

I-15 Flamingo Road to Sahara Avenue

Cost Risk Assessment

Prepared for:

Nevada Department of Transportation

June 2021

COST RISK ASSESSMENT

JUNE 2021





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I. EXECUTIVE SUMMARY

The Cost Risk Assessment (CRA) report for the Nevada Department of Transportation's (NDOT) proposed improvements to the Interstate 15 (I-15) corridor from Flamingo Road to Sahara Avenue identifies project threats and opportunities that could affect project cost and/or budget. The feasibility study is evaluating four potential alternatives, which are all included in this CRA. This CRA is an update to the September 2020 CRA (Appendix E) based on concept revisions, Alternative 1 Shift and Alternative 2 Shift, requested by the City of Las Vegas.

In preparing the CRA, a risk-based estimate was prepared to model project risks assuming all risks would be accepted (pre-response) and preparing the post-response estimate assuming a proactive risk management plan was implemented. The CRA evaluated two different alternatives to identify if the risks may cause significantly different potential outcomes.

Table E-1 presents the September 2020 CRA results for Alternative 1 and Alternative 2 and the April 2021 updated CRA results for Alternative 1 Shift and Alternative 2 Shift, and are intended as a quick summary for NDOT Management and Executive Leadership Team (ELT).

Risk-Adjusted Cost Results (in Millions – YOE \$'s)					
Scenario	Base Cost	Cost Range			
Scenario	Dase Cost	10 th Percentile	70 th Percentile	90 th Percentile	
		Alternative 1			
Pre-Response	\$227.7	\$322.2	\$364.1	\$380.5	
Post-Response	ŞZZT.T	\$315.1	\$356.8	\$371.2	
		Alternative 1 Shift			
Pre-Response	\$254.3	\$406.6	\$439.8	\$453.8	
Post-Response	ŞZJ4.5	\$401.3	\$430.9	\$442.4	
		Alternative 2			
Pre-Response	\$364.5	\$414.5	\$470.7	\$505.8	
Post-Response	Ş304.5	\$409.6	\$461.1	\$483.7	
Alternative 2 Shift					
Pre-Response	\$357.1	\$482.9	\$540.6	\$567.6	
Post-Response	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	\$478.8	\$533.9	\$557.7	

Table E-1 – Risk Adjusted Cost Results (in Millions – YOE \$'s)

Table E-2 summarizes the risk adjusted project completion dates for all alternatives.

Risk-Adjusted Project Completion Date					
Scenario	Base Completion Project Completion Date Range				
Scenario	Date	10th Percentile70th Percentile90th Percentile			
Pre-Response	Dec 2028	November 2031	April 2036	April 2037	
Post-Response	Dec 2028	February 2031	August 2035	June 2036	

Table E-2 – Risk Adjusted Project Completion Date







Figure E-1 presents a one-page snapshot of I-15 Flamingo Road to Sahara Avenue project with respect to overall benefits, costs, and schedule based on the outcomes of the two Shift Alternatives.

Project Summary	I-15 Flamingo Road to Sahara Avenue May 2021			
 Project Description Widen I-15 Improve Flamingo Road Interchange Improve Spring Mountain Interchange Improve I-15 Operations Accommodate City of Las Vegas Ran Drive extension 	ge 10% chance the cost will be le cho 10% chance the cost will be less	<pre>the cost will be more 70th percentile=\$540.6 M Pre-Response 70th percentile=\$533.9 M 10% chance</pre>		
 Project Benefits Increase capacity Reduce overall interchange delay Enhance safety 	CRA Schedule Range 10% cha the cost will b 10% chance the cost will be	Pe less I 70 th percentile- Apr 2036 Pre-Response Post-Response I 70 th percentile – Jun 2035I 10% chance		
Key Project Schedule Risks <u>Threats</u> • Funding Availability • UPRR Coordination • Utility Relocations • Scope Changes • NEPA <u>Opportunities</u> • Design-Build Procurement • Use of Incentive/Disincentive Clause	Key Project Cost Risks <u>Threats</u> • Acquisition allocation of shared • Expansion of bridge spans due • Phasing due to funding availabi • Unknown utilities • Additional sidewalk and bicycle • Right-of-way • UPRR coordination	to UPRR lity		
- ose of meentive Disincentive Clause		igh Nov 2021		

Figure E-1 - I-15 Flamingo Road to Sahara Avenue Project Summary



COST RISK ASSESSMENT

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1. INTRODUCTION

The report summarizes an updated risk-based cost and schedule analysis completed by CA Group for the Nevada Department of Transportation's (NDOT) proposed improvements to the Interstate 15 (I-15) corridor from Flamingo Road to Sahara Avenue. Four alternatives have been identified that would provide improvements to the interstate and interchanges to enhance interchange and freeway operations, capacity, and safety. The following study documents the updated Risk Assessment Workshop for Alternative 1 Shift and Alternative 2 Shift that was conducted by CA Group on April 22, 2021. Due to restrictions related to the on-going COVID-19 pandemic and the fact the current concepts were revisions to concepts discussed in the August 2020 workshop, the workshop was held virtually utilizing Microsoft Teams with a smaller group of staff to identify any modifications to risks based on the concept refinements.

The purpose of the workshop was to:

- Update and document the potential range of uncertainty in both project cost and schedule due to risks (threats and/or opportunities) to assist in selecting a locally preferred alternative;
- Identify any changes or new significant risks or opportunities unique to the different alternatives which would be considered in the selection of the preferred alternative; and
- Identify any changes and prioritize key cost and schedule risks and opportunities for the proposed alternatives.

The workshop and subsequent statistical analysis followed an approach very similar to the Washington State Department of Transportation's Cost Estimate Validation process (CEVP®) and in accordance with NDOT Risk Management and Risk-Based Cost Estimation Guidelines.

The Risk Assessment Workshop consisted of several subject matter experts that are familiar with the project and potential risks and opportunities. Workshop attendees included the following individuals:

- Facilitator Chad Anson, CA Group
- Jack Sjostrom CA Group
- Jim Mischler CA Group
- Jim Caviola CA Group
- Bardia Nezhati Parametrix
- Mohan Garakhalli Atkins

The outcomes of the workshop and Risk Assessment Report are intended to assist in providing NDOT Project Management and Executive Leadership Team (ELT) an estimated overall project cost as well as recommend a schedule and risk management strategies.







2. PROJECT DESCRIPTION AND ASSUMPTIONS

2.1. Project Scope and Phasing

Interstate 15 (I-15) is the primary transportation corridor in southern Nevada, connecting to California and Arizona. Over the past three decades, NDOT has been making significant 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 existing corridor I-15 from Flamingo Road to Sahara Avenue can only accommodate five through lanes in each direction, while future traffic demands are expected to further breakdown I-15 in this segment. The I-15 from Flamingo to Sahara Feasibility Study (Feasibility Study) was initiated by NDOT to develop and evaluate alternatives primarily focusing on improving I-15 safety and traffic operations and identifying right-of-way needs to accommodate future traffic demands. The on-going Feasibility Study is being 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 of 1969 (NEPA), and its implementing regulations, as contained in 23 Code of Federal Regulations (CFR) 771.

This project study area covers 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 the I-15/I-215/CC-215 system interchange. These endpoints form the logical termini of this study, allow for the development of a project that can be constructed alone, serve a significant purpose, and address environmental impacts on a sufficient scale. The area also 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).

Currently four alternatives are under consideration. Alternative 1 consists of widening I-15 in each direction, reconfiguring of the Flamingo Road interchange (southbound ramps and cross street widening over I-15) and reconstructing the Spring Mountain Road flyover from southbound I-15 to eastbound Spring Mountain Road. Ramp braids would also be constructed between the southbound Spring Mountain Road on-ramp and Flamingo Road off-ramp and Flamingo Road on-ramp and Tropicana Avenue off-ramp.







Alternative 2 entails constructing the improvements identified in Alternative 1 and also includes the northbound Russell Road on-ramp and the Tropicana off-ramp and northbound Tropicana on-ramp and Flamingo off-ramp.



Figure 1 – Feasibility Study Limits







Since the September 2020 CRA, Alternative 1 and Alterative 2 under evaluation in the I-15 Flamingo to Sahara Feasibility Study have been revised to incorporate alignment changes that would accommodate the MLK Extension Project as requested by the City of Las Vegas. The modifications to Alternative 1 and Alternative 2, resulting in Alternative 1Shift and Alternative 2 Shift, require shifting I-15 to the east between Flamingo Road and Desert Inn Road. These modifications are identical for both Alternative 1 Shift and Alternative 2 Shift.

Major improvements for Alternative 1 Shift and Alternative 2 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-inplace 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. The I-15 shift occurs within existing NDOT rights-ofway. In addition, a key risk identified in the September 2020 CRA was if the final phase of Project Neon would acquire right-of-way prior to the construction of the I-15 Flamingo Road to Sahara improvements. During the April 2021 update, it this risk was retired as there is high confidence that the NEON right-ofway will be acquired prior to this project.

Additional details on the alternative layouts can be found in the *I-15 Flamingo Road to Sahara Avenue Interchange Feasibility Study*.

2.2 Strategy, Key Conditions and Assumptions:

The following is a compilation of assumptions, existing conditions, analyzed forecasts and project strategies at the time of the workshop.

- Funding
 - Funding has not fully been identified or incorporated into a short-range funding plan.
- Design
 - o Design Level
 - Design for the project is currently at 15-20%







- There are a handful of possible options that will need to be evaluated further during NEPA and final design to address public and stakeholder concerns.
- o Landscaping
 - Maximum budget of 3% of construction. Minimal design completed at time of workshop.
- o Structural
 - Standard bridge types (cast-in-place post tensioned and steel girders) and construction techniques are assumed.
- o Geotechnical
 - No project specific borings have been performed.
- o Pavement
 - NDOT Wizard was utilized for roadway costs, including pavement section costs.
- o Design Deviations or Exceptions
 - No design deviations for NDOT policies or FHWA design exceptions are anticipated at this time.
- Environmental Documentation
 - Project will require a NEPA process.
- Permitting
 - No significant environmental permits are anticipated (excluding USACOE 404).
 - o Contractor will obtain necessary construction permits.
- Right-of-Way
 - Right-of-way acquisitions are anticipated.
- Utilities
 - Several utility impacts anticipated.
 - NVEnergy substation located near T-Mobile Arena will not be impacted.
- Other Stakeholders
 - o NDOT
 - o City of Las Vegas
 - o Clark County
 - o RTC
 - o Adjacent business and property owners
- Procurement
 - o Delivery Method
 - One phase of design-bid-build delivery.
 - The Project Delivery Selection Approach (PDSA) process will used to determine the delivery method. The PDSA is not yet scheduled.
 - o Market
 - A very competitive bidding environment is assumed.
- Construction







- o Maintenance of Traffic
 - A detailed maintenance of traffic plan has not yet been developed.
- o Construction Phasing
 - Constructed as one project.
- > Priority
 - Project will be prioritized per the NDOT's statewide prioritization process.









