to alternatives recommended for further study. At the onset of this Feasibility Study, the transportation needs of the study area were identified and analyzed. From this effort, a purpose and need statement was developed. A more detailed and refined purpose and need statement will be developed following completion of this Feasibility Study, as the project is further developed in the NEPA process.

Congestion within the I-15 corridor creates delay for all users. Additional traffic demand generated by the added capacity improvements to the north and south (Project NEON and I-15 South Design-Build) creates a pinch point in the study corridor without adequate capacity. The purpose of the proposed project is to:

- Resolve existing roadway deficiencies
- Provide transportation improvements to serve existing and future growth areas
- Accommodate regional and local plans

Purpose: Resolve Existing Roadway Deficiencies

Need: The existing I-15 corridor from the Tropicana Avenue interchange to the Sahara Avenue interchange was constructed in the mid-1960's. The corridor has been modified substantially as interchanges were constructed, medians reconfigured, and lane uses revised (transitioning from all general purpose (GP) lanes, separated express lanes, and high occupancy vehicle (HOV) lanes. The original I-15 construction included interchanges at Sahara Avenue, Flamingo Road, and Tropicana Avenue while the Spring Mountain Road Interchange was constructed in the mid-1990s. Clark County constructed the Desert Inn Road Super Arterial over I-15 around the same time. In the mid-1990s the population of the Las Vegas Valley was approximately one million people, and since then the population has more than doubled and is projected to continue to increase. The traffic volumes within this corridor are currently in excess of 325,000 vehicles per day, which far exceeds the original design volumes.

The existing traffic on cross arterials with interchanges of Flamingo Road, Spring Mountain Road, and Sahara Avenue are all projected to increase. The resulting congestion on I-15 and interchange corridors will create delays for users and contribute to increased crash rates, especially at ramp terminal intersections and ramp gores. Factors that also impact the decision-making process in selecting appropriate concepts include the high volumes of traffic using each interchange combined with the existing interchange entrance and exit ramp spacing. These factors have resulted in substantial operational issues in cross weaving conditions, most evident between Tropicana Avenue and Flamingo Road.

Specific areas where deficient traffic operations are observed include:

- Northbound I-15, from north of Tropicana Avenue to north of the Spring Mountain Road exit ramp. This section includes congestion from the interchange cross weave, where both entrance ramps from Tropicana Avenue become the Flamingo Road (1600 feet) and Spring Mountain Road (3000 feet) exit ramps.

- Northbound I-15 exit ramps to Spring Mountain Road are free movement ramps, which deliver traffic eastbound to the Spring Mountain and Mel Tormé Way/Treasure Island intersection, and the westbound to Highland Drive. However, the southbound I-15 exit ramp terminal intersection is a high to low speed ramp.
- Northbound I-15 exit ramp to Sahara Avenue from the HOV lane exit, combined with the Spring Mountain Road entrance ramp and auxiliary lane requires HOV access to Sahara Avenue to weave across 4 lanes in less than 4000 feet.
- Southbound I-15 traffic was metered at the Charleston Boulevard entrance ramp. With the opening of Project NEON, traffic travels southbound at a higher flow rate, which exacerbates the issues with the southbound exit ramp at Flamingo Road. The southbound Flamingo Road exit ramp consists of a low speed loop ramp and this ramp often backs up from the Flamingo Road northbound ramp terminal intersection, around the loop, and onto southbound I-15.
- Southbound I-15 spacing between Flamingo Road and Tropicana Avenue creates a cross-weave that results in slowing and delays. Traffic entering I-15 from Flamingo Road and traffic exiting at both the Tropicana Avenue exit ramp and the southbound collector-distributor (CD) road exit ramp which is just south of the Tropicana Avenue interchange. This cross-weave delay is further magnified by the southbound CD road exit that provides the only I-15 access to Russell Road and Clark County 215 (CC-215) westbound. The southbound CD road exits from I-15 in two lanes, which concentrates this exiting traffic in the right-most lanes from as far north as Flamingo Road.

Purpose: Provide Transportation Improvements to Serve Existing and Future Growth Areas.

Need: The Regional Transportation Commission of Southern Nevada (RTC) Access 2040 Plan (regional transportation plan) has a heightened focus on maintaining good and reliable access through the Resort Corridor. Projections for 2040 show that growth between 2015 and 2040 is expected to increase by 2.7 million trips, equating to 53.6 million additional vehicle miles traveled. Existing roadway deficiencies result in congestion that can contribute to crashes and extended travel delays for motorists.

To meet additional traffic demands projected for 2040 as identified in the NDOT Southern Nevada Traffic Study (SNTS) and RTC's 2040 TransCAD model, capacity improvements to I-15 and its service interchanges are required. On I-15, the addition of one through lane in each direction has been recommended by previous studies. Various studies on I-15 have considered different improvements at service interchanges to enhance operations of I-15 and each interchange. These improvements may require reconfiguration of the existing service interchanges, including adjusting or replacing existing I-15 overpass structures to provide additional width in both the northbound and southbound directions.

The Resort Corridor continues to develop with higher density resorts and casino destinations. The east side of I-15 is evolving, with planned development projects including the 3,400-room Resorts World Las Vegas (expected to open in Summer 2021) and an expansion of the Las Vegas Convention Center (600,000-square-foot exhibition hall) expected to be completed by 2021. The west side of I-15 is chiefly comprised of warehouse-style business centers. With the increasing population and projected growth, and the

addition of the 65,000-seat Raiders' Stadium (currently under construction) and potential development of properties into mega-sites similar to City Center, the west side of I-15 is poised to develop into another Strip-style attraction/destination center. New hotels along Dean Martin Drive and renovations to the Palms Casino are only tiny indicators of the continued and future potential of the west side of I-15. Connectivity through and across the corridor through this segment of I-15 is critical to link these east and west destination centers and aligns with the Resort Core Access vision.

Previous operational improvement projects, including restriping of I-15 to convert the "express lanes" to implement the Southern Nevada HOV Plan recommendations, have attempted to adjust lane use to better distribute (and reduce) congestion areas. The full effect of this conversion has yet to be realized. In addition, the Southern Nevada HOV plan has identified potential HOV only interchange access at Meade Avenue, which is anticipated to alleviate congestion at adjacent service interchanges of Flamingo Road and Sahara Avenue and reduce HOV weaving between these two service interchanges. HOV access must be evaluated to determine its effectiveness in improving operations and relieving adjacent interchange congestion.

Purpose: Accommodate Regional and Local Plans.

Need: Accommodating to regional and local plans encompasses the incorporation of all desired or planned improvement projects and transportation-related needs that have been identified to impact the project study limits and corridor in general. NDOT initiated this Feasibility Study to evaluate approximately 4 miles of I-15 that have not been previously evaluated, to identify the needs of the I-15 corridor and to preserve the existing right-of-way for necessary improvements. Similarly, the City of Las Vegas has undertaken a study along Martin Luther King Boulevard to identify improvements needed to extend and connect it with Dean Martin Drive near Twain Avenue. These two studies should not adversely impact the goals of the other. This study will evaluate new concepts that have not yet been included in the Regional Transportation Plan (RTP). Each concept's impacts on the surrounding system and other planned projects will be evaluated.

Additionally, this project should accommodate NDOT's ongoing development of a valley wide managed lanes/HOV network through the study area and adhere to the vision of the RTC's Access 2040 Plan, as seen in Figure 3.

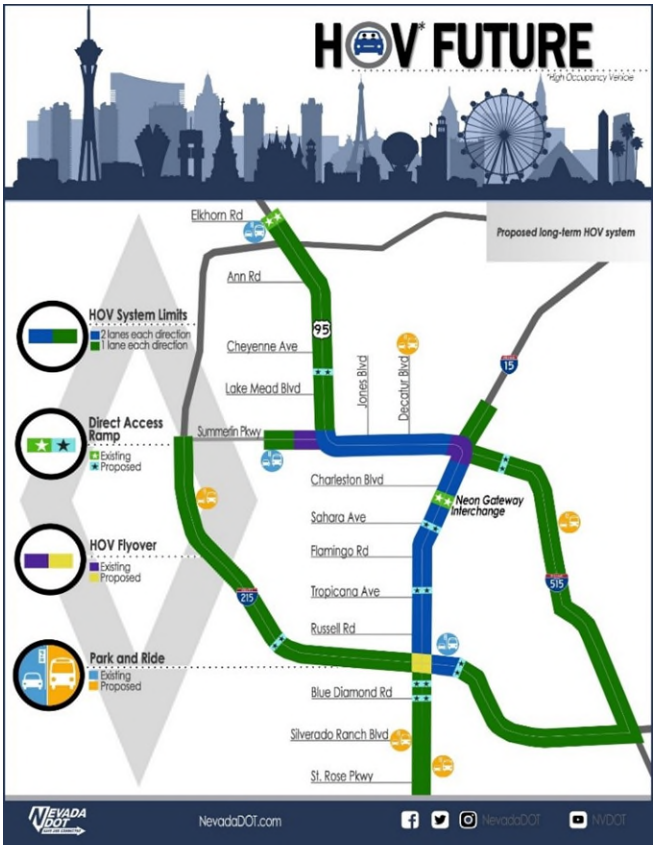


Figure 3. Southern Nevada Proposed HOV System

5. Alternatives Development and Evaluation

A wide range of ideas were developed that included feasible improvements on the freeway, its interchanges, and adjacent local streets, including concepts on both existing and new alignments. The process of developing and screening ideas considered the following:

- Reasonableness of an idea
- Meets the purpose and need for the project
- Ability to avoid or minimize environmental impacts
- Regional planning context
- Stakeholder input
- State and federal requirements

A four-step alternatives development and screening process was carried out to identify the candidate ideas to be studied in detail in the Feasibility Study, supporting PEL checklist, and subsequent NEPA document, as shown in Figure 2. The four steps include:

1. Develop preliminary ideas based on purpose and need
2. Conduct screening based on fatal flaws (Level 1)
3. Conduct screening based on preliminary comparative analysis (Level 2)
4. Conduct detailed screening based on comparative analysis (Level 3)

5.1 Alternatives Development Workshop

The project's Alternatives Workshop was held early in the study process to create improvement ideas that served the overall project need and NDOT's desire to identify future right-of-way needs. The workshop was held on June 24 and June 26, 2019 and participants included NDOT staff, representatives from City of Las Vegas, Clark County, and the Regional Transportation Commission of Southern Nevada (RTC), national experts with specific experience in constrained urban interstate corridor development from other major cities, and local (Las Vegas) consultant staff.

The planning horizon year for this feasibility study was established as year 2040 to conform with the RTP current planning horizon.

The workshop was led by the CA Group team staff and was preceded by an agenda that defined the anticipated workshop content. All invitees were sent the agenda weeks in advance of the workshop. The agenda is provided in Appendix B.

Prior to the workshop, the project team collected data pertaining to the existing conditions and operations of the corridor, including aerial photography and topography, right-of-way verification, project horizontal control, crash information, utility information, Project NEON future phase files, past planning studies, and other pertinent data.

The workshop was conducted over two days with an initial half-day site visit. The half-day site visit allowed attendees who were unfamiliar with the corridor the opportunity to review the corridor's features and characteristics, data and information, observe corridor's function and operation during peak and non-peak hours, roadway and other facilities, structure conditions, physical constraints, adjacent development, traffic composition (trucks, oversize vehicles, taxis, etc.), and experience overall traffic conditions and connectivity.

During the site visit, observers noted the following questions (paraphrased below):

- What are the typical percent trucks typically on I-15 in the corridor?
- Does traffic use I-15 and its interchanges as a way to bypass local roadways for local trips? (for example, between Tropicana Avenue and Flamingo Road)
- Will the HOV system be operated 24 hours or only during the peak?
- Does NDOT plan to use tolling as a means of traffic management?
- Is there an alternate route for trucks or heavy vehicles?

- Where are the main points of congestion?
- What is the design year/project horizon?

Day one consisted of a presentation of initial data, framing the need for the project, and defining NDOT's desired outcome. Information, including existing conditions in the study area, was presented to workshop attendees. A preliminary utility evaluation was presented. Crash data was provided and reviewed to ascertain critical locations that may need special attention. A review of traffic projections excerpted from the SNTS was provided to attendees, along with proposed HOV improvements and improvement alternatives within the study area as described in the Southern Nevada HOV Study.

The attendees were divided into four groups – three teams to consider concepts and develop ideas and a fourth team of technical advisors. Concept forms were provided to each team to complete for each concept developed. Members of the fourth group floated from team to team to ensure that questions related to the data provided were answered, and that team needs were accommodated. An initial brainstorming session allowed the concept teams to jointly review project information and develop a base level of information for development of project questions and initial thoughts.

Day two consisted of refining ideas generated during day one and completing the concept forms to detail each team's ideas for documentation and future concept screening. Teams were asked to refine their day one ideas and complete the concept forms to detail each team's ideas for documentation and future concept screening. Teams wrapped up all concept preparation prior to noon and prepared a report for NDOT Project Management and the executive group. The report was presented, and teams wrapped up final documentation.

The workshop attendance sheets are provided in Appendix A. Attendees at the two-day workshop included:

- Lynnette Russell, NDOT
- Jeff Lerud, NDOT PM
- Casey Sylvester, NDOT
- Chris Wright, NDOT Traffic
- Chris Young, NDOT Env
- Gary Nelson, NDOT
- Hoang Hong, NDOT
- Jeff Henkelman, NDOT ROW
- Jesse Smithson, NDOT Roadway
- John L'Etoile, NDOT L&A
- Roshelle Olson, NDOT
- Laura Wiggins, NDOT Roadway
- Herb Arnold, Clark County
- Joe Damiani, RTC
- John Penuelas, RTC
- Greg McDermott, City of Las Vegas
- Jim Caviola, CA Group
- Chad Anson, CA Group
- Jack Sjostrom, CA Group
- Jim Mischler, CA Group
- Tammy Michels, CA Group
- Vinay Virupaksha, CA Group
- Jackie Kuechenmeister, Parametrix
- Bardia Nezhati, Parametrix
- Chris Petersen, GCW
- Danja Petro, Atkins
- Irene Wang, Atkins
- McKenna Keefer, Atkins
- Paul Saucedo, Atkins
- Susan Berkley, Atkins

Project stakeholders were listed and discussed. The initial listing of stakeholders includes:

- NDOT
- Clark County
- RTC of Southern Nevada, FAST
- FHWA
- City of Las Vegas
- UPRR
- Utility Owners
- Las Vegas Convention and Visitors Authority (LVCVA)

Participating stakeholders during the study process included NDOT, Clark County, RTC of Southern Nevada, and the City of Las Vegas. Workshop attendees participated in development of the project evaluation criteria and the ranking scale. It was agreed that at this early level of detail – with the wide array of concepts that would be screened – the ranking would be on a "poor to best" scale with five steps scored from zero to four to establish meaningful differentiation between concepts for each evaluation criterion. The Alternatives Workshop provided the basis for initial concepts screening and kicked off the alternatives development process.