3. INPUTS

3.1 Base Project Schedule/Flow Chart

A cost-based schedule model was utilized to provide an inclusive cost and schedule quantitative risk assessment that allows for costs to be developed on a year of expenditure basis. A duration "flow chart" was developed for the project to graphically depict key project milestones at a level of detail appropriate for the workshop. The flow chart identified key activities and predecessor relationships that exist between key milestones and is the basis for modeling the project schedule (including delays and opportunities due to risk events) and to calculate inflated, year-of-expenditure costs for each activity identified. Appendix B provides the risk assessment workshop flow chart for the project, as evaluated in this report.

3.2 Scenarios

A scenario was run for pre-response and post-response mitigation in current year costs for each option. It was assumed that the project phasing would be similar for either scenario. The pre-response scenario assumes no mitigation strategies are developed or implemented. The post-response strategy assumes NDOT is proactive in mitigating or monitoring risks. The difference in costs of the two strategies helps NDOT develop a cost/benefit of the level effort that should be applied to mitigating and monitoring risks for the project. A significant difference between scenario costs indicates a considerable effort should be made. In contrast, a minor difference in costs between the scenarios may warrant less effort in risk mitigation and monitoring.

3.3 Exclusions from the Risk Assessment

This Risk Assessment Workshop was conducted to provide the best information available for NDOT ELT and Project Management to make educated decisions on the project and alternatives during this phase. When reviewing the results, it is crucial to consider that this is a snapshot of the project and that the project is still in the early phases of development, requiring some items to be excluded. For this analysis, significant exclusions include:

- The potential for substantial changes to the current design (including additional lanes, ramps, project limits) were not considered. It is recognized that such changes might occur as a result of funding delays, shift in prioritization, and/or changes in regional development and economics.
- Significant changes to the phasing of the project were not considered.
- > Other significant changes to the scope of this project were not considered.

3.4 Base Project Cost

A base cost estimate was developed for the project through NDOT's Wizard cost estimation program. The base estimate was developed by calculating the length and laneage of the new roadway and bridge work area. Other items such as traffic control, signing, ITS, and incidentals (based on NDOT WIZARD Guidance) were assigned a percentage of construction cost. Once this percentage was assigned, the overall cost was checked for reasonableness and the percentage modified, as necessary. Tables 1 and 2 provide a summary







of the base cost estimate for each alternative. It should be noted, that since this is a base estimate, no contingencies were added.

Description	Baseline Cost
Roadway and Removals	\$35,925,442
Structures	\$61,692,165
Traffic Signals	\$814,000
Drainage	\$9,504,783
Additional Items (Miscellaneous Items)	\$25,789,170
Bid Item Subtotal	\$133,725,560
Landscaping and Aesthetics (3%)	\$3,726,623
Traffic Control (10%)	\$12,422,078
Roadside Safety (3%)	\$3,726,623
Erosion Control (1%)	\$1,242,208
Subtotal	\$154,843,092
Mobilization (7%)	\$10,173,682
Contract Total	\$165,016,774
NEPA (1%)	\$1,650,168
Preliminary Engineering & Design (4%)	\$6,600,671
Final Engineering & Design (4.0%)	\$6,600,671
Construction Engineering (15%)	\$24,752,516
Administration (1%)	\$1,650,168
Legal (1%)	\$1,650,168
Subtotal	\$207,921,136
Right-of-Way Acquisition	\$40,162,500
Environmental Considerations (3%)	\$6,237,634
Project Total (Base Cost)	\$254,321,270

Table 1 – Alternative 1 Shift Overall Base Cost Estimate Summary (2021 Dollars)







Description	Baseline Cost
Roadway and Removals	\$41,599,705
Structures	\$82,201,742
Traffic	\$1,122,000
Drainage	\$11,227,238
Additional Items (Miscellaneous Items)	\$23,813,828
Change in Cost due to Alignment Modification	\$37,392,514
Bid Item Subtotal	\$197,357,027
Landscaping and Aesthetics (3%)	\$5,583,894
Traffic Control (10%)	\$18,612,979
Roadside Safety (3%)	\$5,583,894
Erosion Control (1%)	\$1,861,298
Subtotal	\$228,999,092
Mobilization (7%)	\$13,029,085
Contract Total	\$242,028,177
NEPA (1%)	\$2,420,282
Preliminary Engineering & Design (4%)	\$9,681,127
Final Engineering & Design (4.0%)	\$9,681,127
Construction Engineering (15%)	\$36,304,226
Administration (1%)	\$2,420,282
Legal (1%)	\$2,420,282
Subtotal	\$304,955,503
Right-of-Way Acquisition	\$42,974,700
Environmental Considerations (3%)	\$9,148,665
Project Total (Base Cost)	\$357,078,868

Table 2 – Alternative 2 Shift Overall Base Cost Estimate Summary (2021 Dollars)

All project costs are currently anticipated to be borne by NDOT through various funding sources, including Federal funding. A more detailed summary of the base cost estimates prepared for each alternative is presented in Appendix A.

Uncertainty

A cost estimate is a "snapshot" of the anticipated project costs based on the preparer's perception of construction costs at that given time. Many factors will dictate the estimate, including the detail available, current construction market, and size of the project and/or quantities. Nevertheless, there will always be uncertainty in a base cost estimate due to these factors. Uncertainty can be applied to a project cost estimate by giving range of costs and quantities.







The estimator may establish this uncertainty range by analyzing unit costs and quantities based on project location, the scale of quantities, the construction market, and material availability. Depending on the level of design, other factors may play into uncertainty such as available geotechnical information, NEPA constraints, right-of-way, and type of project delivery. Tables 3 and 4 shows the Base Project Cost Uncertainty by crucial project components.

In establishing the uncertainty ranges for each item, consideration was given to factors that might affect quantities or bid prices, such as project location (rural vs. urban), quantities (large or small), items that are difficult to construct or site constraints, methods of payments, timing of advertisement, specialty work, geotechnical, and project delivery methods. Uncertainty is typically expressed in terms of a percentage (of the quantity and/or unit cost) lower or higher than the base.

Activity	Project Cost				
Activity	Low	Base	High		
NEPA	\$1,482,438	\$1,650,168	\$1,847,296		
Preliminary Engineering & Design	\$5,929,753	\$6,600,671	\$7,389,185		
Final Engineering & Design	\$5,929,753	\$6,600,671	\$7,389,185		
Construction Engineering	\$22,236,575	\$24,752,516	\$27,709,445		
Administration	\$1,482,438	\$1,650,168	\$1,847,296		
Legal	\$1,482,438	\$1,650,168	\$1,847,296		
Right of Way Acquisition	\$38,154,375	\$40,162,500	\$50,203,125		
Environmental Considerations	\$5,603,617	\$6,237,634	\$6,982,780		
Construction	\$148,243,831	\$165,016,774	\$184,729,633		
Total	\$230,545,218	\$254,321,270	\$289,945,241		

Table 3 – Alternative 1 Shift Base Cost Uncertainty by Activity (2021 Dollars)

Activity	Project Cost			
Activity	Low	Base	High	
NEPA	\$2,247,750	\$2,420,282	\$2,731,651	
Preliminary Engineering & Design	\$8,990,998	\$9,681,127	\$10,926,606	
Final Engineering & Design	\$8,990,998	\$9,681,127	\$10,926,606	
Construction Engineering	\$33,716,243	\$36,304,226	\$40,974,772	
Administration	\$2,247,750	\$2,420,282	\$2,731,651	
Legal	\$2,247,750	\$2,420,282	\$2,731,651	
Right of Way Acquisition	\$40,825,965	\$42,974,700	\$53,718,375	
Environmental Considerations	\$8,496,493	\$9,148,665	\$10,325,643	
Construction	\$224,774,952	\$242,028,177	\$273,165,146	
Total	\$332,538,899	\$357,078,868	\$408,232,101	

Table 4 – Alternative 2 Shift Base Cost Uncertainty by Activity (2021 Dollars)







Escalation Rates

Escalation rates are a measurement of change (usually increase) in project costs due to inflation, market costs, and the regional and national economy over a project's lifetime. In this analysis, escalation is applied to key project activities outlined in the project schedule, including NEPA, final design, utilities, and construction costs. With escalation, not only do project delays extend the duration of the project, they will typically increase final project costs. This project's escalation is per NDOT's Escalation Rates Forecast Technical Memorandum dated June 18, 2020. Those rates are shown in Table 5.

		Engineering		Right-of-Way			(Constructior	ı
Year	10%	50% (Median)	90%	10%	50% (Median)	90%	10%	50% (Median)	90%
2019	1.15%	1.15%	1.15%	4.75%	4.75%	4.75%	-0.47%	-0.47%	-0.47%
2020	-0.05%	1.23%	2.52%	-3.11%	1.81%	6.72%	-4.85%	0.03%	4.91%
2021	-0.06%	1.73%	4.00%	-3.69%	2.64%	9.81%	-3.11%	1.95%	8.46%
2022	0.19%	2.46%	4.72%	-4.80%	3.19%	11.59%	-1.40%	4.00%	10.16%
2023	0.61%	2.70%	4.76%	-4.33%	4.12%	12.62%	-1.30%	3.82%	9.51%
2024	0.66%	2.68%	4.76%	-4.16%	4.23%	12.57%	-1.50%	3.31%	8.74%
2025	0.40%	2.44%	4.46%	-4.28%	4.31%	12.90%	-1.78%	3.07%	8.45%
2026	0.11%	2.23%	4.29%	-4.42%	4.52%	13.70%	-2.38%	2.87%	8.84%
2027	-0.02%	2.16%	4.35%	-3.26%	5.37%	13.99%	-2.38%	2.82%	8.83%
2028+	-0.08%	2.21%	4.50%	-4.28%	4.31%	12.90%	-3.06%	2.81%	9.50%
Average		2.21%			3.83%			2.74%	

Table 5 – Escalation Rates per NDOT's Escalation Rates Forecast Technical Memorandum

3.5 Risks

During the Risk Assessment Workshop, uncertainty in the base project costs and schedule were identified and characterized. This uncertainty included both threats and opportunities that could impact the project scope, schedule, or budget. These threats and opportunities have been compiled into a risk register, which is presented in Appendix C. Minor items have still been noted in the Risk Register for monitoring throughout the project in the event they become significant risk/opportunity factors. The Risk Register provides the Department more than a summary of potential events that have been considered in the risk-based estimate and schedule; it provides the Project Manager a list of items that need to be monitored and potential strategies that should be implemented to reduce the risk and hopefully avoid significant events impacts to the project.







4. ANALYSIS

4.1 Model

The inputs developed in the workshop (including base cost, schedule, risk, opportunities and uncertainties) were entered into @RISK software. @RISK is a probabilistic, integrated model which utilizes Monte Carlo simulation techniques to generate probability distributions of cost and schedule while also prioritizing risk rankings. The simulation generates 5,000 independent potential outcomes and provides a statistical compilation of selected results. In order to accommodate inflation and true year-of-expenditure dollars; the cost of each flowchart activity was escalated from the estimate reference date to the activity mid-point (including consideration of delays or accelerations due to events) according to the specified escalation rate.

4.2 Pre-Response Results

The following section summarizes various significant cost results from the workshop and risk-based analysis based on the pre-response scenario. The pre-response scenario assumes no risk management strategies are implemented.

It should be noted that the following is a "snapshot" of the project based on information available at the workshop. As the project evolves and more information is developed, identified risks should be mitigated, therefore reducing or "retiring" those risks that could impact the project. However, it is likely as the project progresses, new uncertainties may present themselves and will need to be recognized as part of the risk-based estimate and schedule. There is an adherent opportunity in implementing risk management strategies that, as the project progresses and risks are retired, the risk-based estimate standard deviation will decrease, thereby reducing the seventy-percentile cost and increasing confidence level.

Probability distributions for Alternative 1 Shift total overall project cost pre-response (current year dollars) are shown in Figure 2 in probability mass functions (PMFs) and cumulative distribution functions (CDFs)

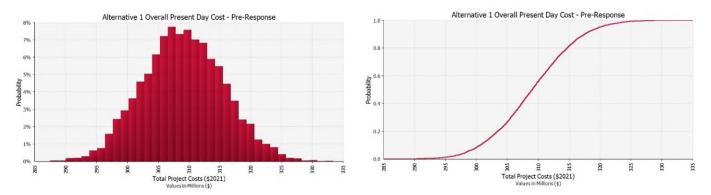


Figure 2 – Alternative 1 Shift - Probability Distribution for Overall Total Present Day Cost (\$2021) – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)







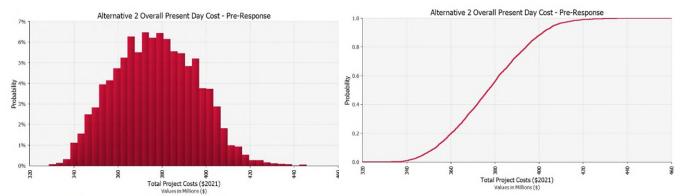


Figure 3 – Alternative 2 Shift - Probability Distribution for Overall Total Present Day Cost (\$2021) – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

format. These probability distributions reflect the base cost combined with identified project risks and opportunities with no mitigation or on-going risk or opportunity management activities.

The PMF portrays a graphical measure of the range of values, including the most likely value, as represented by the tallest bar on the graph. A key risk identified in the September 2020 CRA was if the Project NEON right-of-way would be acquired prior to this project occurring. It was identified in the April 2021 CRA that the right-of-way would most likely be acquired prior and that significant risk was retired. Based on the update alternative and risk register the most likely Alternative 1 Shift project cost in 2021 dollars would be approximately \$308.7 million. In comparison the most likely Alternative 2 Shift project cost in 2021 dollars is estimated at \$380.7 million.

A CDF represents the cumulative probability of not exceeding a particular value (also known as a percentile or confidence level). For example, from the CDFs shown for Alternative 1 Shift in Figure 2(b), the 70th percentile means that there is a 70 percent likelihood that the total cost for the entire project will be less than or equal to approximately \$312.6 million in 2021 dollars. Likewise, the CDF shown in Figure 3(b) indicates a 70th percentile likelihood that the total cost for Alternative 2 Shift would be less than or equal to \$387.6 million in 2021 dollars.

Year of expenditure costs for each alternative are calculated based on an anticipated pre-response riskbased schedules are shown in Figures 4 and 5. Figure 6 identifies the project's overall pre-response riskbased schedule with the most likely completion to be on or before December 2035 based on pre-response activities.







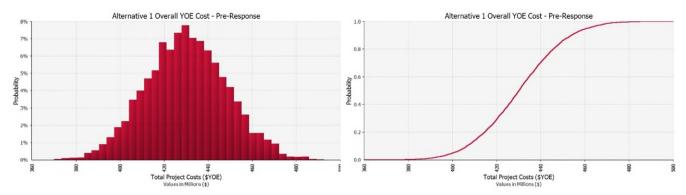


Figure 4 – Alternative 1 Shift - Probability Distribution for Overall Total Year of Expenditure Cost – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

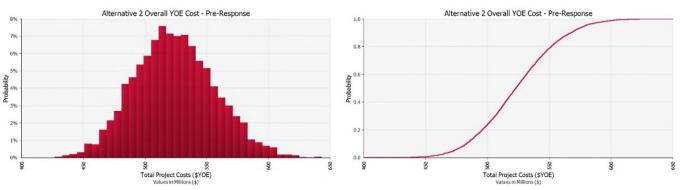


Figure 5 – Alternative 2 Shift - Probability Distribution for Overall Total Year of Expenditure Cost – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

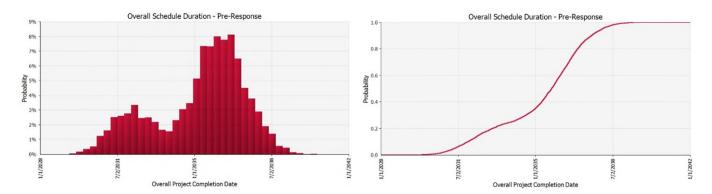


Figure 6 – Probability Distribution for Overall Schedule Duration – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)







4.3 Post-Response Results

Sound project management execution consists of the agencies and those involved to proactively manage risk and opportunities; thereby, reducing potential increases and costs and schedule duration. As part of the workshop, the group identified the potential reduction in risks based on proactive management (Post-Response) and is shown in Figures 7 through 11.

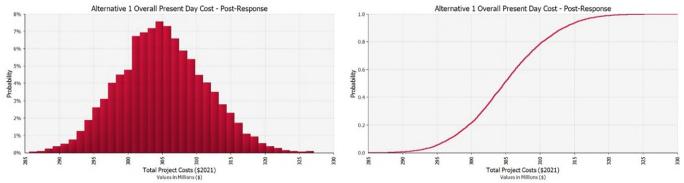


Figure 7 – Alternative 1 Shift - Probability Distribution for Overall Total Present Day Cost (\$2021) – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

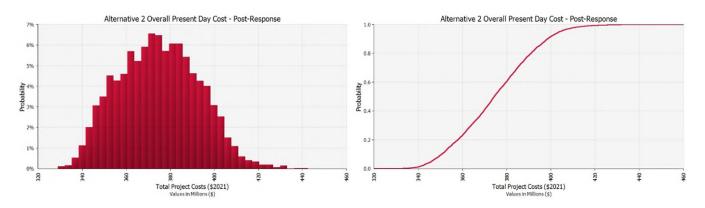


Figure 8 – Alternative 2 Shift- Probability Distribution for Overall Total Present Day Cost (\$2021) – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

Similar to the pre-response graphs in Section 4.2, Alternatives 1 Shift and 2 Shift develop bell shape curves and with proactively managing risks, the most likely Alternative 1 Shift project cost in 2021 dollars would be approximately \$303.1 million. Alternative 2 Shift would most likely have an overall project cost of \$372.8 million in 2021 dollars by utilizing post-response activities and mitigation management.







Figures 9 and 10 show the project would most likely cost \$430.4 million for Alternative 1 Shift and \$523.4 million for Alternative 2 in year of expenditure (YOE) dollars. Anticipated completion through the use of pro-active risk management would most likely be in July 2035 as shown in Figure 11 on page 17.

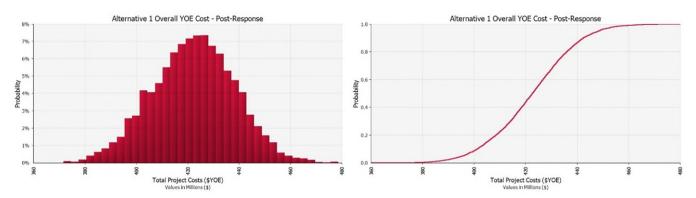


Figure 9 – Alternative 1 - Probability Distribution for Overall Total Year of Expenditure Cost – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

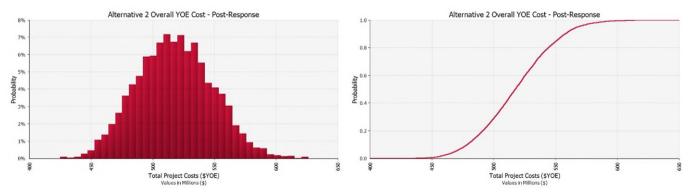


Figure 10 – Alternative 2 - Probability Distribution for Overall Total Year of Expenditure Cost – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

Another method of presenting the project budget and schedule expectations to the general public and outside project stakeholders is by using the mid-80 percent confidence level. This range of cost and duration is bounded by the 10th percentile on the lower end and the 90th percentile on the higher end. This will provide an 80 percent likelihood that the project costs and schedule will be completed within this range, and only a 20 percent likelihood that it will not. Table 6 provides a summary of the mid-80 percent confidence level range post-response.



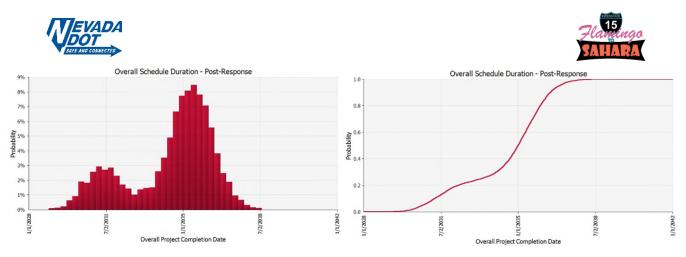


Figure 11 – Probability Distribution for Overall Schedule Duration – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

Description	10 th Percentile (Lower Limit)	90 th Percentile (Upper Limit)					
	Alternative 1 Shift						
Total Project Cost (2021 Dollars)	\$296.8 million	\$313.4 million					
Total Project Cost (YOE Dollars)	\$401.3 million	\$442.4 million					
	Alternative 2 Shift						
Total Project Cost (2021 Dollars)	\$350.6 million	\$398.4 million					
Total Project Cost (YOE Dollars)	\$478.8 million	\$557.7 million					
Project Completion Date	February 2031	June 2036					

Table 6 – Mid-80 Percent Confidence Level Range for the Overall Project Post-Response

Table 7 provides a summary of various post-response probability distributions (i.e. confidence levels) for the overall project including current year cost, year of expenditure and project duration.