The workshop resulted in a total of 80 concepts being prepared for screening, summarized in Appendix C. Sketches of the ideas are included in Appendix D. Each idea is a discreet improvement, such as a ramp modification or addition of a new auxiliary lane, with the overall intent to package feasible ideas into conceptual alternatives .The workshop identified many ideas to be considered, either individually, or in combination, as possible solutions to current or anticipated problems in the I-15 corridor within the study area. On July 3, 2019, the complete list of the ideas developed at the workshop was circulated among the workshop attendees for concurrence on the ideas listed and their descriptions. On July 29, 2019, a team comprised of NDOT and CA Group convened to review the alternatives workshop ideas and to conduct an initial pass/fail screening.

5.2 Decision-Making Process

The workshop used a collaborative decision-making process to develop a consensus among the attendees, including NDOT and FHWA, on the elements of the ideas. At this point, the collaborative decision-making process approved ideas to be further developed and evaluated during the next phase of alternatives development and screening.

The guidelines were developed through collaboration with agency stakeholders so participants understood how consensus was to be achieved during this process, recognizing there is a combination of gains and tradeoffs. Throughout the process, stakeholders were asked to indicate their level of support for the decision. If consensus was not possible, the level of support and dissension was noted. NDOT and

FHWA considered all deliberations and products of the collaboration as decisions were made.

The Technical Advisory Committee (TAC) evaluated the conceptual alternatives recommended for further analysis (Level 3 screening), considering the purpose and need of the project, weighed against mobility, implementatbility, environmental, and other constraints. The study team provided data describing these constraints to the stakeholders, including traffic demand and environmental data. The TAC meetings served as a forum for an iterative discussion process involving review and screening of conceptual alternatives based on increasingly detailed design and criteria.

5.3 Screening Criteria

Workshop participants identified criteria for qualitative and quantitative evaluation of transportation improvement ideas as:

- **Safety:** considers whether the idea could meet design criteria without need for design exceptions and improve safety for users. Ideas that meet design criteria would score higher, e.g., free-flow directional movements would be considered superior to a signalized intersection.
- **Mobility:** considers whether the idea could provide opportunities for users to efficiently move from their origin to their destination and minimize delay. An idea that connects motorists to their destination would score higher than an idea that requires them to travel out of their way.
- **Accessibility:** considers whether the idea could maintain existing connections or add access points between the local road network and the interstate highway system.
- **Compatible with other Plans/Studies:** considers the impacts to future improvements within the I-15 Resort Corridor. These include, but are not limited to, the I-15 South Design-Build, the I-15 Tropicana Interchange preliminary design, and Project NEON.
- **Implementability:** considers relative construction costs of the idea, ease of construction, potential right-of-way impacts, and whether the idea would likely be accepted by the public. This includes assumptions of magnitudes for any (if needed) right-of-way acquisitions or easements. Detailed estimates of construction costs are not available for each of the ideas because they have not been fully developed, but engineering judgement has been applied to compare order of magnitude costs. Higher comparative cost would result in a lower score, but high cost is not considered to be a fatal flaw.
- **Environmental Impacts:** considers whether the idea could result in substantial impacts to the environment such as potential residential or business relocations, environmental justice populations, or encounter existing hazardous waste or materials.
- **Schedule Impact:** considers whether the idea would result in need for additional right-of-way, UPRR impacts, or utility relocations that could lead to delays in implementation.

5.4 Scoring Criteria

The scoring criteria is summarized in Table 1, feasible ideas are scored subjectively and qualitatively ranking them against each criterion on a scale of 0-4. A low score of zero or one is not considered to be a fatal flaw. Ideas determined to contain fatal flaws are not scored. Each criterion carries equal weight. The average of the seven scores is used to compare one idea to others.

TABLE 1 - SCORING CRITERIA FOR COMPARATIVE DIFFERENCES BETWEEN IDEAS

CRITERIA	0 (POOR)	1 (NEUTRAL)	2 (GOOD)	3 (BETTER)	4 (BEST)
SAFETY	Worse than existing, several design exceptions	Comparable to existing with similar number of design exceptions	Slightly better than existing with fewer design exceptions	Better than existing	Much better than existing, no design exceptions needed
MOBILITY	Out of direction travel	Comparable to existing	Slightly better than existing	Better than existing	Much better than existing
ACCESSIBILITY	Existing movements not retained	Comparable to existing	Slightly better than existing	Better than existing	Much better than existing
COMPATIBLE WITH OTHER PLANS/STUDIES	Major Impacts	Moderate impacts	Modest impacts	Minimal impacts	No impacts
IMPLEMENTABILITY	High relative cost and low public acceptance	High relative cost or expected low public acceptance	Moderate cost and expected moderate public acceptance	Low relative cost or expected general public acceptance	Low relative cost and expected high public acceptance
ENVIRONMENTAL IMPACTS	Major impacts that NDOT will not consider (i.e. acquisition of hotel/casino, residential tower, or shopping mall)	Potential impacts could be considered significant even with mitigation	Potential impacts could be mitigated to be not significant	There are some potential impacts, but they are considered minimal	There no potential impacts
SCHEDULE	R/W relocations; UPRR impacts; major utility relocations	R/W relocations; or UPRR impacts; major utility relocations	R/W without need for relocations; moderate utility impacts	Minimal R/W needed; modest utility impacts	No new R/W; No major UPRR or utility impacts

As shown in Table 1, feasible ideas were scored by subjectively and qualitatively ranking them against each criterion on a scale of 0-4. A low score of zero or one is not considered to be a fatal flaw. Ideas determined to contain fatal flaws are not scored. Each criterion carries equal weight. The average of the seven scores was used to compare one idea to other ideas.

6. Level 1 Screening (Fatal Flaw Screening)

Alternatives workshop participants identified 80 ideas for transportation improvements within the study area. The Level 1 screening evaluation was intended to eliminate ideas that have fatal flaws. The following criteria were applied to screen unfeasible ideas from further consideration:

- does not preserve or is not related to preserving the I-15 right-of-way to align with future and ongoing projects,
- is outside the project's planning study limits,
- would require revision to an adjacent project with an approved NEPA decision
- would require reconfiguration of the entire I-15 corridor beyond the project's planning study limits, or
- was found not to be geometrically feasible and were therefore eliminated as having fatal flaws.

Twenty-three of the workshop's 80 ideas were eliminated based on the criteria listed above. The elimination of these ideas from further consideration was presented to workshop attendees via email. No objections were made on these pass/fail results.

7. Level 2 Screening – Ultimate and Interim Ideas

The comparative screening process reviewed 53 ultimate ideas and 4 interim ideas for compatibility with each other and other improvements within the study area. A cutoff was established for evaluating ultimate ideas, requiring a total idea score of 2.00 or greater for ultimate ideas to advance to the detailed screening process. Lower scoring ultimate ideas (in whole or in part) could be added back for consideration in subsequent phases of alternatives development if it is determined that ultimate ideas initially thought to be superior are determined by subsequent analysis not to be as effective as anticipated. Using this cutoff score, 23 ultimate ideas advanced for quantitative evaluation and is summarized by rank in Table 2 and Table 3.

Interim ideas are improvements that could be implemented within the near future, either as their own stand-alone project, or as part of another project. These ideas may or may not be in conflict with an ultimate alternative, but their implementation would provide benefit to road users and/or pedestrians in the interim until a final project alternative can be constructed. Four interim ideas were screened during the evaluation and are summarized in the *Interim Ideas Memorandum.*

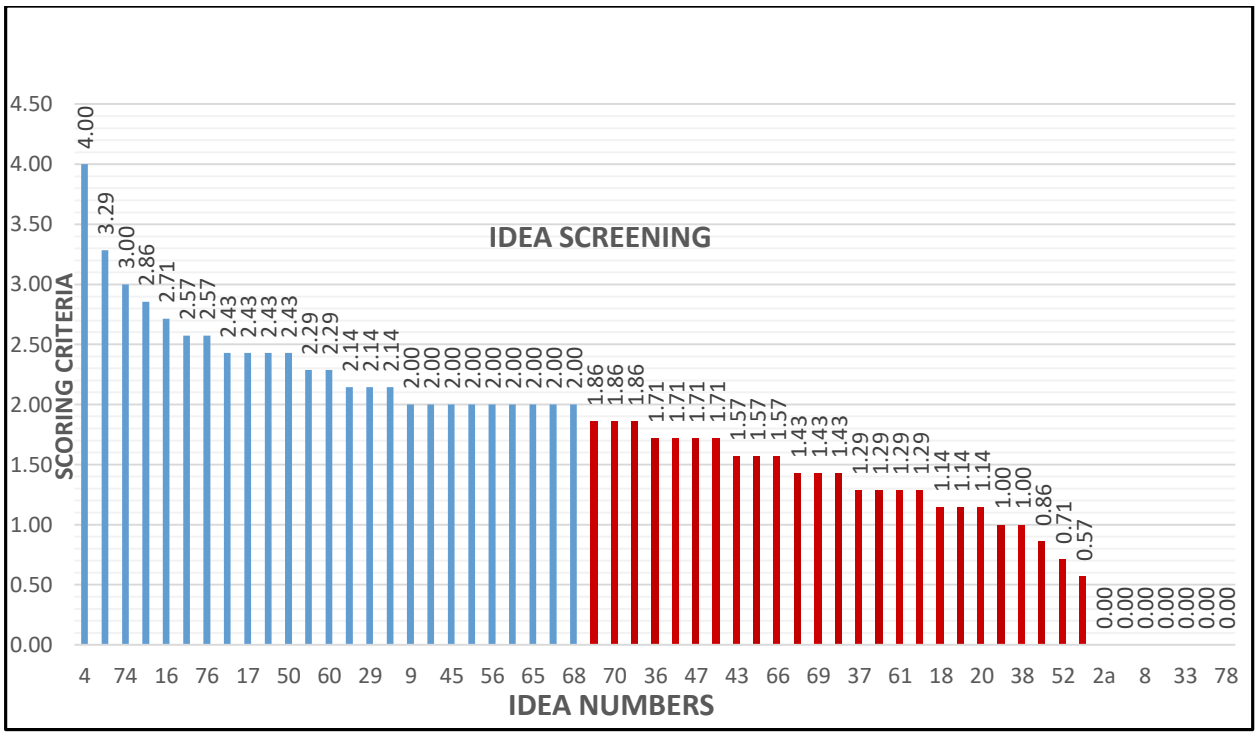


Table 2. Idea Screening Results

The following is a summary of each of the interim and ultimate ideas and the Alternatives Workshop participants' recommendation for implementation.

Table 3. List of Ultimate and Interim Ideas		Safety	Mobility	Accessibility	Compatible w/ Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance Average	Idea Category
Idea No.	Idea Description	Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)								
4	Use technology (smart signs) to manage truck/heavy vehicle traffic - signing specific lanes for truck use only through the corridor. Left or right most lanes (GP) can be mixed traffic. *Note if less than 12' lanes are needed, recommend not using truck restricted lanes.	4	4	4	4	4	4	4	4.00	I
14	Convert existing Flamingo Rd interchange to a typical DDI. Eliminate the I-15 SB to Flamingo Rd EB loop ramp. There is potential to move I-15 SB ramps terminal intersection closer to I-15 mainline. This idea minimizes impacts to the rest of the interchange.	3	3	4	4	3	4	2	3.29	U
74	Add one lane to I-15 in each direction to provide 2 HOV +4 GP from I-15 south to Project NEON.	4	3	2	4	3	3	2	3.00	U
13	Convert the existing Flamingo Rd interchange to a modified DDI. This idea maintains I-15 SB to Flamingo Rd EB loop ramp with separate roadway outside of DDI.	2	3	4	4	2	3	2	2.86	U
16	Reconstruct the I-15/Spring Mountain Rd interchange to a typical DDI.	3	2	4	4	2	2	2	2.71	U
12	Braid I-15 NB on-ramp from Tropicana Ave with I-15 NB off-ramp to Flamingo Rd.	3	3	2	4	2	3	1	2.57	U

Table 3. List of Ultimate and Interim Ideas										
		Safety	Mobility	Accessibility	Compatible w/ Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance Average	Idea Category
Idea No.	Idea Description	Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)								
76	Braid all ramps.	4	3	2	4	2	2	1	2.57	U
1	Provide full HOV access at Harmon Ave and Meade Ave. Develop improved through street at Meade Ave for a continuous east-west access.	3	4	4	2	0	2	2	2.43	U
17	Reconstruct the I-15/Spring Mountain Rd interchange to include roundabouts while maintaining the existing flyovers if needed for traffic.	2	3	4	1	2	3	2	2.43	U
34	Modify the Flamingo Rd interchange to a DDI or a SPDI.	3	2	2	3	2	3	2	2.43	U
50	Reconstruct Tropicana Ave SB off-ramp further north and braid with the Flamingo Rd SB on-ramp. Remove I-15 SB to Flamingo Rd EB loop ramp and combine it with the WB off-ramp. Construct flyover for the Flamingo Rd EB off-ramp. Relocate Flamingo Rd SB on-ramp to increase vehicle entry speed, but current location could work for braid.	3	3	3	2	2	2	2	2.43	U
28	Add a SB to EB flyover ramp to the Flamingo Rd interchange similar to Tropicana Ave or Spring Mountain Rd and remove the SB to EB loop ramp. This would allow pedestrians on the south side of the I-15/Flamingo Rd structure, which in turn would provide multimodal opportunities on Flamingo Rd to better access Dean Martin Dr.	2	3	3	1	2	3	2	2.29	U

Table 3. List of Ultimate and Interim Ideas										
		Safety	Mobility	Accessibility	Compatible w/ Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance Average	Idea Category
Idea No.	Idea Description	Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)								
60	Reconstruct Spring Mountain Rd SB on-ramp with a smaller pork chop island, decreased ramp entry angle, and increased right turn lane storage on EB Spring Mountain Road. This should reduce vehicle speeds on the EB approach to the on-ramp to be more comparable to WB entry speeds and reduce potential vehicle conflicts. This will also increase capacity/storage on EB Spring Mountain Rd.	1	1	2	2	4	4	2	2.29	I
27	Extend Tropicana Ave NB on-ramp; braid with Flamingo Rd off-ramp (north of Harmon Ave); combine Tropicana Ave NB on-ramp with Flamingo Rd NB on-ramp (creating a CD road) on existing Spring Mountain Rd bridge.	3	3	2	3	1	1	2	2.14	U
29	Construct a connection between Highland Dr and Sammy Davis Jr Dr/ Frank Sinatra Dr/Industrial Rd over/under UPRR; construct a conventional I-15 interchange. Remove NB loop on-ramp; replace with WB to NB high speed on-ramp.	3	2	3	1	2	2	2	2.14	U
54	Construct parallel one-way frontage roads from south of Spring Mountain Rd to Sahara Rd to complement a simplified interstate system that meets driver expectations.	3	3	4	2	1	1	1	2.14	U
9	Use a CD road and braided ramps. Idea will limit access between adjacent cross streets and reduce friction on I-15 mainline.	3	2	2	4	1	1	1	2.00	U

Table 3. List of Ultimate and Interim Ideas										
		Safety	Mobility	Accessibility	Compatible w/ Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance Average	Idea Category
Idea No.	Idea Description	Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)								
26A	Reconfigure Idea 26 to exit Tropicana, Flamingo, and possibly Spring Mountain to a SB CD road. Test options for best operations.	3	2	3	1	1	2	2	2.00	U
45	Braid Tropicana Ave NB off-ramp with Russell Rd NB on-ramp. This pulls the traffic onto NB I-15 further south giving more weave space for Flamingo Rd NB off-ramp and Spring Mountain Rd NB off-ramp.	3	3	3	1	1	2	1	2.00	U
46	Tropicana Ave NB on-ramp combined with Flamingo Rd NB on-ramp to braid together under Spring Mountain Rd NB off-ramp. Allows for more free flow off to Flamingo Rd and Spring Mountain Rd, works with Idea 45.	3	3	3	2	1	1	1	2.00	U
56	Move the CC-215 WB off-ramp (SB CD Road on-ramp) further south to reduce backup/conflicts with Tropicana Ave SB on-ramp, then braid the Flamingo Rd SB on-ramp and Tropicana Ave SB off-ramp.	3	3	3	1	1	2	1	2.00	U
57	Remove the existing Flamingo Rd SB to WB loop ramp and combine with the extended SB to EB off-ramp. Reconstruct existing Spring Mountain Rd SB on-ramp and braid with reconstructed Flamingo Rd SB off-ramp. This could be accomplished with a braid of the Spring Mountain Rd SB on-ramp.	2	2	2	3	2	2	1	2.00	U

Table 3. List of Ultimate and Interim Ideas										
		Safety	Mobility	Accessibility	Compatible w/ Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance Average	Idea Category
Idea No.	Idea Description	Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)								
65	Construct DDI at Spring Mountain Rd with the eastern crossover grade separated. Install a traffic signal for Western Ave crossover where traffic volume is much lower. Connect south end of Highland Dr. to Aldebaran Ave.	2	3	3	2	1	2	1	2.00	U
67	Construct NB elevated CD road, Tropicana Ave on-ramp to Spring Mountain Rd off-ramp. Requires that CD road be merged sooner to the south (i.e., at Russell Rd). Construct over Frank Sinatra Dr as needed. Will have to grade separate at Harmon Ave and Flamingo Rd. May require the relocation of the power substation located in the NE corner of the Tropicana Ave interchange.	3	3	2	2	1	2	1	2.00	U
68	Same as Idea 67, except Tropicana Ave on-ramp is braided over CD road to I-15.	3	3	2	2	1	2	1	2.00	U

Out of the 53 ultimate ideas that were developed, 23 ultimate ideas scored greater than 2.00 and were considered for further evaluation. Seven of the ultimate ideas scored greater than 2.00 but are not recommended for further consideration. The remaining ultimate ideas are carried forward for further development and analysis.

7.1 Ideas Not Recommended For Further Consideration

Seven ideas summarized in Table 4 scored higher than 2.00 out of 4.00, but are not recommended for further consideration.

These ideas remained available to the study team in the event that higher scoring ideas did not provide the anticipated benefits to meeting the purpose and need for the project.

Table 4. Ultimate Ideas Not Recommended for Further Consideration

Idea No.	Idea Description	Score	Idea Disposition
17	Idea No. 17 proposes to reconstruct the I-15/Spring Mountain Road interchange to include roundabouts while maintaining the existing flyovers if needed for traffic capacity.	2.43	Roundabouts are not feasible because of the roundabout on the west side of I-15. It would require a significant right-of-way acquisition. This idea also not feasible because of high traffic volumes. It may not operate efficiently with high traffic volumes. The traffic volumes are based on the design year (2040). Idea No. 17 is not recommended for further analysis.
27	Extend Tropicana Ave NB on-ramp; braid with Flamingo Rd off-ramp (north of Harmon Ave); combine Tropicana Ave NB on-ramp with Flamingo Rd NB on-ramp (creating a CD road) on existing Spring Mountain Rd bridge.	2.14	It is not feasible for a third level CD road over Flamingo Road and it is not feasible to braid Flamingo Road off-ramp north of Harmon Avenue with Tropicana Avenue NB on-ramp requires right-of-way acquisition. This idea is not recommended for further analysis.
29	Construct a connection between Highland Dr and Sammy Davis Jr Dr/ Frank Sinatra Dr/Industrial Rd over/under UPRR; construct a conventional I-15 interchange. Remove NB loop on-ramp; replace with WB to NB high speed on-ramp.	2.14	It is feasible to convert the existing I-15/Spring Mountain Road interchange to a typical DDI or SPDI. It is not feasible for a third level over or under Spring Mountain Road and Idea No. 29 is not recommended for further analysis.

Table 4. Ultimate Ideas Not Recommended for Further Consideration			
Idea No.	Idea Description	Score	Idea Disposition
46	Tropicana Ave NB on-ramp combined with Flamingo Rd NB on-ramp to braid together under Spring Mountain Rd NB off-ramp. Allows for more free flow off to Flamingo Rd and Spring Mountain Rd, works with Idea 45.	2.00	It is not feasible for a third level CD road over Flamingo Road and this idea is not recommended for further analysis. This idea requires right-of-way acquisition and a re-alignment of Frank Sinatra Drive further to the east.
65	Construct DDI at Spring Mountain Rd with the eastern crossover grade separated. Install a traffic signal for Western Ave crossover where traffic volume is much lower. Connect south end of Highland Dr. to Aldebaran Ave.	2.00	It is not feasible geometrically to connect Highland Drive to Aldebaran Avenue over I-15 and the ramps and is not recommended for further analysis.
67	Construct NB elevated CD road, Tropicana Ave on-ramp to Spring Mountain Rd off-ramp. Requires that CD road be merged sooner to the south (i.e., at Russell Rd). Construct over Frank Sinatra Dr as needed. Will have to grade separate at Harmon Ave and Flamingo Rd. May require the relocation of the power substation located in the NE corner of the Tropicana Ave interchange.	2.00	It is not feasible for a third level CD road and it is undesirable to relocate the substation. This idea would require major reconfiguration of I-15 NB CD on-ramp location to I-15. The elevated CD road would require significant structures. This idea is not recommended for further analysis.
68	Same as Idea 67, except Tropicana Ave on-ramp is braided over CD road to I-15.	2.00	It is not feasible for a third level CD road and it is undesirable to relocate the substation as described in Idea No. 67. This idea would require major reconfiguration of I-15 NB CD on-ramp location to I-15. The elevated CD road would require significant structures. This idea is not recommended for further analysis.

8. Level 3 Screening – Development of Conceptual Alternatives

Conceptual alternatives were developed by determining the final improvements from adjacent ultimate projects; NDOT's Project NEON to the north, and the I-15 South Design-Build project to the south. These two ultimate improvements projects serve as bookends to the project study area. Modification of their recommended and constructed features is not desired, as it could affect both project's NEPA decisions. Therefore, south of Flamingo Road, southbound I-15 would be comprised of 1 HOV lane and 4 GP lanes, and 2 HOV lanes and 4 GP lanes north of Flamingo Road. Northbound I-15 would be comprised of 1 HOV lane and 4 GP lanes south of Twain Avenue, and 2 HOV lanes and 4 GP lanes north of Twain Avenue. These conditions were paired together with the minimum number of continuous I-15 lanes required to form a "base configuration" for each I-15 direction was created for AIMSUN modeling. Iterative testing was performed where traffic issues were identified.

The following configurations represent those that addressed a majority of the traffic issues and were deemed acceptable for comparative review. They were laid out geometrically in MicroStation and tested for traffic operations with AIMSUN.

Plan view exhibits of these alternatives are in Appendix B.

The conceptual alternatives were further developed from the sketches included in Appendix D and are based on project mapping and NDOT's Design Manual's freeway and arterial design criteria listed in Table 5. All of the feasible ideas remained available to the project team as they worked to develop alternatives that meet the needs of this project.

Traffic modeling for this project is based on the Aimsun model developed for the SNTS, as calibrated for the study limits of this project. Lane configurations are in accordance with traffic demands predicted by the calibrated Aimsun traffic model for this project.

Aimsun modeling was performed for SB I-15, NB I-15, I-15/Flamingo Road interchange, and I-15/Spring Mountain Road interchange. Combinations of ultimate ideas were chosen to include ideas recommended for further consideration so that effectiveness could be measured, and planning level construction costs could be estimated.

Table 5. Major Elements of Design Criteria	
Freeway Design Speed	65 mph
Ramp Design Speeds	50/35 mph (preferred/minimum)
Freeway and Ramp Lane Width	12 feet
Freeway Shoulder Widths 12/8 feet left and right	(preferred/minimum)
Ramp Shoulder Widths	4 feet left, 8 feet right
Superelevation Rates	e_{max} = 6 percent
Roadway Vertical Clearance	16 feet 6 inches
Rail Vertical Clearance	23 feet 4 inches

8.1 Southbound I-15 Concepts

Southbound No-Action

The Southbound No-Action concept serves as the baseline for comparing all southbound designs and includes the future phase of Project NEON and the I-15/Tropicana Avenue Interchange project improvements. The future phase of Project NEON will braid the southbound Sahara Avenue on-ramp and Spring Mountain Road off-ramp and widens I-15 north of Desert Inn Road to 2 HOV lanes and 4-GP lanes configuration. The future phase of Project NEON does not account for the proposed HOV interchange at Meade Avenue.

Southbound Concept 1

- Provide 1 HOV lane, 4 GP lanes (south of Flamingo Road) and 2 HOV lanes, 4 GP lanes (north of Flamingo Road) on I-15.
- Southbound Sahara Avenue on-ramp (parallel entrance) to merges SB I-15 just north of Meade Avenue (post work shop idea).
- Construct a combined southbound Tropicana Avenue/Flamingo Road off-ramp near the Spring Mountain Road Interchange (post work shop idea).
- Braid the combined southbound Tropicana Avenue/Flamingo Road off-ramp with the southbound Spring Mountain Road on-ramp (post work shop idea).
- Accommodate future single-lane HOV connections in each direction from the median of I-15 to Meade Avenue (Meade Avenue HOV interchange) as proposed by Idea No 1.

Southbound Concept 2

- Provide 1 HOV lane, 4 GP lanes (south of Flamingo Road) and 2 HOV lanes, 4 GP lanes (north of Flamingo Road).
- Southbound Sahara Avenue on-ramp (parallel entrance to merge southbound I-15 just north of Meade Avenue.
- Construct a combined southbound Tropicana Avenue/Flamingo Road off-ramp near the Spring Mountain Road interchange. (post work shop idea)
- Construct an auxiliary lane between the southbound Sahara Avenue on-ramp and the combined southbound Tropicana Avenue/Flamingo Road off-ramp(post work shop idea).
- Braid the combined southbound Flamingo Road/Tropicana Avenue off-ramp with the SB Spring Mountain Road on-ramp (post work shop idea).
- Accommodate a future Meade Avenue HOV interchange as proposed by Idea No 1.

Southbound Concept 3

- Provide 1 HOV lane, 4 GP lanes (south of Flamingo Road) and 2 HOV lanes, 4 GP lanes (north of Flamingo Road).
- Southbound Sahara Avenue on-ramp (parallel entrance) to merge southbound I-15 just north of Meade Avenue (post work shop idea).
- Braid the southbound Flamingo Road off-ramp with the southbound Spring Mountain Road on-ramp as proposed by Idea No. 57.
- Braid the southbound Tropicana Avenue off-ramp with the southbound Flamingo Road on-ramp as proposed by Idea No. 50.
- Construct an auxiliary lane between the southbound Spring Mountain Road on-ramp and the southbound Tropicana Avenue off-ramp. Construct an auxiliary lane between the southbound Flamingo Road on-ramp and the southbound CD road exit (post work shop idea).
- Accommodate a future Meade Avenue HOV interchange as proposed by Idea No 1.

8.2 Northbound I-15 Concepts

Northbound No-Action

The Northbound No-Action concept serves as the baseline for comparing all northbound designs and includes the future phase of Project NEON and the I-15/Tropicana Avenue Interchange project improvements. The Tropicana Avenue interchange project improvements carry northbound CD road lanes under a fully reconstructed I-15/Tropicana Avenue interchange, adding capacity at Tropicana Avenue, which then provides a 1 HOV lane and 4 GP lanes configuration, with 2 lanes entering northbound I-15 from Tropicana Avenue. The future phase of Project NEON widens northbound I-15 north of Desert Inn Road to the 2 HOV lanes and 4 GP lanes configuration and will construct an exit to a new northbound CD road near Sahara Avenue.

Northbound Concept 1

- Provide 1 HOV lane, 4 GP lanes (south of Twain Avenue) and 2 HOV lanes, 4 GP lanes (north of Twain Avenue.
- Improvements on northbound I-15 would begin north of Flamingo Road, assuming the No-Action configuration south of Flamingo Road (post work shop idea).
- Construct a parallel entrance for the Spring Mountain Road loop on-ramp to NB I-15 (post work shop idea).
- Accommodate a future Mead Avenue HOV interchange as proposed by Idea No. 1.

Northbound Concept 2

- Provide 1 HOV lane, 4 GP lanes (south of Twain Avenue) and 2 HOV lanes, 4 GP lanes (north of Twain Avenue).
- Construct a ramp from the northbound CD road (I-15 South Project) to northbound I-15 for the eastbound CC-215 to northbound I-15 traffic near Sunset Road (post work shop idea).
- Braid the northbound Russell Road on-ramp with the northbound CD road/southbound Tropicana Avenue off-ramp and continue it as an auxiliary lane to the Flamingo Road off-ramp as proposed by Idea No. 45.
- Braid the northbound Tropicana Avenue on-ramp with the northbound Flamingo Road off-ramp near the Tropicana Avenue interchange and merge the northbound Tropicana Avenue on-ramp to Northbound I-15 before the Spring Mountain Road off-ramp as proposed by Idea No. 12.
- Accommodate a future Mead Avenue HOV interchange as proposed by Idea No. 1.