	Alternati	ve 1 Shift	Alternati	Alternative 2 Shift		
	Total Project Cost (2021 \$ Mil)	Total Project Cost (YOE \$ Mil)	Total Project Cost (2021 \$ Mil)	Total Project Cost (YOE \$ Mil)	Overall Completion Date	
Base	\$254.3	\$311.5	\$357.1	\$437.3	Dec 2028	
Mean	\$305.0	\$422.6	\$374.7	\$517.9	May 2034	
Standard Dev.	\$6.4	\$16.0	\$18.1	\$30.5	722 Days	
5%	\$294.8	\$395.6	\$346.0	\$468.9	Aug 2030	
10%	\$296.8	\$401.3	\$350.6	\$478.8	Feb 2031	
15%	\$298.3	\$404.9	\$354.2	\$485.1	Aug 2031	
20%	\$299.6	\$408.5	\$357.9	\$491.1	Feb 2032	
25%	\$300.7	\$411.6	\$361.2	\$496.3	Mar 2033	
30%	\$301.6	\$414.1	\$363.9	\$500.9	Dec 2033	
35%	\$302.4	\$416.3	\$366.9	\$505.2	Apr 2034	
40%	\$303.2	\$418.4	\$369.6	\$509.5	Jul 2034	
45%	\$304.0	\$420.4	\$372.1	\$513.3	Oct 2034	
50%	\$304.8	\$422.6	\$374.3	\$517.4	Jan 2035	
55%	\$305.6	\$424.6	\$376.8	\$521.6	Mar 2035	
60%	\$306.4	\$426.7	\$379.7	\$525.3	May 2035	
65%	\$307.2	\$428.9	\$382.3	\$529.8	Jul 2035	
70%	\$308.2	\$430.9	\$384.9	\$533.9	Aug 2035	
75%	\$309.2	\$433.2	\$387.9	\$538.5	Oct 2035	
80%	\$310.3	\$436.0	\$391.0	\$544.1	Dec 2035	
85%	\$311.8	\$438.9	\$394.5	\$550.7	Mar 2036	
90%	\$313.4	\$442.4	\$398.4	\$557.7	Jun 2036	
95%	\$315.7	\$448.3	\$403.8	\$567.6	Nov 2036	

Table 7 – Summary of Probability Distributions for Overall Cost and Schedule – Post Response

As Table 7 indicates, completion of the project could extend out to November 2036, if not longer. Based on the above information, there is 70th percentile confidence level that the project could be delivered by August 2035 with a maximum cost of \$533.9 million (Alternative 2).

4.4 Significant Risks, Uncertainties and Strategies

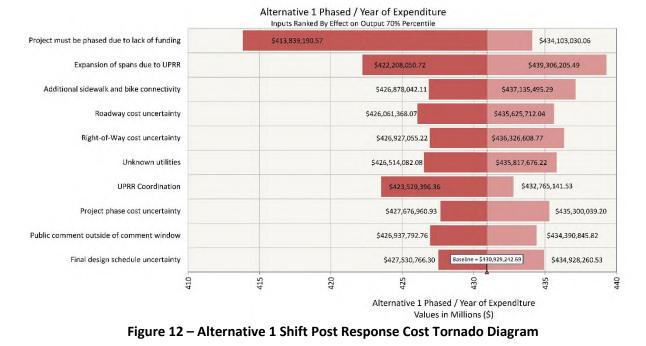
Cost Risks

The tornado tables in Figures 12 and 13 show the potential impacts of the top ten post-response cost risks for Alternatives 1 Shift and 2 Shift respectively. Additional information about the risks is provided in Appendix C – Risk Register. The risk names are listed on the vertical axis with expected cost impact identified. Risks in the tornado diagram are ranked in descending order showing the greatest risk to cost on top.









For Alternative 1 Shift costs, the largest risk and opportunity is phasing of the project due to lack of funding which extends project cost escalation impacts.

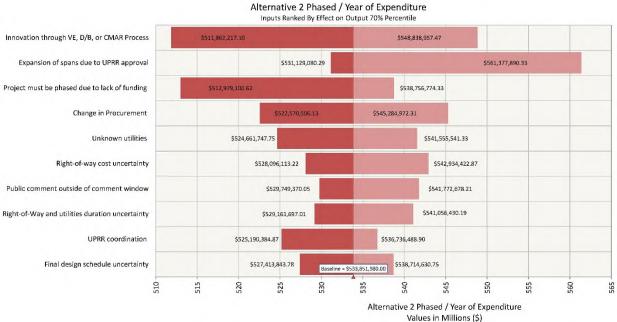


Figure 13 – Alternative 2 Shift Post Response Cost Tornado Diagram







For Alternative 2 Shift costs, the largest risk/opportunity item affecting the 70th percentile cost will be innovation developed through the value engineering, design-build, or CMAR process. UPRR guidance of mainline I-15 bridge structures can have a significant impact to both Alternatives 1 Shift and 2 Shift. Coordination with UPRR will be a high priority as the project moves into preliminary design. Funding and right-of-way cost allocation may also have a significant impact to Alternative 2 Shift.

Schedule Risks

The tornado table in Figure 14 shows the most significant potential impacts of the schedule risks for the project. Currently, the most significant item driving the project schedule is if the project must be phased over a substantial time frame due to lack of funding. Once the timing of funding has been solidified, other risks may play a more significant role in the 70th percentile project completion date. Additional information about the risks is provided in Appendix C – Risk Register. The risk names are listed on the vertical axis with expected schedule impact identified. Risks in the tornado diagram are ranked in descending order showing the greatest risk to schedule on top.

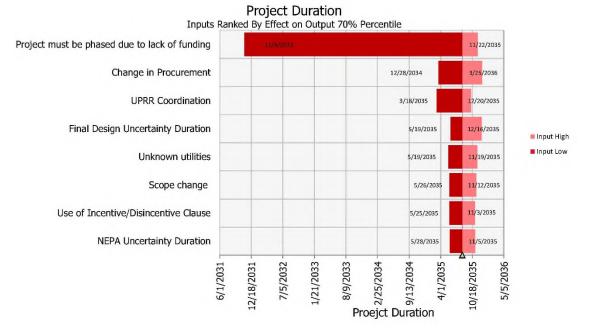


Figure 14 – Post Response Schedule Tornado Diagram







5.0 CLOSING

Based on the results of discussions during the Risk Assessment Workshop and this report, the following recommendations are made:

- 1. When possible, based on the above described uncertainties, it is best to provide project costs and durations in a range based on the mid-80 percentile confidence level as shown in Table 2 to help manage stakeholder expectations.
- 2. Recognize and communicate that this report is a snapshot into the project at the time of the Risk Assessment Workshop. As the project progresses various uncertainties will be retired, while new uncertainties may surface. In general, as time moves on the range between various confidence levels should diminish. NDOT should consider updates to the risk-based estimate at various milestones including preliminary and intermediate design submittals.
- 3. Utilize the 70th percentile confidence level estimates to help establish reasonable budgets and schedules, and then strive through risk management strategies identified in the risk register to bring the project in under budget and schedule.
- 4. Implement the strategies discussed in Section 4.3 to reduce the uncertainties in the top threats and opportunities. As the risks are retired or mitigated, update the risk-based estimate to identify the next 5-10 risks that the project team should focus on. By focusing resources on the most significant risks the project team will be able to efficiently retire those risks and reduce the mid-80th percentile confidence range.
- 5. By implementing a proactive risk management plan, it is safe to assume that NDOT will be able to reduce the 70th percentile project cost by approximately \$3 million and reduced the project duration by approximately 5 months. However, there are several major risks and opportunities that once retired and an overall outcome is known, significant impacts to the 70th percentile cost and schedule will most likely occur.

These results are intended to provide NDOT and the Project Team with the information needed to aid in making educated decisions about the project scope, schedule, and budget. In addition, this report should aid in developing risk management strategies to ensure a successful project is developed and implemented within publicized schedules and budgets.