Northbound Concept 3

- Provide 1 HOV lane, 4 GP lanes (south of Twain Avenue) and 2 HOV lanes, 4 GP lanes (north of Twain Avenue).
- Construct a ramp from the northbound CD road (I-15 South Project) to northbound I-15 for the eastbound CC-215 to northbound I-15 at Sunset Road (post workshop idea).
- Braid the northbound Russell Road on-ramp with the northbound CD road/southbound Tropicana Avenue off-ramp and continue it as an auxiliary lane to Flamingo Road off-ramp as proposed by Idea No. 45.
- Braid the northbound Tropicana Avenue on-ramp with the northbound Flamingo Road off-ramp near the Tropicana Avenue interchange as proposed by Idea No. 12.
- Accommodate a future Mead Avenue HOV interchange as proposed by Idea No. 1.

8.3 Interchange Concepts

The following configurations were evaluated for the I-15/Flamingo Road interchange:

- No-Action
- Tight Diamond Interchange (TDI) (post work shop idea)
- Diverging Diamond Interchange (DDI) as proposed by Idea No. 34

The following configurations were evaluated for the I-15/Spring Mountain Road interchange configurations:

- No-Action (would require reconstruction of the southbound I-15 to eastbound Spring Mountain Road flyover to accommodate I-15 improvements)
- Diverging Diamond Interchange (DDI) as proposed by Idea No. 16
- Modified Diverging Diamond Interchange (DDI) – Grade Separated east crossover as proposed by Idea No. 65

8.4 Comparison of Concepts

The I-15 southbound, northbound, and interchange concepts were evaluated by the project team. A scoring consensus meeting with held with project team members and the results are shown in Tables 6, 7, and 8.

TABLE 6 – CONCEPTUAL SB I-15 ALTERNATIVE COMPARISON	Comparative Differences Between Conceptual Alternatives							
	Safety	Mobility	Accessibility	Compatible with Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance
Configurations	**Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)**							
I-15 SB – No Action (Tropicana Interchange and Future NEON as existing)	2	2	2	3	4	4	4	21
Southbound Concept 1 • SB 1-Lane Sahara Ave. on-ramp (parallel entrance) – drops/merge to SB I-15 north of Meade Avenue • Braid combined SB 2-Lanes Tropicana Ave/Flamingo Rd off-ramp with SB 1-Lane Spring Mountain Rd. on-ramp • 1-HOV Lane, 4-GP Lanes (South of Flamingo Rd. and 2-HOV Lanes, 4-GP Lanes (North of Flamingo Rd.) • Accommodate Meade Ave. HOV Interchange	3	2	4	4	3	4	3	23

TABLE 6 – CONCEPTUAL SB I-15 ALTERNATIVE COMPARISON	Comparative Differences Between Conceptual Alternatives							
	Safety	Mobility	Accessibility	Compatible with Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance
Configurations	**Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)**							
Southbound Concept 2 • 1-Auxiliary Lane – between SB Sahara Ave on-ramp and combined SB Tropicana Ave/Flamingo Rd off-ramp (at Spring Mountain Rd) • Braid combined SB 2-Lanes Flamingo Rd/Tropicana Ave off-ramp with SB 1-Lane Spring Mountain Rd on-ramp • 1-HOV Lane, 4-GP Lanes (South of Flamingo Rd.) and 2-HOV Lane, 4-GP Lanes (North of Flamingo Rd.) • Accommodate Meade Ave. HOV Interchange	3	3	4	4	3	4	3	24
Southbound Concept 3 • SB 1-Lane Sahara Ave. on-ramp (parallel entrance) – drops/merge to SB I-15 • 2-Lanes SB Flamingo Rd off-ramp braided with 1-Lane SB Spring Mountain Rd. on-ramp • 2-Lanes SB Tropicana Ave. off-ramp braided with 1-Lane SB Flamingo Rd. on-ramp • 1-Auxiliary Lane – between SB Spring Mountain Rd. on-ramp and SB Tropicana Ave. off-ramp • 1-HOV Lane, 4-GP Lanes (South of Flamingo Rd.) and 2-HOV Lane, 4-GP Lanes (North of Flamingo Rd.) • Accommodate Meade Ave. HOV Interchange	3	4	4	4	3	4	3	25

Southbound I-15 Concepts

Safety – Excluding the No-Action, each of the concepts include modest outside widening of southbound I-15 between Russell Road and Sahara Avenue, which provide satisfactory traffic operations performance and are expected to improve safety as compared to the No-Action concept. Concepts 1, 2, and 3 are expected to provide better safety performance and are scored as 3 out of 4, one point downgraded

because of the I-15 inside shoulder substandard width.

Mobility – Concepts 2 and 3 provide better mobility than Concept 1 and the No-Action concept. Concept 3 scored 4 out of 4 because travel time through the interchanges area would be much better than Concepts 1, 2, and the No-Action. Concept 1 is downgraded two points to 2 out of 4 because it does not add an auxiliary lane between the southbound Spring Mountain Road on-ramp and the combined southbound Tropicana Avenue and Flamingo Road off-ramps, and it combined the southbound Tropicana Avenue and Flamingo Road off-ramps. Concept 2 is downgraded one point to 3 out of 4 because it combined the southbound Tropicana Avenue and Flamingo Road off-ramps.

Accessibility – Concepts 1, 2, and 3 provide better accessibility than the No-Action. Concepts 1, 2, and 3 accommodate future single-lane HOV connections in each direction from the median of I-15 to Meade Avenue are scored as 4 out of 4, while the No-Action concept is downgraded 2 points to 2 out of 4 because it does not accommodate the future HOV interchange at Meade Avenue.

Compatible with Other Plans/Studies –Concepts 1, 2, and 3 accommodate future single-lane HOV connections in each direction from the median of I-15 to Meade Avenue and the City's Martin Luther King Boulevard extension improvement and scored as 4 out of 4, while the No-Action concept is downgraded 2 points to 2 out of 4 because it does not accommodate the future HOV at Meade Avenue or the City's Martin Luther King Boulevard extension improvement.

Implementability – Each of the concepts improves traffic operations performance as compared with the No-Action concept and would be expected to meet with acceptance by the public. Anticipated project costs based on construction footprint, new structures, and right-of-way impacts are estimated to be higher for Concepts 1, 2, and 3. Scoring for Implementability is therefore 3 out of 4 for the three concepts.

Environmental Impacts – Each of the build concepts are anticipated to have minimal to no environmental impacts, and each concept is therefore scored 4 out of 4.

Schedule – Concepts 1, 2, and 3 would need right-of-way between Tropicana Avenue and Flamingo Road along Dean Martin Drive. Schedule impacts are anticipated to be high, therefore Concepts 1, 2, and 3 downgraded one point to 3 out of 4.

TABLE 7 – CONCEPTUAL NB I-15 ALTERNATIVE COMPARISON	Comparative Differences Between Conceptual Alternatives							
	Safety	Mobility	Accessibility	Compatible with Other	Implementabilit	Environmental Impacts	Schedule Impacts	Overall Performance
Configurations	**Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4=(Best)**							
I-15 NB – No Action (Tropicana Interchange and Future NEON as existing)	2	2	2	3	4	4	4	21
Northbound Concept 1 • No improvements until north of Flamingo Rd • 1-HOV Lane (South of Twain Ave and 2-HOV Lanes (North of Twain Ave) • Accommodate Meade Ave HOV Interchange • Spring Mtn loop on-ramp (parallel entrance) – drops/merges to NB I-15 • I-15 NB – 1-HOV Lane, 4-GP Lanes (South of Twain Ave and 2-HOV Lanes, 4-GP Lanes (North of Twain Ave)	3	2	4	3	4	3	3	22
Northbound Concept 2 • 1-Lane Slip Ramp at Sunset Rd – EB CC 215 to NB I-15 • 1-Lane NB Russell Rd on-ramp (as a full auxiliary lane to Flamingo off-ramp) braid with 2-Lane NB CD Rd/SB Tropicana Ave off-ramp • 1-Lane NB Tropicana Ave on-ramp braid with 1-Lane NB Flamingo Rd off-ramp • I-15 NB – 1-HOV Lane, 4-GP Lanes (South of Twain Ave and 2-HOV Lanes, 4-GP Lanes (North of Twain Ave) • Accommodate Meade Ave HOV Interchange	3	3	4	3	4	3	3	23

TABLE 7 – CONCEPTUAL NB I-15 ALTERNATIVE COMPARISON	Comparative Differences Between Conceptual Alternatives							
	Safety	Mobility	Accessibility	Compatible with Other	Implementabilit y	Environmental Impacts	Schedule Impacts	Overall Performance
Configurations	**Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4=(Best)**							
Northbound Concept 3 • 1-Lane Slip Ramp at Sunset Rd – EB CC 215 to NB I-15 • 1-Lane NB Russell Rd on-ramp (as a full auxiliary lane to Flamingo off-ramp) braid with 2-Lane NB CD Rd/SB Tropicana Ave off-ramp • 2-Lanes NB Tropicana Ave on-ramp braid with 1-Lane NB Flamingo Rd off-ramp • I-15 NB – 1-HOV Lane, 4-GP Lanes (South of Twain Ave and 2-HOV Lanes, 4-GP Lanes (North of Twain Ave) • 1-Auxiliary Lane – between NB Russell Rd. on-ramp and NB Flamingo Rd. off-ramp • 1-Auxiliary Lane – between NB Tropicana Ave. on-ramp and NB Spring Mountain Rd. off-ramp • Spring Mtn loop on-ramp (parallel entrance) – drops/merges to NB I-15 • Accommodate Meade Ave HOV Interchange	3	4	4	4	4	3	3	25

Northbound I-15 Concepts

Safety – Excluding the No-Action, each of the concepts include modest outside widening of northbound I-15 between Russell Road and Sahara Avenue, which provide satisfactory traffic operations performance and are expected to improve safety as compared to the No-Action concept. Concepts 1, 2, and 3 are expected to provide better safety performance and are scored as 3 out of 4, one point downgraded because of the I-15 inside shoulder substandard width.

Mobility – Concept 3 provides better mobility than Concepts 1, 2, and the No-Action. Concept 3 scored 4 out of 4 because travel time through the interchanges area would be much better than Concepts 1, 2, and

the No-Action. Concept 1 is downgraded 2 points to 2 out of 4 because it does not add an auxiliary lane between the northbound Russell Road and on-ramp and northbound Flamingo Road off-ramp, and it does not add a slip-ramp on northbound CD road (eastbound CC-215 to northbound I-15 at Sunset Road). Concept 2 is downgraded one point to 3 out of 4 because it does not add an auxiliary lane between the northbound Tropicana Avenue on-ramp and the northbound Spring Mountain Road off-ramp.

Accessibility – Concepts 1, 2, and 3 provide better accessibility than the No-Action. Concepts 1, 2, and 3 accommodate future single-lane HOV connections in each direction from the median of I-15 to Meade Avenue are scored as 4 out of 4, while the No-Action concept is downgraded two points to 2 out of 4 because it does not accommodate the future HOV at Meade Avenue.

Compatible with Other Plans/Studies – Concepts 1, 2, and 3 accommodate future single-lane HOV connections in each direction from the median of I-15 to Meade Avenue and the City's Martin Luther King Boulevard extension improvement and scored as 4 out of 4, while the No-Action concept is downgraded two points to 2 out of 4 because it does not accommodate the future HOV at Meade Avenue or the City's Martin Luther King Boulevard extension improvement.

Implementability – Each of the concepts improves traffic operations performance as compared with the No-Action concept and would be expected to meet with acceptance by the public. Anticipated project costs based on construction footprint, new structures, and right-of-way impacts are estimated to be higher for Concepts 1, 2 and 3. Scoring for Implementability is therefore 3 out of 4 for the three concepts and No-Action is scored 4 out of 4.

Environmental Impacts – Each of the concepts are anticipated to have minimal to no environmental impacts, and each concept is therefore scored 4 out of 4.

Schedule – Concepts 1, 2, and 3 would need right-of-way between Tropicana Avenue and Flamingo Road along Dean Martin Drive and on the east side of northbound I-15, between Desert Inn Road and Sahara Avenue. Schedule impacts are anticipated to be high, therefore Concepts 1, 2, and 3 downgraded one point to 3 out of 4.

TABLE 8 – CONCEPTUAL I-15/FLAMINGO RD AND I-15/SPRING MOUNTAIN RD. INTERCHANGE CONCEPT COMPARISON		Comparative Differences Between Conceptual Alternatives							
		Safety	Mobility	Accessibility	Compatible with Other Plans/Studies	Implementability	Environmental Impacts	Schedule Impacts	Overall Performance
Interchange	**Interchange Configurations**	**Scoring Criteria 0=(Poor) 1=(Neutral) 2=(Good) 3=(Better) 4= (Best)**							
Flamingo Rd./I 15 Int.	No-Action	3	2	3	2	4	4	4	22
	Tight Diamond Interchange (TDI)	4	4	4	4	3	4	3	26
	Diverging Diamond Interchange (DDI)	3	3	4	3	4	4	4	25
Spring Mountain Rd./I-15 Int.	No-Action (Reconstruct the SB I-15 to EB Spring Mountain Road flyover)	3	3	4	4	4	4	4	26
	Diverging Diamond Interchange (DDI)	3	2	3	3	3	3	4	21
	Modified Diverging Diamond Interchange (DDI) – Grade Separated east crossover	2	3	3	3	2	3	4	20

I-15/Flamingo Road Interchange Concepts

Safety – Each interchange concept provides satisfactory traffic operations performance and are expected to improve safety as compared to the No-Action (existing interchange configuration). The Tight Diamond Interchange (TDI) is expected to provide better safety performance and scored 4 out of 4. The No-Action (existing interchange configuration) and the Diverging Diamond Interchange (DDI) are scored 3 out of 4, one point downgraded because of the existing southbound I-15 to eastbound Flamingo Road loop ramp and the DDI is different from the adjacent interchanges. Per FHWA guidance, adjacent interchanges should not have wildly differing configurations in order to maintain driver expectations.

Mobility – The TDI and DDI interchange concepts provide better mobility than the No-Action concept (existing interchange configuration). The TDI and DDI concepts score 4 out of 4 because the travel time through the interchange area would be better than existing.

Accessibility – The TDI and the DDI concepts provide better accessibility than the No-Action (existing configuration) concept. The TDI and DDI concepts score 4 out of 4 because both concepts maintain the

existing connections and improve the interchange access points by removing the existing southbound I-15 to eastbound Flamingo Road loop ramp.

Compatible with Other Plans/Studies – The TDI concept maintains similar interchange configuration with adjacent interchanges, maintains driver expectations, and are scored 4 out of 4. The DDI and the No-Action (existing configuration) are different from the adjacent interchanges and are downgraded 1 and 2 points out of 4 respectively.

Implementability – Relative to construction costs, the DDI and the No-Action (existing configuration) concepts score lower than the TDI concept. The TDI concept is downgraded 1 point out of 4 because the Flamingo Road bridge needs to be widened to accommodate the configuration. The DDI and the No-Action (existing configurations) score 4 out of 4.