APPENDIX A Base Cost Estimate



COST RISK ASSESSMENT

APPENDIX A - A-1 JUNE 2021

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1 0% 1 1% \$2,66,294 \$2,56,254 1 0% 1 0% 1 1% \$1,61,570 10,00% \$2,56,254 1 0% 1 0% 1 1% \$1,46,150 10,00% \$5,37,400 \$2,56,254 1 0% 1 1% \$1,46,150 10,00% \$5,37,400 \$5,37,400 1 0% 1 1% \$1,46,150 10,00% \$5,37,400 \$5,347,300 1 0% 1 1% \$5,485,300 10,00% \$5,347,30 \$5,00% \$5,347,30 1 0% 1 1% \$5,435,300 10,00% \$5,416,300 \$5,00% \$5,416,300 1 0% 1 1% \$5,366,60 10,00% \$5,316,400 \$5,316,400 1 0% 1 1% \$5,356,60 10,00% \$5,310,400 \$5,00% \$5,310,600 1 0% 1 1% \$5,356,560 10,00%	WIDEN FLAMINGO OVER DEAN MARTIN	-	950	-	940	-	rs.	\$1,891,959	-10.00%	\$2,102,177	10.00%	\$2,312,395	\$2,102,177
1 0% 1 1% 1 1% 3,4,6,1,70 1,00% 5,3,74,46 5,3,74,46 1 0% 1 0% 1 15 5,1,35,30 10,00% 5,3,370 10,00% 5,3,370 10,00% 5,3,370 10,00% 5,3,30 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,163,200 10,00% 5,3,16,306 10,00% 5,3,16,1306 10,00% 5,3,16,1306 10,00% 5,3,10,60 10,00% 5,3,10,60 5,3,10,60 5,3,10,60 5,3,10,60 5,3,10,60 5,3,10,60 10,00% 5,3,10,60 10,00% 5,3,10,60 10,00% 5,3,10,60 10,00% 5,3,10,60	SPRING MOUNTAIN OVER LOOP RAMP	-	560	÷	%0	-	S	\$2,096,390	-10.00%	\$2,329,322	10.00%	\$2,562,254	\$2,329,322
1 0% 1 LS \$77.3.30 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.716 10.00% \$89.0.716 10.00% \$89.0.716 10.00% \$89.0.716 10.00% \$89.0.700 10.00% \$89.0.716 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.700 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.7130 10.00% \$89.0.00% \$89.0.0.0%	1-15 OVER TWAIN	-	9%0	+	940	+	R	\$4,416,120	-10.00%	\$4,906,800	10.00%	\$5,397,480	\$4,906,800
1 0% 1 1% 1% 5% 46.17.00 5% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 16.00% 5% 5% 16.00% 5% 5% 16.00% 5% 5% 16.00% 5%		+	560	1.	%0	1	R	\$723,330	-10.00%	\$803,700	10.00%	\$884,070	\$803,700
1 0% 1 0% 1 1% 57,435,800 10.00% 58,362,000 50,06,8 59,08,151 1 0% 1 0% 1 1% 1% 58,5309 -10.00% 53,25,00% 501,151 50% 54,036.766 50,0% 54,036.766 50,0% 54,036.766 50,0% 53,10,151 55,00% 53,10,161 52,00% 53,10,161 52,00% 53,10,161 52,00% 53,10,161 52,00% 53,10,161 52,00% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,10,0% 53,10,161 52,11,000 51,10,00% 53,12,0,00 51,0,0% 53,11,000 51,00% 51,24,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000 51,04,000		-	940	F	950	1	rs	\$4,186,080	-10.00%	\$4,651,200	10.00%	\$5,118,320	\$4,651,200
1 0% 1 LS 58.56.309 10.00% \$72.30,131 25.00% \$810,151 1 0% 1 LS \$2.906,472 10.00% \$3.229,413 25.00% \$4136,766 1 0% 1 LS \$4.56,851 -10.00% \$5.206,466 \$5.110,055 \$5.110,056 \$5.110,056 \$5.110,056 \$5.110,056 \$5.110,056 \$5.110,056 \$5.110,056 \$5.110,056 \$5.100,055<	MB/SB I-15 OVER SPRING MOUNTAIN	-	560	Į,	%0	-	S	\$7,435,800	-10.00%	\$8.262,000	10.00%	\$9,088,200	\$5,262.000
1 0% 1 1% 1% 1% 1% 3720,121 25,00% 3910,151 1 0% 1 0% 1 1% 55,00% 57,00% 54,00% 54,00% 56,01% 54,00% 56,00% 56,01%	Walls												
1 0% 1 LS 82.906.472 10.00% 83.229.413 25.00% 84.036.766 84.036.766 1 0% 1 LS \$1519.673 10.00% \$3.29.413 25.00% \$3.10.065 \$3.11.200 \$3.10.065 \$3.11.200 \$3.10.065 \$3.11.200 \$3.10.065 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3.11.200 \$3.10.86 \$3	RETAINING WALLS AT FLAMINGO	-	9%0	-	0%	÷	R	S655,309	-10.00%	\$728,121	25.00%	\$910,151	\$726,121
1 0% 1 LS \$1,519,679 10,00% \$1,688,552 25,00% \$2,110,635 1 1 0% 1 0% 1 LS \$536,551 -10,00% \$509,446 \$500% \$637,433 1 0% 1 0% 1 LS \$536,560 -10,00% \$500% \$637,433 1 0% 1 LS \$356,560 -10,00% \$500% \$637,433 1 0% 1 LS \$356,500 -500% \$176,000 20,00% \$214,800 1 0% 1 LS \$167,200 -5,00% \$176,000 20,00% \$211,200 1 0% 1 LS \$167,200 -5,00% \$176,000 20,00% \$211,200 1 0% 1 LS \$167,200 -5,00% \$176,000 20,00% \$261,1200 1 0% 1 LS \$282,600 -5,00% \$176,000 20,00% \$261,1200<	RETAINING WALLS AT SPRING MOUNTAIN	-	960	-	960	F	R	\$2,906,472	-10.00%	\$3,229,413	25.00%	\$4,036,766	\$3,229,413
1 0% 1 0% 1 LS \$456.851 -10.00% \$506.946 25.00% \$637.433 1 1 0% 1 0% 1 0% 1 0.0% \$637.433 1 10.00% \$637.433 1 1 1 0% \$637.433 1 1 1 0% \$136.400 \$600% \$637.433 1 1 0% \$134.600 \$600% \$637.433 1 <t< td=""><td>RETAINING WALLS AT SM NB OFF-RAMP @ TWAIN</td><td>-</td><td>%0</td><td>F</td><td>80</td><td>-</td><td>LS LS</td><td>\$1,519,679</td><td>-10.00%</td><td>\$1,688,532</td><td>25.00%</td><td>\$2,110,085</td><td>S1,688,532</td></t<>	RETAINING WALLS AT SM NB OFF-RAMP @ TWAIN	-	%0	F	80	-	LS LS	\$1,519,679	-10.00%	\$1,688,532	25.00%	\$2,110,085	S1,688,532
1 0% 1 0% 1 0% 3396,200 3396,200 3439,240	RETAINING WALL AT SM NB OFF-RAMP TO WB SM	1	960	1	%0	-	S	\$458,951	-10.00%	\$509,946	25.00%	\$637,433	\$509.946
AND 1 0% 1 LS \$145,200 5.00% \$176,000 \$200% \$174,000 \$200% \$214,800 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200 \$200% \$214,200	SOUNDWALL ALONG 1-15 SB BETWEEN SPRING MOUNTAIN AND SAHARA	+	0%		056		v.	S168 560	-10 00%	\$398 400	10 00%	OPC REPS	5398 400
TRAFFIC TRAFFIC AND 1 0% 1 LS \$145,300 5.0% \$154,000 20.0% \$134,800 \$211,200 AND 1 0% 1 LS \$145,300 5.0% \$155,000 20.0% \$211,200											Str	uctures Subtotal	\$61,692,165
mails mails <th< td=""><td></td><td></td><td></td><td></td><td>TRA</td><td>UPPIC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>					TRA	UPPIC							
AMP 1 0% 1 LS \$146,300 5.00% \$154,000 200% \$134,800 \$100% \$134,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$214,800 \$211,200 </td <td>Traffic Signals</td> <td></td>	Traffic Signals												
AMP 1 0% 1 LS \$16,200 5.00% \$175,000 20.00% \$211,200 AMP 1 0% 1 LS \$16,700 5.00% \$175,000 20.00% \$211,200 AMP 1 0% 1 LS \$282,600 -5.00% \$176,000 20.00% \$211,200 APD 0% 1 LS \$282,600 -5.00% \$316,000 20.00% \$328,650 ADDINALITENS ADDINALITENS Additional Items Subtotal Additional Items Subtotal Additional Items Subtotal 328,657,546 Additional Items Subtotal	FLAMINGO RD WB WITH I-15 NB CM-RAMP	+	0%	1	0%	-	LS I	\$146,300	-5.00%	\$154,000	20.00%	\$184,800	\$154,000
AMP 1 0% 1 LS \$16,200 -5.00% \$176,000 20.00% \$371,200 -5.00% \$376,000 20.00% \$378,600 -	FLAMINGO RD WB WITH 1-15 SB ON RAMP	1	0%	-	096	1	LS	\$167,200	-5.00%	\$176,000	20.00%	\$211,200	\$176,000
MPS 1 0% 1 LS \$229,600 5.00% \$308,000 \$358,600 \$358,500 \$358,600 \$358,500 \$358,500 \$338,600 \$338,600 \$358,500 \$338,600 \$338,600 \$358,500 \$338,600 \$338,500 \$338,600 \$34	FLAMINGO RD WB WITH I-15 SB CFF-RAMP	-	0%	÷	0%	-	S	\$167,200	-5.00%	\$176,000	20.00%	\$211,200	\$176,000
ADDITIONAL IT EWS	SPRING MOUNTAIN W/ 1-15 SB RAMPS	-	0%	-	0%	1	S	\$292,600	-5.00%	\$308,000	20.00%	\$369,600	
Items 1 0% 1 LS \$23,210,253 -10 00% \$25,789,170 15.00% \$29,657,546 Items 1 0% 1 LS \$23,210,253 -10 00% \$25,789,170 15.00% \$29,657,546 Items DRAMACE Additional Items Subrotal Additional Items Subrotal Inage 1 0% 1 LS \$8,554,305 -10.00% \$8,604,783 50,00% \$14,257,175 Items Subrotal												Traffic Subtota	\$814,000
Items 1 0% 1 LS \$23,210,253 -10.00% \$25,789,170 15.00% \$29,657,566 DRA/NAGE DRA/NAGE Additional News Subtotal Additional News Subtotal inage 1 0% 1 LS \$8,554,305 -10.00% \$12,00% \$12,00% \$12,057,175			and the second second	and	NOLLIGA	(AL ITEMS	-	Contraction and	and the second			Contraction of	Contraction of the other
DRA/NACE DRA/NACE Additional flams Subtall nage 1 0% 1 LS \$8,554,305 -10.00% \$14,257,175 1 0% 1 LS \$8,554,305 -10.00% \$0,00% \$14,257,175	2	-	0%	+	%0	-	S1	\$23,210,253	-10 00%	-	15.00%	\$29,657,546	
DRAINAGE DRAINAGE nage 1 0% 1 LS \$8,554,305 -10,00% \$10,20% \$14,257,175 1 0% 1 LS \$8,554,305 -10,00% \$10,20% \$14,257,175											Addition	al Items Subtota	\$25,789,170
nage 1 0% 1 US \$8,554,305 -10.00% \$9,604,783 50,00% \$14,267,175 0%					DRA	NAGE							
1 1 0% 1 LS \$8,554,305 -10.00% \$9,504,783 50.00% 514,257,175 Drainage Subiotal										_			
		-	0%	-	0%0	-	S	\$8,554,305	-10.00%		50.009	\$14,267,175	\$9,504,783
											•	Irainage Sublota	







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Table A-1 – Alternative 1 Shift Baseline Cost Estimate

EVADA DOT

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	Qui	Quantity or Pecentage				Current Year Unit Cost		Current Year
Item	(Low) Under (%)	Base	(%) Over (High)	JUN	(Low) Under (%)	Base	(%) Over (High)	Base Total Cost
	St	ub-Total Preser	Sub-Total Present Day Construction Cost	st				\$133,725,560
Landscaping and Aesthetics		3.0%		E		\$3.726,623		\$3,726,623
Erosion Control		1.0%				\$1,242,208		\$1,242,208
Traffic Control		10.0%				\$12,422,078		\$12,422,078
Roadside Safety		3.0%				\$3,726,623		\$3,726,623
Additional Items		0.0%				SO		\$0
						Sub-Total		\$154,843,092
Mobilization		7.0%				\$10,173,682		S10,173,682
		Total Present	Total Present Day Construction Cost					\$165,016,774
Construction Engineering/Inspection		15.0%		E		\$24,752,516		S24,752,516
NEPA		1.0%				\$1,650,168		\$1,650,168
Preliminary Engineering & Design		4.0%				\$6,600,671		\$6,600,671
Final Engineeering		4.0%				\$6,600,671		\$6,600,671
Administration		1.0%				\$1,650,168		\$1,650,168
Legal		1.0%				\$1,650,168		\$1,650,168
	Total Pri	esent Day Com	Total Present Day Construction and Engineering Cost	ng Cost				\$207,921,135
			RIGHT-OF-WAY		Contraction of the second s	and the second se	and the second se	
Right-of-Way		1		SJ	\$38,154,375 -5.00%	% \$40,162,500	25,00% \$50,203,125	25 S40,162,500
							Right-of-Way Subtotal	total \$40,162,500
Environmental Consideration		3.0%			_	\$6,237,634		\$6,237,634
	Ove	rall Total Prese	Overall Total Present Day Cost - Alternative	/e 1				\$254,321,269

CA Group, Inc

Table A-1 – Alternative 1 Shift Baseline Cost Estimate (Cont.)