Environmental Impacts – Each of the interchange concepts are anticipated to have minimal to no environmental impacts, and each concept therefore scored 4 out of 4.

Schedule – Each concept does not require new right-of -way but relative to construction costs, the DDI and the No-Action (existing configuration) concepts are lower than the TDI concept. The TDI concept is downgraded 1 point out of 4 because the Flamingo Road bridge needs to be widened to accommodate the configuration. The DDI and the No-Action (existing configurations) score 4 out of 4.

I-15/Spring Mountain Road Interchange Concepts

Safety – Each interchange concept provides satisfactory traffic operations performance and are expected to improve safety as compared to the Modified DDI. The existing No-Action with the reconstructed flyover and the DDI are expected to provide better safety performance and are scored as 3 out of 4. The existing No-Action with the reconstructed flyover concept is downgraded 1 point out of 4 because of the eastbound to northbound loop ramp. The DDI concept is downgraded 1 point out of 4 because DDI is different from the adjacent interchanges. The Modified DDI concept scored 2 out of 4, two points downgraded because of the grade separated eastern crossover and it is different from the adjacent interchanges. Per FHWA guidance, adjacent interchanges should not have wildly differing configurations in order to maintain driver expectations.

Mobility – The existing No-Action with the reconstructed flyover and the Modified DDI interchange concepts provide better mobility than the DDI concept. The existing No-Action with the reconstructed flyover and the Modified DDI concepts score 3 out of 4 because the travel time through the interchange area would be better than the DDI concept.

Accessibility – The existing No-Action with the reconstructed flyover concept provides better accessibility than the DDI and Modified DDI. The existing No-Action with the reconstructed flyover scored 4 out 4 and the DDI and the Modified DDI concepts score 3 out of 4 because both concepts remove some existing local access points.

Compatible with Other Plans/Studies – The existing No-Action with the reconstructed flyover concept maintain similar interchange configuration with adjacent interchanges, maintains driver expectations, and

scored 4 out of 4. The DDI and the Modified DDI are different from the adjacent interchanges and are downgraded 1 point out of 4.

Implementability – Relative construction costs of the No-Action with the reconstructed flyover concept is lower than the DDI and the Modified DDI concepts. The No-Action concept with the reconstructed flyover scored 4 out of 4. The DDI concept is downgraded 1 point out of 4 and the Modified DDI scored 2 out of 4 because of the grade separated eastern crossover.

Environmental Impacts – Each of the interchange concepts are anticipated to have minimal to no environmental impacts. The existing No-Action with the reconstructed flyover concept scored 4 out of 4 and the DDI and Modified DDI score 3 out of 4.

Schedule – Each concept does not require new right-of -way and impacts are not anticipated. Each concept scored 4 out of 4.

Recommendations

The concepts evaluated resulted in Southbound Concept 3 and Northbound Concepts 1 and 3 combined with the I-15/Flamingo Road tight diamond interchange and the No-Action with flyover reconstruction for the I-15/Spring Mountain Road interchange carried forward for further evaluation.

9. Conceptual Alternatives

This section outlines the two conceptual alternatives, including a description of the proposed freeway and local roadway modifications.

9.1 Conceptual Alternative 1

As described for Conceptual Alternative 1, the lane configuration for both directions on I-15 for Conceptual Alternative 2 was determined by matching the improvements made as part of Project NEON to the north and the I-15 South Design-Build project to the south. South of Flamingo Road, southbound I-15 would have 1 HOV lane and 4 GP lanes, and 2 HOV lanes and 4 GP lanes north of Flamingo Road. Northbound I-15 would have 1 HOV lane and 4 GP lanes south of Twain Avenue and 2 HOV lanes and 4 GP lanes north of Twain Avenue. This configuration would provide the minimum level of improvement required to match future conditions at the north and south ends of the study area.

Under Conceptual Alternative 2, the I-15/Flamingo Road interchange would be modified to a typical tight diamond interchange (TDI). The I-15/Spring Mountain interchange would remain in its current configuration, but reconstruction of the southbound I-15 to eastbound Spring Mountain Road flyover is needed. The flyover would be reconstructed to accommodate additional lanes on I-15.

Conceptual Alternative 2 proposes to add a slip-ramp on the northbound CD road, from eastbound CC-215 to northbound I-15 at Sunset Road. The following ramps would be braided: northbound Russell Road on-ramp (as a full auxiliary lane to Flamingo Road off-ramp) with the northbound CD Road/southbound Tropicana Avenue off-ramp, and northbound Tropicana Avenue on-ramp with the northbound Flamingo Road off-ramp. Auxiliary lanes would be added between the northbound Russell Road on-ramp and the

northbound Flamingo Road off-ramp and the northbound Tropicana Avenue on-ramp and the northbound Spring Mountain Road off-ramp. Future single-lane HOV connections in each direction would be accommodated by leaving adequate space in the median of I-15 to Meade Avenue.

9.2 Comparison of Conceptual Alternatives

Conceptual Alternatives provide comparable traffic operations performance improvements over the no-build alternative. Table 9 illustrates areas of differences between the alternatives that may be considered in the subsequent NEPA phase to identify a Preferred Alternative.

Table 9. Comparison of Conceptual Alternatives

	Conceptual Alternative 1	Conceptual Alternative 2
I-15 NB	• No improvements until north of Flamingo Rd • 1 HOV lane, 4 GP lanes (south of Twain Ave) and 2 HOV lanes, 4 GP Lanes (north of Twain Ave) • Accommodate Meade Ave HOV interchange • Spring Mountain loop ramp is a parallel drop/merge to NB I-15	• 1 lane slip ramp at Sunset Rd – EB CC 215 to NB I-15 • 1 lane NB Russell Rd on-ramp (as a full auxiliary lane to Flamingo Rd off-ramp) braid with 2 Lane NB CD Rd/SB Tropicana Ave off-ramp • 2 lanes NB Tropicana Ave on-ramp braid with 1 lane NB Flamingo Rd off-ramp • 1 HOV lane, 4 GP lanes (south of Twain Ave) and 2 HOV lanes, 4 GP lanes (north of Twain Ave) • Auxiliary lane between NB Russell Rd on-ramp and NB Flamingo Rd off-ramp • Auxiliary lane between NB Tropicana Ave on-ramp and NB Spring Mountain Rd off-ramp • Accommodate Meade Ave HOV interchange
I-15 SB	• 1 lane Sahara Ave on-ramp (parallel entrance) – drops/merge to SB I-15 • 2 lanes SB Flamingo Rd off-ramp braided with 1 lane SB Spring Mountain Rd on-ramp • 2 lanes SB Tropicana Ave off-ramp braided with 1 lane SB Flamingo Rd on-ramp • Auxiliary Lane between SB Spring Mountain Rd on-ramp and SB Tropicana Ave off-ramp • 1 HOV lane, 4 GP lanes (south of Flamingo Rd) and 2 HOV lanes, 4 GP lanes (north of Flamingo Rd.)	
I-15 and Flamingo Road Interchange	TDI Configuration	
I-15 and Spring Mountain Road Interchange	Existing Configuration (Reconstruct the SB I-15 to EB Spring Mountain Road flyover)	
Cost	approximately $252.7 million	approximately $350.6 million

9.3 Evaluation Against the Purpose and Need

Purpose and Need: Resolve Existing Roadway Deficiencies – Conceptual Alternatives 1 and 2 resolve existing roadway deficiencies. In Conceptual Alternatives 1 and 2 on SB I-15, SB Tropicana Avenue off-ramp braided with SB Flamingo Road on-ramp and SB Spring Mountain Road on-ramp braided with SB Flamingo Road off-ramp and in Conceptual Alternative 2, NB Russell Road on-ramp braided with NB CD Road and NB Tropicana Avenue on-ramp braided with NB Flamingo Road off-ramp would increase the weaving distances between Tropicana Avenue and Flamingo Road and between Flamingo Road and Spring Mountain Road. Ramp merges and tapers meet or exceed current geometric design criteria. Each of the alternatives would add auxiliary lanes between Tropicana Avenue and Sahara Avenue.

Purpose and Need: Provide Transportation Improvements to Serve Existing and Future Growth – Conceptual Alternatives 1 and 2 provide satisfactory traffic operations performance for year 2040 traffic projections that are based on population growth projections by RTC. Based on modeling using Aimsun Next, each of the alternatives meet the needs of the total traffic demand for year 2040 with satisfactory traffic operations performance.

Purpose and Need: Accommodate Regional and Local Plans – Conceptual Alternatives 1 and 2 were configured to accommodate the future construction of the Meade Avenue HOV interchange, and The City of Las Vegas MLK extension improvement west of I-15.

9.4 Conceptual Build Alternatives Ranking

Note to Reviewer: The following scoring analysis is preliminary for discussion and will be revised after a design team review meeting.

Conceptual Alternatives 1 and 2 were scored based on the scoring criteria defined in Table 1.

Safety – Each of the alternatives include modest outside widening of I-15 between Russell Road and Sahara Avenue, which provides satisfactory traffic operations performance and are expected to improve safety as compared to the No-Action Alternative. Conceptual Alternatives 1 and 2 are expected to provide better safety performance and are scored as 3 out of 4, one point downgraded because of the I-15 inside shoulder substandard width.

Mobility – Each of the alternatives provide better mobility than the No-Action Alternative. Conceptual Alternatives 1 and 2 are scored 4 out of 4 because travel time through the interchanges area would be better than existing.

Accessibility – Conceptual Alternative 2 provides better accessibility than Conceptual Alternative 1. Conceptual Alternative 2 adds a slip ramp from eastbound CC-215 to northbound I-15 at Sunset Road and is scored as 4 out of 4, while Conceptual Alternative 1 is downgraded one point to 3 out of 4 because it does not add a slip ramp.

Compatible with Other Plans/Studies – Conceptual Alternative 1 and Conceptual Alternative 2 scored 4 out of 4 since both accommodate future single-lane HOV connections in each direction from the median

of I-15 to Meade Avenue and the City's Martin Luther King Boulevard extension improvement . The No-Action concept is downgraded two points to 2 out of 4 because it does not accommodate planned future improvements.

Implementability – Each of the alternatives improves traffic operations performance as compared with the No-Action Alternative and would be expected to meet with acceptance by the public. Project costs are estimated to be highest for Conceptual Alternative 2, followed by Conceptual Alternative 1. Scoring for Implementability is therefore 2 out of 4 for Conceptual Alternative 2, 3 out of 4 for Conceptual Alternative 1.

Environmental Impacts – Each of the alternatives are anticipated to have minimal to no environmental impacts, and each alternative is therefore scored 4 out of 4.

Schedule – Conceptual Alternative 1 and 2 would need right-of-way between Desert Inn Road and Sahara Avenue on the east side of I-15 and between Tropicana Avenue and Flamingo Road along Dean Martin Drive. Conceptual Alternative 2 would need more right-of-way between Tropicana Avenue and Flamingo Road along Frank Sinatra Drive. Schedule impacts are anticipated to be high, therefore Conceptual Alternative 2 downgraded two points to 2 out of 4 and downgrade one point to 3 out of 4 for Conceptual Alternative 1.

Table 10. Ranking of Conceptual Alternatives

CRITERIA	ALTERNATIVES		
	No-Action	**1**	**2**
Safety	2	3	3
Mobility	3	4	4
Accessibility	2	3	4
Compatibility with other Plans/Studies	2	4	4
Implementability	3	3	2
Environmental Impacts	4	4	4
Schedule	4	3	2
Total	20	24	23
Average Score	2.86	3.43	3.29

Technical Memorandum

To: Jenica Keller, P.E., NDOT/ Joey Passkey, P.E. CLV
Date: February 9, 2021

From: Jack Sjostrom, CA Group

Subject: MLK Extension Project Design Review

Copies: I-15 Flamingo to Sahara TAC distribution

CA Group has performed a brief evaluation of the City of Las Vegas' (City) Martin Luther King (MLK) Boulevard Extension Project. This evaluation was performed to determine whether the City's design is compatible with potential improvements to Interstate 15 (I-15) under consideration by NDOT and confirm the compliance of the MLK Extension Project's preliminary design to the American Association of State Highway and Transportation Officials (AASHTO) and Nevada Department of Transportation (NDOT) design guidelines. The evaluation included review of both horizontal and vertical geometrics, right of way impacts, adjacent development, and probable interaction with NDOT's desired or needed improvements.

Currently, the City's feasibility study for the MLK Extension Project is a high-level conceptual design at 10 percent development. Advancing the design of the proposed MLK improvements is pending the City's coordination with area stakeholders.

Revisions to NDOT's current alternatives and progression of revisions to the Feasibility Study cannot proceed without input from and coordination with the City.

The following items are documented to identify the critical elements that would be impacted by or impact the I-15 improvements identified as part of the I-15 Flamingo to Sahara Feasibility Study. This summary is not intended to provide a full evaluation of the MLK Extension Project's conceptual design.

Note, figures in this memorandum that depict the City's possible project improvements show those elements in cyan, while the possible NDOT I-15 improvements are shown in yellow, white, and gray; all overlaid on the aerial photography provided for the Feasibility Study.

PROPOSED MLK EXTENSION DESIGN REVIEW ITEMS

a) The proposed retaining wall between southbound Rancho and the proposed MLK Extension should be extended from the current design so that the two roadways are allowed to match vertically (see Figure 1). The MLK Extension is grade separated over Sahara, the southbound (SB) I-15 to eastbound (EB) Sahara off-ramp, and the EB Sahara to SB I-15 ramp, then MLK's profile lowers to match in to and merge with the existing Rancho roadway. Only the SB connection from Sahara is perpetuated. Northbound (NB) Rancho would not have direct access to/from Sahara.