And And order field	-	-		Several in Automa	. 6		A starts		1	CURRENT TEAR UNIT COST			Current Tear
1 0% 1 0% 1 1% 515.60.56.56.56.56.56.56.56.56.56.56.56.56.56.	treg	(TOW)	Under (%)	Base	ROAD	er (High)	and a	(Low) Und	er (%)	gase	(%)	Over (High)	Base Total Cost
1 0% 1 0% 1 1% 845,205,60 465,205,60 1 0% 1 0% 1 1%													
1 0% 1 1% <td></td> <td>-</td> <td>0%</td> <td>1</td> <td>920</td> <td>1</td> <td>SJ</td> <td>\$35,629,552</td> <td>-10.00%</td> <td>\$39,558,391</td> <td>15.00%</td> <td>\$45,526,660</td> <td>\$39,588,391</td>		-	0%	1	920	1	SJ	\$35,629,552	-10.00%	\$39,558,391	15.00%	\$45,526,660	\$39,588,391
1 0% 1 0% 1 1%	Demolition												
Image: constraint of the constratent of the constraint of the constraint of the constraint of the		-	0%	-	0%0	-	S	\$1,810,183	-10.00%	\$2,011,314	15.00%		
Model France 0					STRUCT	URES						>	
1 0% 1 1 15 59.91.186 10.00% 55.463.05 10.00% 56.005% 56.603.05 1 0% 1 0% 1 1 1 5 57.10.17 57.73.86 10.00% 55.73.13 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.73.53 57.00 56.76.33 57.00 56.76.33 57.00 56.76.33 57.00 56.76.33 57.03 57.00 56.76.33 57.03 <td>Bridges</td> <td></td>	Bridges												
1 0% 1 1% 1 1% 1% 1% 6.65.323 1.00% 5.66.5.321 1.00% 5.66.5.321 1.00% 5.66.5.321 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.365 1.00% 5.77.366 1.00% 5.77.365 1.00% <t< td=""><td>RUSSELL RD OVER NBCD</td><td>-</td><td>%0</td><td>÷</td><td>9%0</td><td>1</td><td>15</td><td>SA 914,188</td><td>-10.00%</td><td>\$5,460,209</td><td>10.00%</td><td>\$6.006,230</td><td>S5,460,209</td></t<>	RUSSELL RD OVER NBCD	-	%0	÷	9%0	1	15	SA 914,188	-10.00%	\$5,460,209	10.00%	\$6.006,230	S5,460,209
1 0% 1 0% 1 0% 1 0% 5.4.30.56 10.0% 5.2.11561 1 0% 1 0% 1 0% 1 0% 5.4.30.57 10.0% 5.2.013.56 1 0% 1 0% 1 0% 1 1 0% 5.4.30.57 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.56 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.52 10.0% 5.2.430.52 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.57 10.0% 5.2.430.52 10.0% 5.2.435.73	TROPICANA ON RAMP OVER FLAMINGO OFF RAMP	+	%0	+	0%	+	SI	\$7,249,442	-10.00%	\$8,054,935	20.00%	\$9,665,922	\$8,054,935
1 0% 1 0% 1 1 0% 53.40.3.07 10.0% 53.40.3.01 10.0% 53.40.3.01 1 0% 1 0% 1 0% 1 10% 53.40.3.01 10.0% 53.40.3.01 1 0% 1 0% 1 <th< td=""><td>TROPICANA OFF RAMP OVER FLAMINGO ON RAMP</td><td>1</td><td>0%</td><td>1</td><td>%0</td><td>1</td><td>SJ</td><td>S4,264,025</td><td>-10.00%</td><td>\$4,737,805</td><td>10.00%</td><td>S5,211,586</td><td>\$4,737,805</td></th<>	TROPICANA OFF RAMP OVER FLAMINGO ON RAMP	1	0%	1	%0	1	SJ	S4,264,025	-10.00%	\$4,737,805	10.00%	S5,211,586	\$4,737,805
1 0% 1 0% 1 10% 23.301.274 10.00% 53.61.054 53.61.054 1 0% 1 0% 1 10% 1 10% 51.75.158 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.61.054 10.00% 53.71.21.58 10.00% 53.71.21.58 10.00% 53.71.21.58 10.00% 53.71.21.54 10.00% 53.71.21.54 10.00% 53.71.21.24 10.00% 53.71.21.24 10.00% 53.71.21.24 10.00% 53.71.21.26 10.00% 53.71.21.21 10.00% 53.71.21.21 10.00% 53.71.21.21 10.00% 53.71.21.21	SPRING MOUNTAIN BRIDGE OVER THE LOOP RAMP	-	%0	Ŧ	920	1	SI	\$3,103,475	-10.00%	\$3,448,306	10.00%	\$3,793,137	\$3,448,306
1 0% 1 1% 5% 5% 5% 0% 5% <td>WIDEN FLAMINGO OVER H15</td> <td>-</td> <td>%0</td> <td>-</td> <td>0%</td> <td>-</td> <td>S</td> <td>\$2.971,147</td> <td>-10.00%</td> <td>\$3,301,274</td> <td>10.00%</td> <td>\$3,631,401</td> <td>\$3,301,274</td>	WIDEN FLAMINGO OVER H15	-	%0	-	0%	-	S	\$2.971,147	-10.00%	\$3,301,274	10.00%	\$3,631,401	\$3,301,274
1 0% 1 0% 1 0% 1 1	WIDEN FLAMINGO OVER FRANK SINATRA	-	0%	+	0%		LS I	S2,016,068	-10.00%	\$2,240,096	10.00%	\$2,464,106	S2,240,096
1 0% 1 0% 1 0% 1 0% 1 0% 1 100% 13.517.55 1000% 51.577.56 1000% 51.577.56 13.517.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1 15.577.55 1	WIDEN 1-15 NG OVER UPRR	-	%0	4	9%0	÷	S	\$1,231,186	-10,00%	\$1,434,651	20.00%	\$1,721,581	\$1,434,651
1 0% 1 0% 1 LS S1365.774 1.00% \$3.430.100% \$3.433.173 \$3.437.173 1 0% 1 0% 1 LS \$3.65.713 1.00% \$3.537.173 \$3.537.173 \$3.537.173 \$3.577.31 \$3.577.32 \$3.577.33 \$3.577.33 \$3.577.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.33 \$3.777.325.30 \$3.777.325.30 \$3.777.3	WIDEN 1:15 SB OVER SPRING MOUNTAIN	-	0%0	-	046	-	2	\$1,239,833	-10.00%	\$1,377,592	10.00%	\$1,515,351	\$1,377,592
VFNMP 1 0% 1 0% 1 100% 51.321 100% 51.321 31.321 VFNMP 1 0% 1 0% 1 10% 51.321 51.31 51.312 51.312 51.312 51.312 51.312 51.312 51.312 51.312.312 51.312.312 51.312	PRING MOUNTAIN OFF RAMP OVER FLAMINGO ON-RAMP	-	0%	-	0%	•	R	\$3.965.774	-10.00%	\$4,406,416	10.00%	\$4,847,058	S4,406,416
MARTINI 1 0% 1 LS Sci.71,373 1:00% Sci.267,307 Sci.767,307 MARTINI 1 0% 1 LS Sci.73,730 1:00% Sci.767,307 Sci.767,307 MARTINI 1 0% 1 LS Sci.736,366 1:00% Sci.767,307 Sci.767,307 MARTINI 1 0% 1 LS Sci.726,366 1:00% Sci.767,307 Sci.767,307 MARTINI 1 0% 1 LS Sci.726,366 1:00% Sci.771,307 Sci.773,305 MARTINI 1 0% 1 LS Sci.778,81 1:00% Sci.771,307 Sci.773,305 MARTINI 1 0% 1 LS Sci.778,81 1:00% Sci.710 Sci.771,01 MARTINI 1 0% 1 LS Sci.778,91 1:00% Sci.710 Sci.750,91 MARTINI 1 0% 1 LS Sci.728,91 1:00% Sci.710 Sci	1-15 SB (SBCD) OVER SPRING MOUNTAIN ON PAMP	-	%0	-	9%0	+	S	S3,561,331	-10.00%	\$5,957,034	10.00%	\$4,352,737	\$3,967,034
INTAININ 1 0% 1 LS SVALERS-615 1:000% ST-605-806 1:000% SZ-120.397 INTAININ 1 0% 1 0% 1 LS SVALERS-616 1:000% SZ-120.397 SZ-120.397 RENDGE 1 0% 1 LS SVALERS-616 1:000% SZ-661.822 1:000% SZ-120.397 1:000% SZ-120.397 1:000% SZ-113.397 1:000% SZ-13.132 1:000% <	1-15 SB (SBCD) BRIDGE OVER DEAN MARTIN	-	0%		9%0	1	SI	S4,718,739	-10.00%	\$5,243,043	10.00%	\$5,767,347	\$5,243,043
Investion 1 0% 1 LS \$1,5,6,103 \$1,000% \$5,551,005 \$5,517,005 \$5,551,005 \$5,517,005 \$5,551,005 \$5,517,005 \$5,551,005 \$5,517,005 \$5,5107,05 \$5,517,005 \$5,517,005 \$5,517,005	115 \$8 (SBCO) BRIDGE OVER TWAIN	-	0%	-	9%0	-	3	S4,189,415	-10.00%	\$4,654,906	10.00%		54,654,906
BRIOGE 1 0% 1 LS SIAJBRG 1:000% SIADBLAZ	1-15 SB (SBCD) BRDIGE OVER SPRING MOUNTAIN	-	460	-	%0	+	S	51,728,103	-10.00%	\$1,920,114	10.00%	\$2,112,125	\$1,920,114
IN BIORS 1 0% 1 LLS \$683,703 -10.00% \$77,713,737 10.00% \$73,73,337 10.00% \$73,13,337 10.00% \$51,13,961 501,13,13 55,00% 533,13,13 55,00% 533,13,13 55,00% 533,13,13 55,00% 533,13,13 55,00% 533,53,13 500% 533,13,13 55,00% 533,13,13 55,00% 533,53,13 500% 533,13,13 55,00% 533,53,13 500% 533,13,13 55,00% 533,53,13 500% 533,13,13 55,00% 533,53,13 500% 531,13,10 500% 531,13,10 531,13,10 531,13,10 531,13,10 531,14,10 531,14,10 531,14,10		-	0%	-	960	-	S	S4,546,640	-10.00%	\$5.051,822	10.00%	\$5,557,004	\$5,051,822
Martman 1 0% 1 LS \$1891999 -10.00% \$2.102,177 10.00% \$2.312,395 \$ Markman 1 0% 1 0% 1 LS \$1093788 -10.00% \$12.198,653 10.00% \$13.415.18 \$ Walk 1 0% 1 0% 1 LS \$109.00% \$12.196,653 \$0.00% \$13.415.18 \$ Walk 1 0% 1 LS \$100.00% \$53.113 \$25.00% \$343.240 \$ </td <td>HACIENDA BRDIGE OVER 1-15 NB/SB</td> <td>-</td> <td>0%</td> <td>Ŧ</td> <td>0%</td> <td>•</td> <td>S</td> <td>\$6,638,703</td> <td>-10.00%</td> <td>\$7,376,337</td> <td>10.00%</td> <td>\$8,113,971</td> <td>\$7,376,337</td>	HACIENDA BRDIGE OVER 1-15 NB/SB	-	0%	Ŧ	0%	•	S	\$6,638,703	-10.00%	\$7,376,337	10.00%	\$8,113,971	\$7,376,337
NHISS 1 0% 1 LS \$10,00% \$12,196,663 10,00% \$13,416,513 \$13,416,513 Walls 1 0% 1 0% 1 LS \$680,119 10,00% \$12,196,663 \$5,00% \$395,110 \$357,110 \$356,110	WIDEN FLAMINGO OVER DEAN MARTIN	-	9%0	1	0%0		SI	S1,891,959	-10.00%	\$2,102,177	10.00%	\$2,312,395	\$2,102,177