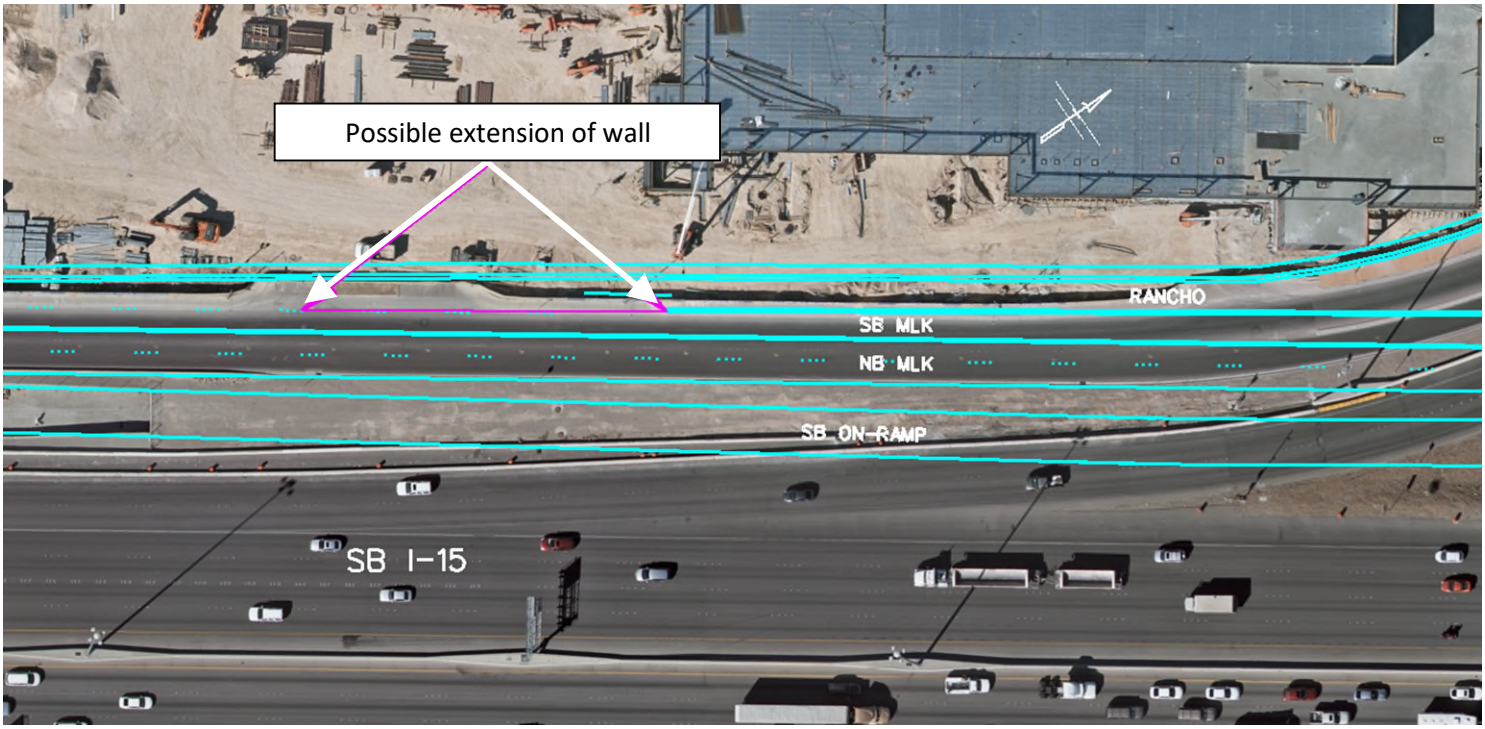


Figure 1

This area is also subject to additional impacts as discussed below in item E.

Recommendation:
The retaining wall between MLK and Rancho should be extended by approximately 200 feet where the two roadways can match vertically. Options to perpetuate the existing NB Rancho access to Sahara should be considered.

b) As drawn, the proposed ramp geometry from the MLK Extension to Eastbound (EB)/Westbound (WB) Spring Mountain does not allow development of the minimum vertical clearance of 16.5 feet at the required point (see Figure 2).

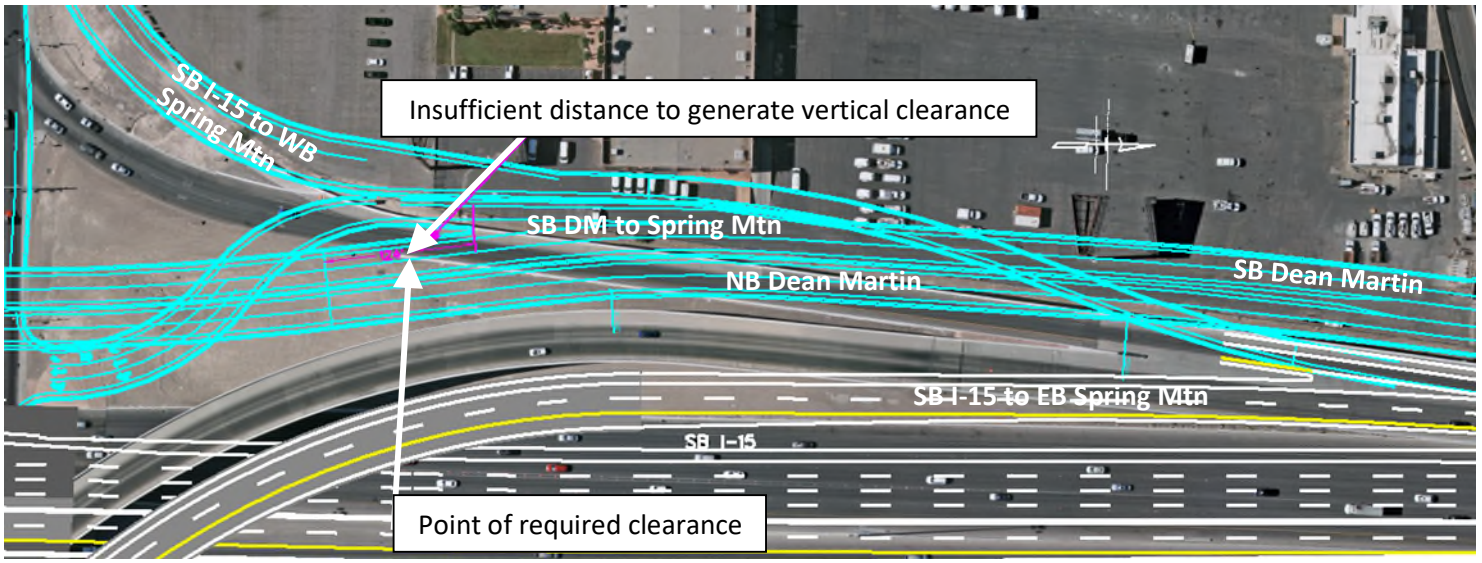


Figure 2

There are several options that could be considered to resolve this:

1. The SB I-15 to WB Spring Mountain off-ramp could be moved further north to gain more distance to achieve the vertical clearance, and the MLK Extension could be moved over the ramp to EB/WB Spring Mountain;
2. The MLK Extension could be changed to pass over Desert Inn and over the SB I-15 to WB Spring Mountain off-ramp, this would preclude access to/from Desert Inn;
3. The MLK Extension could be realigned to be closer to I-15 (to the east) to gain more distance for the EB/WB Spring Mountain off-ramp and to avoid impacting the adjacent building on the west side. Additionally, the SB I-15 to EB Spring Mountain ramp could be realigned to the east to get even more space; or
4. The intersection at Spring Mountain could be moved to be west of the MLK Extension, with a longer bridge for the MLK Extension to accommodate the SB I-15 entrance ramp.

<u>Recommendation:</u>
Realign I-15's exit ramp, MLK Extension, and the MLK Extension ramps as noted in option 3.

c) The proposed WB Spring Mountain to SB I-15 on-ramp turning radius will not allow a WB-67 vehicle to turn without impacting the existing I-15 bridge piers (see Figure 3). Additionally, this configuration will require that the I-15 SB bridge over Spring Mountain be reconstructed, as the proposed horizontal proximity of the ramps to the bridge abutments would result in undermining their foundations.

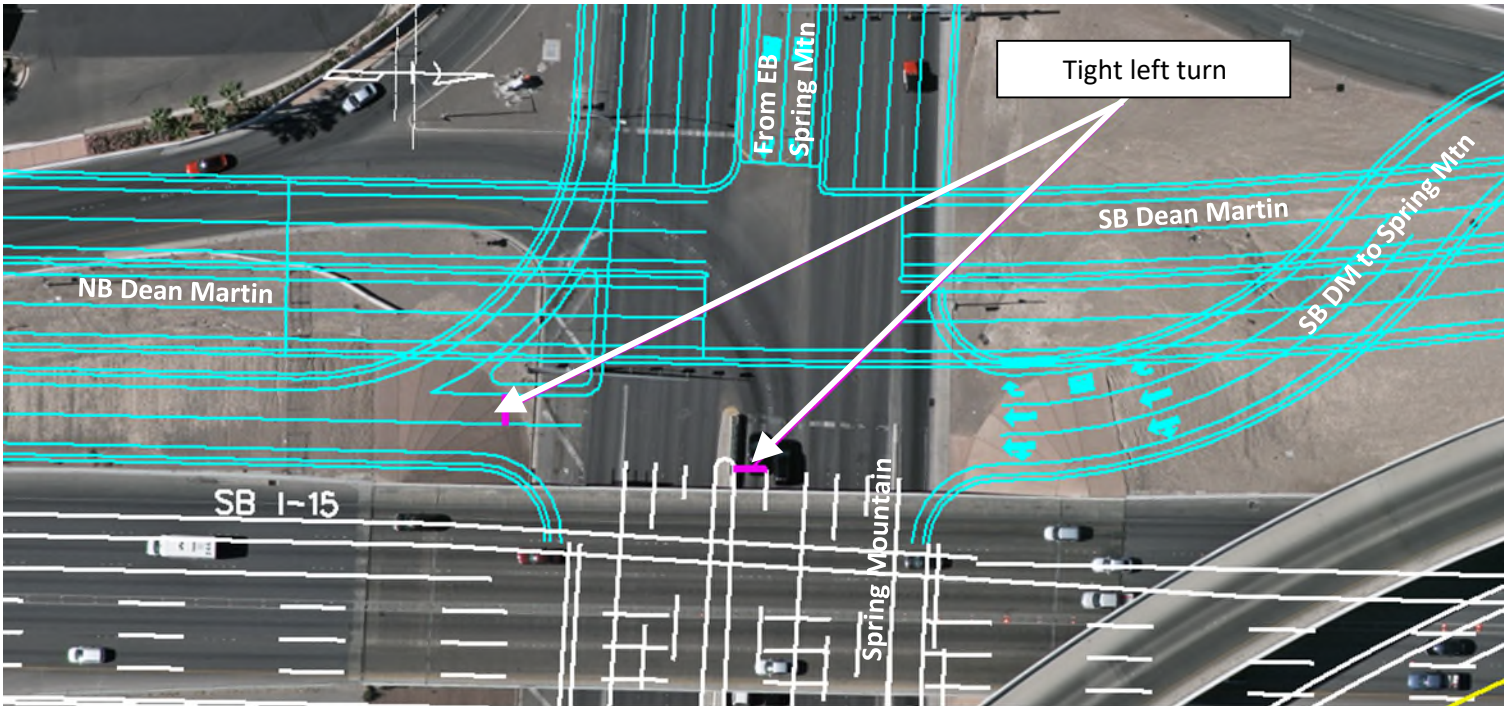


Figure 3

Options that may be considered to resolve this are:

1. Replace the existing I-15 bridge over I-15, either to be a single span structure or to adjust the edge of bridge and reconstruct its abutments; or
2. Move the intersection at Spring Mountain to the west of the MLK Extension.

Recommendation:
To save the I-15 SB bridge over Spring Mountain, it is recommended to go with option 2 to shift the MLK ramps WEST to maintain the foundations of the north and south abutments, as suggested in the previous point above.

d) The proposed SB Spring Mountain on-ramp vertical profile does not meet the design criteria (up-grade) (No figure provided). As currently configured the ramp grade exceeds 6%, whereas the Department's Road Design Guide limits grades on ramps to 6% or flatter.

Two options may be considered to resolve this without a design exception:

1. The proposed MLK extension SB on-ramp could tie-in with the I-15 Flamingo to Sahara SB on-ramp; or
2. The SB on-ramp gore could be extended further south to achieve the required maximum ramp up-grade.

PROPOSED MLK EXTENSION IMPACTS

The design review identified several impacts of the proposed MLK Extension which range in severity from minimal to substantial.

e) All existing access points and/or driveways on the east side of Palace Station Casino would become inaccessible to all access direction because of vertical differentials between the Palace Station Casino property and the MLK extension (*the previous layout of Preliminary MLK Extension Project has ingress/egress access to Palace Station Casino*). The design team analyzed the possibility of shifting the alignment of I-15 to the east, but it was determined that shifting the alignment was not feasible due to right-of-way constraints on the east.

f) The proposed MLK Extension at Spring Mountain would impact the existing I-15 north and south abutments due to the proximity of the proposed MLK Extension ramps to I-15.

g) The proposed intersection of MLK Extension and Twain requires a modification or replacement of the Union Pacific Railroad (UPRR) bridge (see Figure 4). The proposed configuration shows a clear span in excess of 433 feet that may not be feasible using bridge types permitted by UPRR.

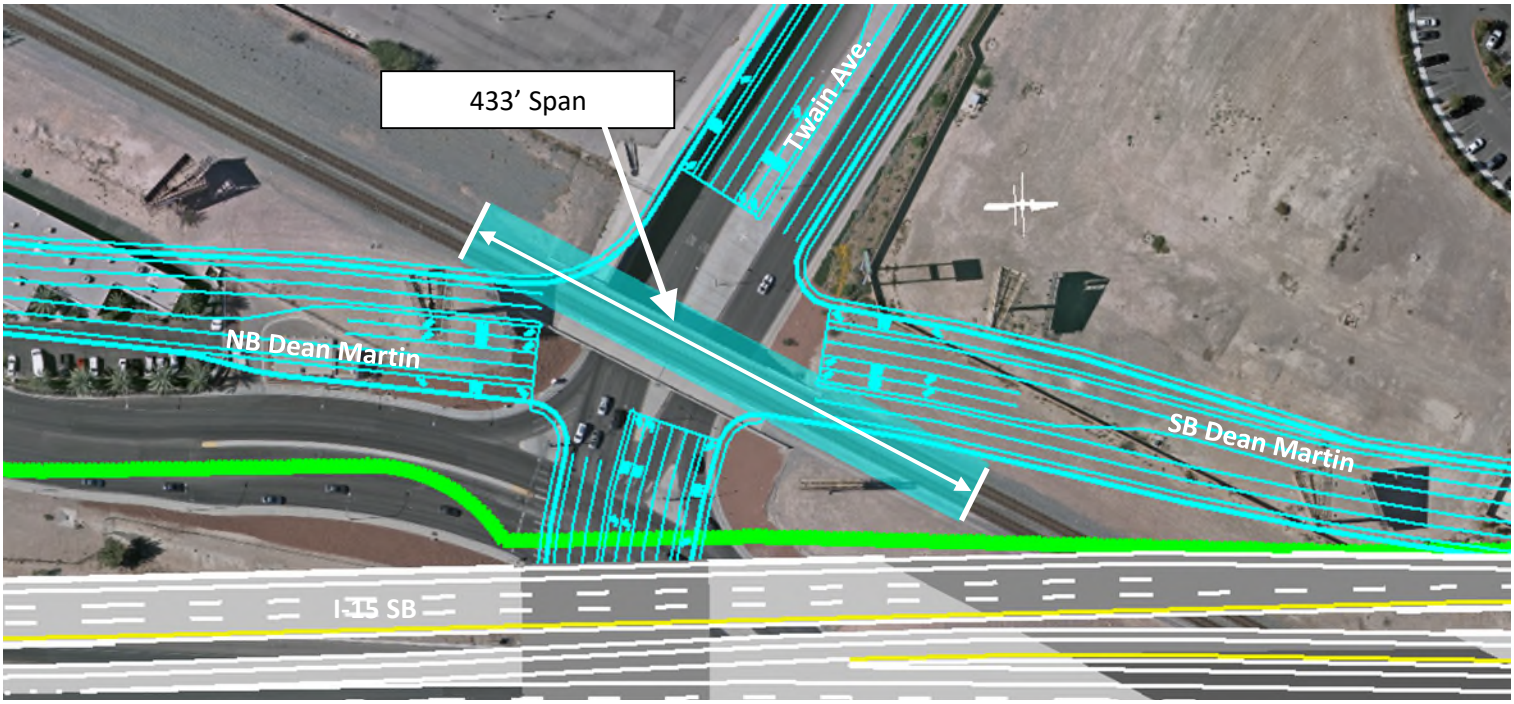


Figure 4

h) The proposed MLK Extension would impact the recently constructed CARVANA building just south of Highland. The building is situated close to the I-15 right of way and there is not enough space to accommodate the proposed MLK Extension improvements without impacting the building (*see Figure 5, site visit picture below*).

Figure 5 - Looking South

RECOMMENDATIONS

It is recommended that these discussion points and recommendations be coordinated between NDOT and the City to identify resolutions that meet the intent and desired project outcome(s) of both parties. CA Group is looking forward to supporting the conversation and participating to determine the most appropriate course of action for the items identified in this memorandum.

Technical Memorandum

To: Jenica Keller, NDOT

Date: March 9, 2021

From: Jack Sjostrom, CA Group

Subject: MLK Extension Project Traffic Analysis Sensitivity Review

Copies: I-15 Flamingo to Sahara TAC distribution

CA Group performed a brief evaluation of the City of Las Vegas' (City) Martin Luther King (MLK) Boulevard Extension Project and completed a comparison of the traffic volumes on I-15 using two TransCAD models provided by the Regional Transportation Commission of Southern Nevada (RTC). The two TransCAD models included one 2040 No-Action scenario, and 2040 scenario with the City's MLK Extension Project coded in the model. The evaluation was only a sensitivity analysis to look at what positive or negative impacts the MLK Extension Project would have on I-15. This analysis showed the alternatives include the right number of lanes and improvements on I-15 with or without the MLK Extension Project.

The comparison showed less than a 1 percent reduction in I-15 traffic volumes with the MLK Extension Project improvements included in the model. As shown in Table 1 and the following charts, the proposed MLK Extension Project improvements produce a negligible effect on I-15 traffic volumes. Therefore, the conclusions of the I-15 Flamingo to Sahara Feasibility Study traffic analysis remain valid, and additional traffic analyses are not recommended to be performed.

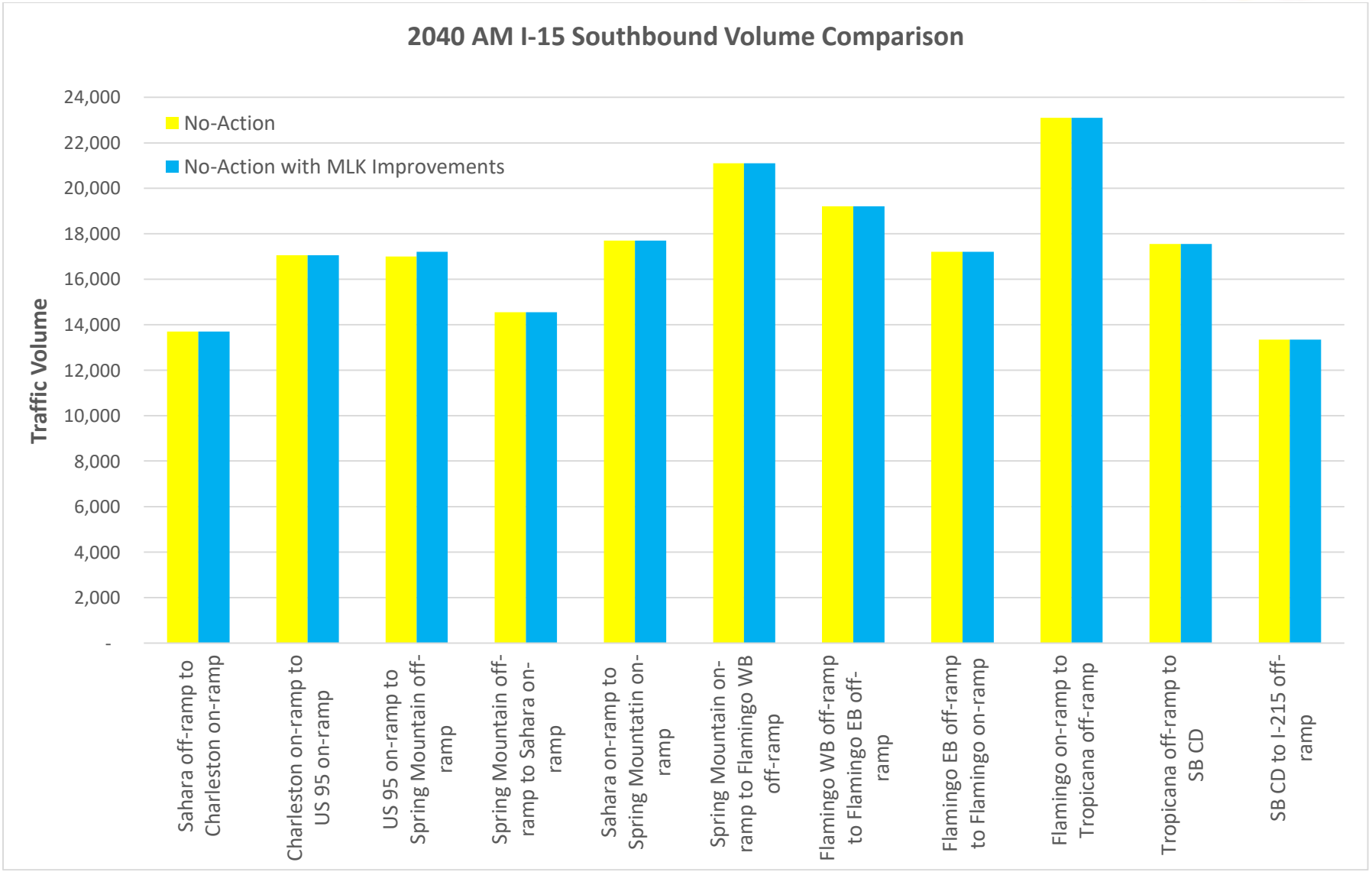
NOTE: CA Group's scope did not include MLK in the Aimsun model, which means that traffic utilization or performance of a completed MLK concept cannot be evaluated as part of the Feasibility Study's traffic analysis. It is likely that interactivity in an Aimsun model between the MLK Extension and I-15 could show some I-15 traffic being diverted to MLK. In addition, CA Group's scope did not include conducting an Aimsun analysis for this project with and without MLK Boulevard Extension project. It is recommended that subsequent study or NEPA action of the I-15 Central Corridor include the MLK Boulevard Extension Project, analyzing it in microsimulation analysis to accurately determine its impacts and benefits.

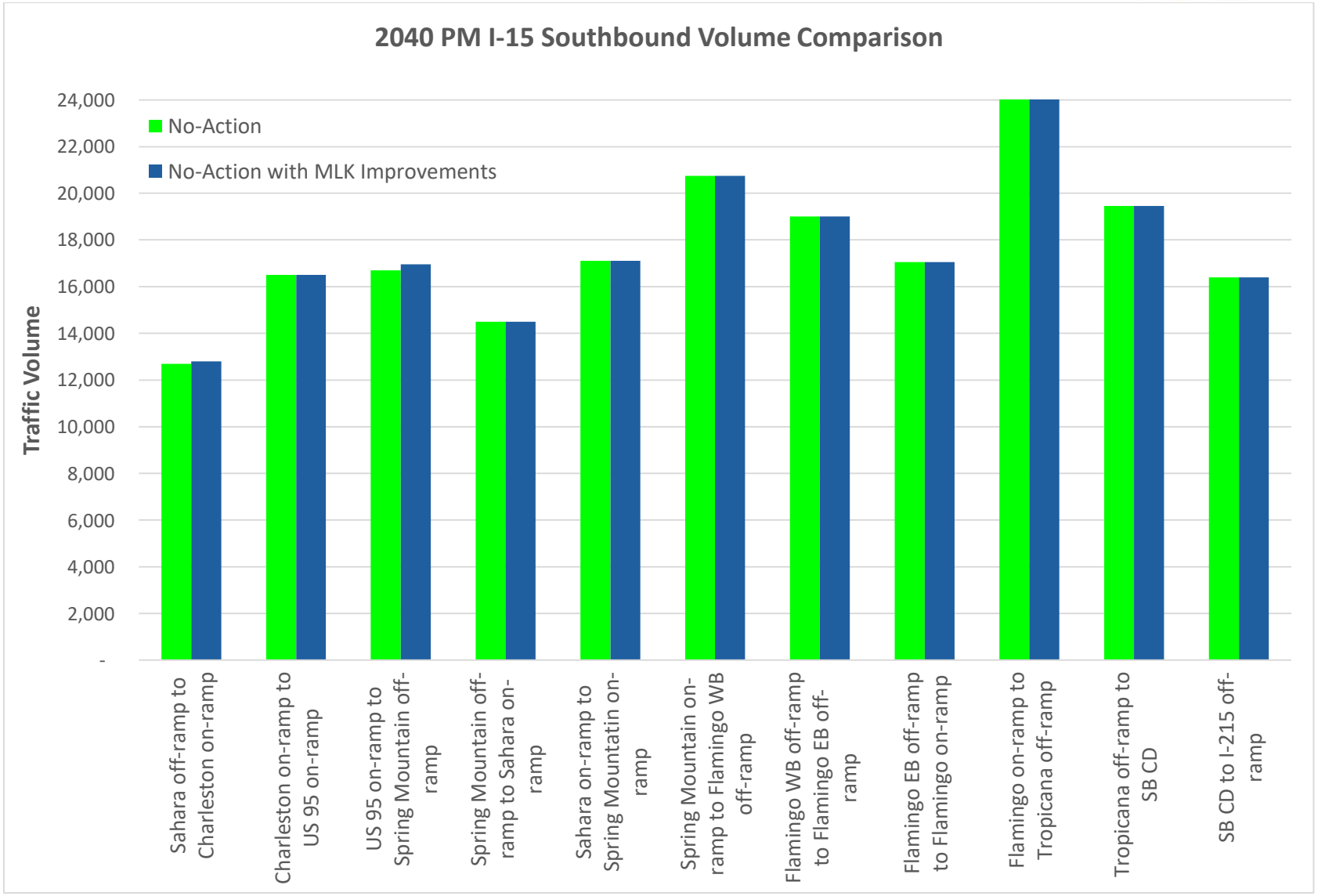
Table 1. 2040 Traffic Volume Comparison (With and Without MLK Extension Project)

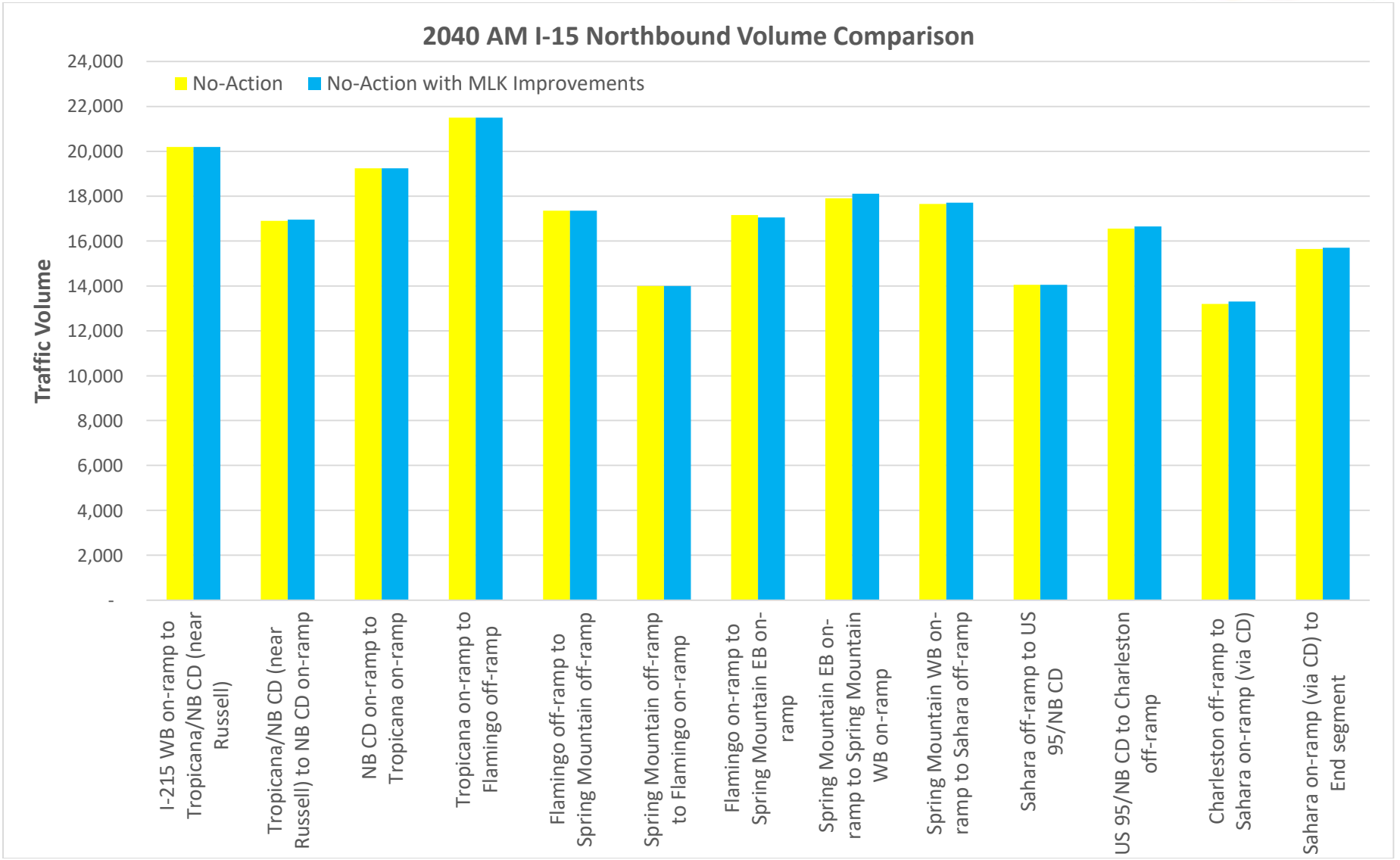
I-15 SOUTHBOUND									
Segment		2040 No-Action		2040 No-Action with MLK Improvements		Difference		Difference (Percentage)	
From	To	AM	PM	AM	PM	AM	PM	AM	PM
Sahara off-ramp	Charleston on-ramp	13,700	12,700	13,700	12,800	-	100	-	0.8%
Charleston on-ramp	US 95 to I-15 ramp	17,050	16,500	17,050	16,500	-	-	-	-
US 95 to I-15 ramp	Spring Mountain off-ramp	17,000	16,700	17,200	16,950	200	250	1%	1%
Spring Mountain off-ramp	Sahara on-ramp	14,550	14,500	14,550	14,500	-	-	-	-
Sahara on-ramp	Spring Mountain on-ramp	17,700	17,100	17,700	17,100	-	-	-	-
Spring Mountain on-ramp	Flamingo WB off-ramp	21,100	20,750	21,100	20,750	-	-	-	-
Flamingo WB off-ramp	Flamingo EB off-ramp	19,200	19,000	19,200	19,000	-	-	-	-
Flamingo EB off-ramp	Flamingo on-ramp	17,200	17,050	17,200	17,050	-	-	-	-
Flamingo on-ramp	Tropicana off-ramp	23,100	24,100	23,100	24,100	-	-	-	-
Tropicana off-ramp	I-15 to SB CD	17,550	19,450	17,550	19,450	-	-	-	-
I-15 to SB CD	I-215 off-ramp	13,350	16,400	13,350	16,400	-	-	-	-