Molia 0% 1 0% 1 0% 55.0% 55.0% 55.110 55.110 55.110 55.110 55.0% 555.110 55.0% 555.110 55.0% 555.110 55.0% 555.110 55.0% 556.110 55.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.110 56.0% 556.100 56.0% 560.100 56.0% 560.100 56.0% 560.100 56.0% 560.100 56.0% 560.100 56.0%	22	-	%0	-	0%0	1	SI	S10,978,788	-10.00%	\$12,198,653	10.00%	\$13,418,518	S12.198,653
SSELL 1 0% 1 LS \$869(19 110.00% \$316,568 \$350,710 \$357,110 UNTAIN 1 0% 1 0% 1 LS \$160,756 1000% \$564,137 \$500% \$385,110 UNTAIN 1 0% 1 LS \$2006,472 10.00% \$554,137 \$500% \$406,756 UNTAIN 1 0% 1 LS \$2006,472 10.00% \$564,137 \$500% \$436,240 UNTAIN 1 0% 1 LS \$2160,752 10.00% \$544,137 \$500% \$436,240 UNTAIN 1 0% 1 LS \$2160,752 \$10,00% \$543,430 \$400% \$543,240 UNTAIN 1 0% 1 LS \$315,00% \$353,234,413 \$25,00% \$343,240 List \$316,0730 532,4413 25,00% \$347,300 \$200% \$371,200 MAMP 1 0% 1 L	Walls		-				-						
P.C.MA 1 0% 1 LS \$277,861 -10.00% \$530,137 \$500% \$5467/51 Dirtain 1 0% 1 0% 1 LS \$240,723 \$10,00% \$534,137 \$500% \$5467/51 UNTAIN 1 0% 1 0% 1 LS \$240,723 \$10,00% \$533,524,137 \$500% \$4067/51 UNTAIN 1 0% 1 LS \$2480,723 \$10,00% \$533,524,137 \$500% \$4067/51 UNTAIN 1 0% 1 LS \$353,550 -10,00% \$353,234,00 \$4067/61 \$364,137 \$200% \$4067/61 UNTAIN 1 0% 1 LS \$353,550 -10,00% \$353,240 \$211,200 State 1 0% 1 LS \$314,300 537,600 \$200% \$324,1200 NAMPS 1 0% 1 LS \$314,000 \$314,600 \$200% \$324,1200	RETAINING WALLS AT RUSSELL	•	9%0	+	960	4	SI	\$689.119	-10.00%	\$785,888	25.00%	\$957.110	\$765.688
Mullicio 1 0% 1 1% 1% 1% 1% 1% 1% 5% 5% 137 25.00% 5% 5% 5% 5% 5% 7% 5%	RETAINING WALLS AT TROPICANA	F	%0	-	960	1	SJ	\$277,861	-10.00%	\$308,734	25.00%	\$385,918	\$308,734
UNITAIN 1 0% 1 LS \$2.906,472 -10.00% \$3.226,413 25.00% \$4.06,766 34.06,766 UNITAIN 1 0% 1 LS \$3.256,413 25.00% \$4.30,076 \$4.31,1200 \$4.40,076 \$4.31,1200 \$4.40,076 \$4.41,1200	RETAINING WALLS AT FLAMINGO	1	%0	1	940	1	LS I	\$480.723	-10.00%	\$534,137	25.00%	\$667,671	1E1 W255
UNCAIN 1 0% 1 LS \$338,400 \$10,00% \$43,82,00 \$44,82,00 \$44,82,00 \$44,82,00 \$44,82,00 \$44,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,82,00 \$54,80,00 \$50,00% \$51,1200 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 \$51,24,00 <td>RETAINING WALLS AT SPRING MOUNTAIN</td> <td>-</td> <td>0%</td> <td>+</td> <td>0%</td> <td>+</td> <td>S</td> <td>\$2,906,472</td> <td>-10.00%</td> <td>\$3,229,413</td> <td>25.00%</td> <td>\$4,036,766</td> <td>\$3,229,413</td>	RETAINING WALLS AT SPRING MOUNTAIN	-	0%	+	0%	+	S	\$2,906,472	-10.00%	\$3,229,413	25.00%	\$4,036,766	\$3,229,413
TRAFFIC Structures Subtotal 1 0% 1 0% 1 LS \$167.200 \$5.00% \$176.000 20.00% \$271.200 1 0% 1 0% 1 LS \$167.200 \$5.00% \$271.200 \$271.200 1 0% 1 LS \$167.200 \$5.00% \$176.000 \$20.00% \$271.200 1 0% 1 LS \$167.200 \$5.00% \$176.000 \$20.00% \$271.200 1 0% 1 LS \$167.200 \$5.00% \$176.000 \$20.00% \$271.200 1 0% 1 LS \$146.300 \$20.00% \$374.600 \$20.00% \$374.600 \$20.00% \$316.600 I I I I I	OUNDWALL ALONG 1-15 SB BETWEEN SPRING MOUNTAIN AND SAHARA		0%	F	920	÷	-	S158 560	-10.00%	\$398.400	10.00%	S438.240	\$398.400
TRAFFIC TRAFFIC 1 0% 1 0% 5.00% \$176.000 20.00% \$211.200 1 0% 1 0% 1 15 \$167.200 5.00% \$211.200 \$2.00% \$2.11.200 1 0% 1 0% 1 15 \$167.200 5.00% \$2.00% \$2.21.400 1 0% 1 1 1 1 \$3.460 5.00% \$3.76.000 20.00% \$5.21.400 1 0% 1 1 1 1 1 \$3.460 \$5.00% \$5.60% \$2.14.00 \$2.22.400 1 0% 1 1 1 1 \$3.460 \$5.00% \$5.60% \$3.16.00% \$3.16.400 1 0% 1											Str	uctures Subtotal	.1
1 0% 1 0% 1 1% 1% 1% 516,000 20,00% \$211,200 1 0% 1 0% 1 1% 5367,200 5.00% \$317,600 20,00% \$321,200 1 0% 1 0% 1 1% 1% \$317,500 20,00% \$322,400 \$322,400 \$322,400 \$322,400 \$311,200 \$322,400 \$311,200 \$322,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,400 \$312,410 \$312,400 \$312,400 \$312,410 <t< td=""><td></td><td></td><td></td><td></td><td>TRAF</td><td>FIC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>					TRAF	FIC							
1 0% 1 0% 1 LS \$167,200 5.00% \$176,000 20.00% \$311,200 1 0% 1 0% 1 15 \$167,200 5.00% \$176,000 20.00% \$311,200 1 0% 1 0% 1 LS \$161,200 5.00% \$321,1200 1 0% 1 LS \$164,300 5.00% \$324,000 20.00% \$184,800 1 0% 1 LS \$146,300 5.00% \$315,400 20.00% \$184,800 1 0% 1 LS \$146,300 5.00% \$316,800 30% \$316,800 1 0% 1 LS \$146,300 5.00% \$316,800 \$20.0% \$316,800 1 0% 1 LS \$146,300 \$0.0% \$316,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$16,800 \$													
1 0% 1 LS \$167.200 5.00% \$176.000 20.00% \$271.200 1 0% 1 0% 1 LS \$332.400 \$50.0% \$184.000 \$20.00% \$184.000 1 0% 1 0% 1 LS \$532.400 \$5.00% \$184.000 \$20.00% \$184.000 1 0% 1 LS \$5.00% \$5.60% \$5.60% \$5.16.800 \$16.600 1 0% 1 LS \$5.60% \$5.64.000 20.00% \$5.16.800 \$16.60% 1 0% 1 LS \$5.14.200 \$2.84.000 \$0.00% \$5.16.800 \$16.60% \$5.16.800 \$16.60% \$5.16.800 \$16.60% \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16.800 \$5.16	RUSSELL RD E8 WITH 1-15 NB ON-RAMP	-	%0	-	360	+	S	\$167,200	-5.00%	\$176,000	20.00%	\$211,200	\$176,000
1 0% 1 0% 1 1% 532.400 5.00% 5332.2.400 5.22.400 532.400 532.400 532.400 512.414 512.441 512.414 512.414 512.414 512.414 512.414 512.400 512.414 512.414 512.414 512.414 512.414 512.614 512.614 512.614 512.614 512.614 512.614 512.614 512.614 512.562.502 512.612.414 <	TROPICANA RD EB WITH 1-15 NB ON RAMP	1	0%0	-	940		S	\$167,200	-5.00%	\$176,000	20.00%	\$211,200	\$176,000
1 0% 1 0% 1 LS \$140,300 5.00% \$154,600 20.00% \$154,600 1 0% 1 15 \$250,800 -5.00% \$20.00% \$316,600 1 0% 1 15 \$250,800 -5.00% \$20.00% \$316,600 ADDITONALTENS ADDITONALTENS 5.00% \$27,3813,528 16.00% \$27,385,602 1 0% 1 1 1 1 1 \$27,385,602 1 0% 1 1 1 1 1 \$27,385,602	FLAMINGO RD WITTS OFFICIN RAMPS	•	%0	1	960	4	S	\$334,400	-5.00%	\$352,000	20.00%	\$422,400	\$352.000
1 0% 1 LS \$250,800 5,00% \$316,800 \$316,800 ADDITIONAL ITEMS ADDITIONAL ITEMS 5,00% \$373,859,000 \$377,355,900 \$377,355,900 1 0% 1 D% 1 LS \$21,450,445 -10,00% \$377,355,902 1 0% 1 D% 1 LS \$21,450,445 5,00% \$377,355,902 1 0% 1 D% 1 LS \$375,552,835 -5,00% \$377,392,514 \$30,262,140	FLAMINGO RD EB W/ 1-15 NB ON RAMP	-	%0	-	940	+	S	\$146,300	-5.00%	\$154,000	20.00%	\$154,800	\$154,000
Traffic Subtodal ADDITIONAL ITEMS ADDITIONAL ITEMS Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2" ADDITIONAL ITEMS Colspan="2">Colspan="2" Table 2 Colspan="2">Colspan="2" Table 2 Colspan="2">Colspan= 2" Table 2 Colspan= 2" SST.356.902 SST.366.902 SST.366.902 SST.366.902 Colspan="2" SST.366.914 Colspan="2" SST.366.914 Colspan="2" Additional terms Subtodal	SPRING MOUNTAIN W/ 115 SB ON RAMP		0%0	1	960	+	LS I	\$250,800	-5.00%	\$264,000	20.00%	\$316,800	
ADDITIONALITEMS ADDITIONALITEMS Ittems 1 0% 1 0% 527,355,902 Ittems 1 0% 1 0% 535,552,858 -5,00% 537,392,514 539,26,140 Ittems 1 0% 1 LS \$35,552,858 -5,00% \$37,392,514 539,26,140												Traffic Subtotal	
I thems 1 0% 1 0% 1 0% 1 LS \$21,422,445 -10.00% \$23,813,828 15.00% \$27,385,902 1 Oelta 1 0% 1 LS \$35,522,888 -5.00% \$37,392,514 5.00% \$39,262,140 Additional flams Subbala					ADDITIONU	AL ITEMS							
1 Delta 1 0% 1 1 0% 1 LS \$35,522.835 5.00% \$37,392,514 5.00% \$39,262,140 Additional flame Subbala	Additional thems	1	960	1	940	1	3	\$21,432,445	-	\$23,813,628	15.00%	\$27,385,902	\$23,813,828
Additional Nems Subtotal	Alternative 1 Delta		03%	1	9%0	1	SI	\$35,522,838	-5.00%	\$37,392,514	5.00%	\$39.252,140	
											Additions	al Nems Subtotal	-