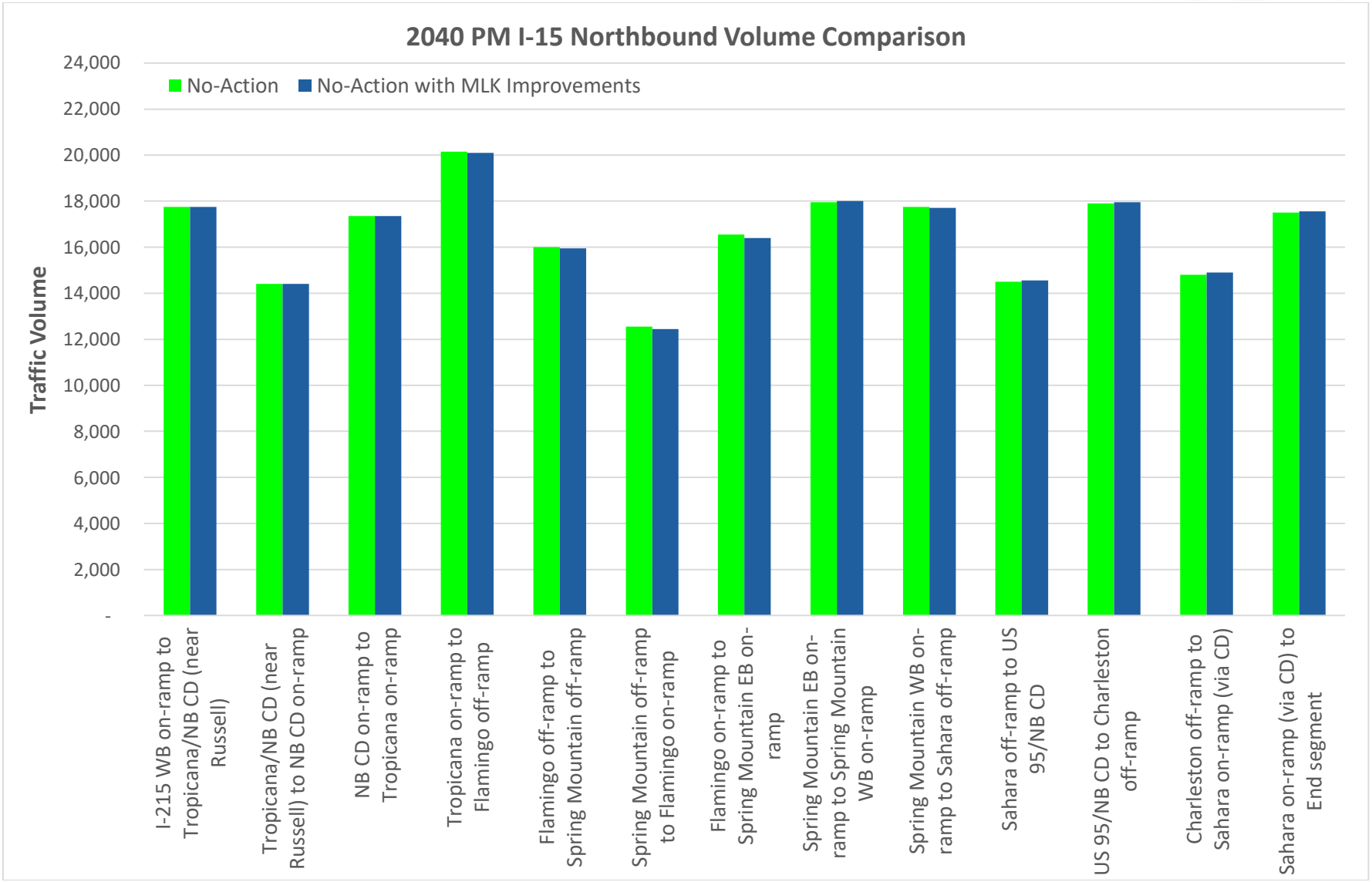
Table 1. 2040 Traffic Volume Comparison (With and Without MLK Extension Project), continued

I-15 NORTHBOUND									
Segment		2040 No-Action		2040 No-Action with MLK Improvements		Difference		Difference (Percentage)	
From	To	AM	PM	AM	PM	AM	PM	AM	PM
I-215 WB on-ramp	Tropicana/NB CD (near Russell)	20,200	17,750	20,200	17,750	-	-	-	-
Tropicana/NB CD (near Russell)	NB CD on-ramp	16,900	14,400	16,950	14,400	50	-	-	-
NB CD on-ramp	Tropicana on-ramp	19,250	17,350	19,250	17,350	-	-	-	-
Tropicana on-ramp	Flamingo off-ramp	21,500	20,150	21,500	20,100	-	(50)	-	-
Flamingo off-ramp	Spring Mountain off-ramp	17,350	16,000	17,350	15,950	-	(50)	-	-
Spring Mountain off-ramp	Flamingo on-ramp	14,000	12,550	14,000	12,450	-	(100)	-	-0.8%
Flamingo on-ramp	Spring Mountain EB on-ramp	17,150	16,550	17,050	16,400	(100)	(150)	-0.6%	-0.9%
Spring Mountain EB on-ramp	Spring Mountain WB on-ramp	17,900	17,950	18,100	18,000	200	50	1%	-
Spring Mountain WB on-ramp	Sahara off-ramp	17,650	17,750	17,700	17,700	50	(50)	-	-
Sahara off-ramp	US-95/NB CD	14,050	14,500	14,050	14,550	-	50	-	-
US-95/NB CD	Charleston off-ramp	16,550	17,900	16,650	17,950	100	50	0.6%	-
Charleston off-ramp	Sahara on-ramp (via CD)	13,200	14,800	13,300	14,900	100	100	0.8%	0.7%
Sahara on-ramp (via CD)	End Segment	15,650	17,500	15,700	17,550	50	50	-	-


2040 AM I-15 Southbound Volume Comparison
Traffic Volume
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
No-Action
No-Action with MLK Improvements
Sahara off-ramp to Charleston on-ramp
Charleston on-ramp to US 95 on-ramp
US 95 on-ramp to Spring Mountain off-ramp
Spring Mountain off-ramp to Sahara on-ramp
Sahara on-ramp to Spring Mountatin on-ramp
Spring Mountain on-ramp to Flamingo WB off-ramp
Flamingo WB off-ramp to Flamingo EB off-ramp
Flamingo EB off-ramp to Flamingo on-ramp
Flamingo on-ramp to Tropicana off-ramp
Tropicana off-ramp to SB CD
SB CD to I-215 off-ramp


2040 PM I-15 Southbound Volume Comparison
Traffic Volume
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
No-Action
No-Action with MLK Improvements
Sahara off-ramp to Charleston on-ramp
Charleston on-ramp to US 95 on-ramp
US 95 on-ramp to Spring Mountain off-ramp
Spring Mountain off-ramp to Sahara on-ramp
Sahara on-ramp to Spring Mountatin on-ramp
Spring Mountain on-ramp to Flamingo WB off-ramp
Flamingo WB off-ramp to Flamingo EB off-ramp
Flamingo EB off-ramp to Flamingo on-ramp
Flamingo on-ramp to Tropicana off-ramp
Tropicana off-ramp to SB CD
SB CD to I-215 off-ramp


2040 AM I-15 Northbound Volume Comparison
No-Action
No-Action with MLK Improvements
Traffic Volume
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
I-215 WB on-ramp to Tropicana/NB CD (near Russell)
Tropicana/NB CD (near Russell) to NB CD on-ramp
NB CD on-ramp to Tropicana on-ramp
Tropicana on-ramp to Flamingo off-ramp
Flamingo off-ramp to Spring Mountain off-ramp
Spring Mountain off-ramp to Flamingo on-ramp
Flamingo on-ramp to Spring Mountain EB on-ramp
Spring Mountain EB on-ramp to Spring Mountain WB on-ramp
Spring Mountain WB on-ramp to Sahara off-ramp
Sahara off-ramp to US 95/NB CD
US 95/NB CD to Charleston off-ramp
Charleston off-ramp to Sahara on-ramp (via CD)
Sahara on-ramp (via CD) to End segment


2040 PM I-15 Northbound Volume Comparison
No-Action
No-Action with MLK Improvements
Traffic Volume
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
I-215 WB on-ramp to Tropicana/NB CD (near Russell)
Tropicana/NB CD (near Russell) to NB CD on-ramp
NB CD on-ramp to Tropicana on-ramp
Tropicana on-ramp to Flamingo off-ramp
Flamingo off-ramp to Spring Mountain off-ramp
Spring Mountain off-ramp to Flamingo on-ramp
Flamingo on-ramp to Spring Mountain EB on-ramp
Spring Mountain EB on-ramp to Spring Mountain WB on-ramp
Spring Mountain WB on-ramp to Sahara off-ramp
Sahara off-ramp to US 95/NB CD
US 95/NB CD to Charleston off-ramp
Charleston off-ramp to Sahara on-ramp (via CD)
Sahara on-ramp (via CD) to End segment

Technical Memorandum

To: Jae Pullen, P.E., NDOT

Date: April 14, 2021

From: Jack Sjostrom, CA Group

Subject: Shift to Accommodate MLK Extension Project Cost Estimate Summary

Copies: I-15 Flamingo to Sahara TAC distribution

CA Group has performed an evaluation of the City of Las Vegas' (City) Martin Luther King (MLK) Boulevard Extension Project. This evaluation was performed to determine whether the City's design is compatible with potential improvements to Interstate 15 (I-15) under consideration by NDOT. Alternative 1 and Alterative 2 under evaluation in the I-15 Flamingo to Sahara Feasibility Study have been reevaluated to incorporate alignment changes that would accommodate the MLK Extension Project. The modifications to either Alternative 1 or Alternative 2 require shifting I-15 to the east between Flamingo Road and Desert Inn Road. These modifications are identical for both Alternatives 1 and 2.

CA Group prepared a conceptual cost estimate for the Alternative 1 Shift using the NDOT Wizard estimating tool. The difference between the original Alternative 1 estimate and the new Alternative 1 Shift estimate was then applied to the original Alternative 2 estimate to yield an approximate cost of an Alternative 2 Shift. See **Table 1** for the cost estimate difference summary.

Table 1 – Cost Estimate Difference Summary

Alternative 1	**Total cost estimate, 2019 Alternative 1**	**Total cost estimate, 2019 Alternative 1 Shift**	**Alternative 1 cost estimate difference (change, Δ)**
	$250,414,149	$335,835,677	$85,421,528
Alternative 2	**Total cost estimate, 2019 Alternative 2**	**Total cost estimate, 2019 Alternative 2 Shift**	**Alternative 2 cost estimate difference (change, Δ)**
	$396,695,749	$482,117,277	$85,421,528

Major improvements to the I-15 shift that would be required to accommodate the MLK Extension Project include:

- Reconstruct the I-15 median between Flamingo Road and Desert Inn Road and reconstruct portions of I-15 to adjust the I-15 cross slope (superelevation) between Flamingo Road and Desert Inn Road.
- Reconstruct the northbound (NB) off-ramp to Spring Mountain Road and reconstruct the NB on-ramp/loop ramp from eastbound (EB) Spring Mountain Road to NB I-15.
- Reconstruct the NB and southbound (SB) I-15 bridge over Twain Avenue.

- Reconstruct the NB and SB I-15 bridges over Spring Mountain Road.
- Demolish the I-15 bridge over Sammy Davis Jr. Drive/Industrial Road and reconstruct I-15 with mechanically stabilized earth (MSE) and retaining walls.

Retaining wall locations and heights would be determined during detailed design. In addition to cast-in-place or MSE walls for new or widened bridges, MSE retaining walls are anticipated to accommodate grade differentials where there is insufficient space to allow for sloping embankments.

There are no new additional right-of-way impacts necessary to accommodate the MLK Extension Project. The I-15 shift occurs within existing NDOT rights-of-way.

Major construction/improvement elements that make up the total I-15 Shift project cost in 2019 dollars are shown in **Table 2**.

Table 2 – Major Construction Elements Required for I-15 Shift

Brief Description	Cost Estimate
I-15 over Twain, L=141', W=232', H=17', no median, Concrete $150/SF	$ 4,906,800
Spring Mountain NB off-ramp over Twain, L=141', W=38', H=17', Concrete $150/SF	$ 803,700
NB I-15 and NB Spring Mountain over UPRR, L=408', W=76', H=17', Concrete $150/SF	$ 4,651,200
NB I-15 over Spring Mountain, L=255', W=110', H=17', Concrete $150/SF	$ 4,207,500
SB I-15 over Spring Mountain, L=255', W=106', H=17', Concrete $150/SF	$ 4,054,500
SB I-15 off-ramp to EB Spring Mountain	$ 2,560,500
Concrete Pavement	$ 4,733,004
Retaining Walls	$ 2,230,410
I-15 SB Ramps at Spring Mountain Signal	$ 264,000
Demolition – Bridges	$ 5,784,065