Table A-2 – Alternative 2 Shift Baseline Cost Estimate

		Ou	Quantity or Pecentage	tage				Cur	Current Year Unit Cost	Cost		Current Year
Item	(Tow)	(Low) Under (%)	Base	(%) Ove	(%) Over (High)	Unit	(Low) Under (%)		Base	-	%) Over (High)	Base Total Cost
Drainage												
	+	%0	-	0%0	-	SJ	S10,104,514	-10.00%	\$11,227,238	50.00%	\$16,840,857	\$11,227,238
										D	Drainage Subtotal	\$11,227,238
		Sub	Sub-Total Present Day Construction Cost	Day Construc	ction Cost							\$197,357,027
Landscaping and Aesthetics			3.0%						S5,583,894			\$5,583,894
Erosion Control			1.0%						S1,861,298			\$1,861,298
Traffic Control			10.0%						\$18,612,979			\$18,612,979
Roadside Safety			3.0%						\$5,583,894			\$5,583,894
Additional Items			0.0%						\$0			\$0
									Sub-Total	-		\$228,999,091
Mobilization			7.0%						\$13,029,085			\$13,029,085
		T	Total Present Day Construction Cost	ny Construction	on Cost							\$242,028,176
Construction Engineering/Inspection			15.0%						\$36,304,226			\$36,304,226
NEPA			1.0%						\$2,420,282			\$2,420,282
Preliminary Engineering & Design			4.0%						\$9,681,127			\$9,681,127
Final Engineeering			4.0%						\$9,681,127			\$9,681,127
Administration			1.0%						S2,420,282			\$2,420,282
Legal			1.0%						S2,420,282			\$2,420,282
		Total Pres	Total Present Day Construction and Engineering Cost	uction and E	Ingineering	Cost						\$304,955,502
				RIGHT-OF-WAY	F-WAY				State of the second		A LOUGH COLUMN	Contraction of the local distance
Right-of-Way			-			rs	\$40,825,965	-5.00%	\$42,974,700	25	\$53,718,375	\$42,974,700
										Right-	Right-of-Way Subtotal	\$42,974,700
Environmental Consideration			3.0%						S9,148,665			\$9,148,665
		Overa	Overall Total Present Day Cost - Alternative 2	t Day Cost - A	Alternative 2	~						\$357,078,867

Table A-2 – Alternative 2 Shift Baseline Cost Estimate (Cont.)













APPENDIX B Workshop Baseline Flow Chart



COST RISK ASSESSMENT

APPENDIX B - B-1 JUNE 2021





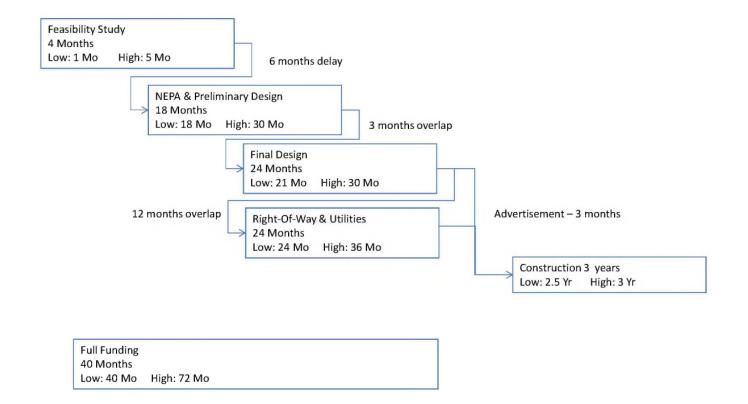


Figure B -1 – Baseline Flow Chart







APPENDIX C Post Response Risk Register



COST RISK ASSESSMENT

APPENDIX C - C-1 JUNE 2021





						A	Alternative 1	1					Alternative 2	ive 2		
Threat/Opportunity	Description	Status	Strategy			Cost Impact		S	Schodule Impact			3	st impact	L	chedule Impact	Notes
				Ukalihood	Inw	Mast Ukely	HIGH	Law	Mast Ukely High	High	Ulitatihood	Low M	Most Ukely High		Low Most Ultely High	
								CONSTRUCTION								
Displaced persons residing in corridor (Construction)		Active	Accept													Unise: HDDT's Digdinced Perioria Policy to propare design details to address displaced perioria. Maintenance will clean the condor prior to conservational (constrat while trates on how this could connect selection.)
Minor Change Drifers	NDOT averages approximately 3% of construction cost	Active	Accept	Medium	NE.	12	W						Same			NDOT has an excellent partnering program that needs to continue.
Drifted Shafts	D/B is more challenging due to expedited whedels. Released to D-B delivery method.	ACDVC	Mingate	Low				"OM I-	*OM 5-	-3 MO.					Same	Lot of unknown site conditions for diffed shafts. Miligated through perthening.
Underheitt weather	Average 5% of working days	Active	Accept	High					35						Same	
Gentracter resources/quality		Active	Accept	Low (D-8- 8)(CMAR) Very Litw (D-8)	\$1004	\$250K	\$500K	DMI	2MD	OWE			Same		Same	Poor performance or late of emources from Contractor os Subsperiaecons. None likely undor Denign-Bid-Build scenario or CMAR.
						0	CONTRACTING AND PROCUREMEN	AND PROU	UREMENT							
Major reconstruction efforts require closure of 1-15																Develop phasing plan to finit or incrementally upprade the project based on the ofternative(s).
Change in Pruceweekel (CMARVD-B)		Active	Accept	Modium	85	750%	NOT	QM 9	OW 6	-1 YR			Same		Same	Combining decign with early concinuction activities
tenavation through VE. D/B - CMAR process		ACDVO	Accept	Medium	-10%	-12.5%	-15%						Same			
Recient of Federal Stare		Active	Monitar	Very Low				UAT-	-2 MR	-3 VR					Same	Difficult to access right now, Once an alternative, rook, and fuding tources, grants such an INFRA and BULD could be applied for and potentially with.
Use of Incentive/Olsincentive clauses		Active	Accept.	Medium	\$1 MIL	S2 MILL	S4 M	-3 MO	-45 MD	-6 MO			Same		Sane	
							DES	DESIGN/PS&E								
Tertilis projections require favorables that are not feasible within the evolution (coopering)		Retired														Traille, modeling process much conform to regional anapertomy/valumet/CD anabless. Evoluate facilitie programming and MCD techoss handle to detormine revealue atternatives. Mitigated and involved as part of the Feorbiefly Stools.
												-				Next to work with NGOT to determine schedule of
Schedule of Project NEON's future phase is unknown.		Retired														improvements and potential alternative tickes Provide concept teries on and/connershifter future phase and account for throw and work for future phases and account for throw and/or the future phases and account for the above before this phases is constructed. Behaved
Landscape plan treates areas for displaced persons to						Annes						T	Course of Course			Work with NDGT LEA to develop LEA concepts that
occupy project R/W.						-							Dirtes			discourage occupancy of the R/W.
Coordination with adjacent City of Las Vegal MLK Extension		Active	Mitigate	Medium	\$500K	TIM STS	TIM ES	2 MD	4 MD	5 MO			Same		Same	Could have an impact to alternative development during the NEPA/Preliminary Design phase.
DLV MLK Extension groged concurrent construction.		Active	Munitur	Low				1 MO	2 MO	4 MO					Same	This would be during Construction.
Sidewalks do nut exist on holh vides of all hundwave through the NDOT R/W, but do on adjacent threets. Billo connectivity will also more to be evaluated.	Primary movements have been incorporated into altwinatives. Connectivity to CIV MUCEsteriation will need to be evoluated.	Active	Accept	Law	3500%	TIWSTS	SIS MIL						Serre			Develop intex and alluminities that privide believe pedentrian connectivity through the corridor's criticing to adverve.
HDV System	Is HOV 1 lane/2 lane, while be operated? 34/77	ACDIVE	Accept	Low				DW 5	6 MD	OW 6					Same	If HDV system is motified during the design proces routed impart schedule based on modification/keveluations.
High Spinni Raif		Active	Ministrar	LOW												Could change traffic patterns. Will not know true imports till implimmented which reald he in 3034.







						1	All Burning Street, St		ENVIRONMENTAL & INTUKAULUS				
Displaced persone resulting in corridor (NEPA)		Active	Monitar	low									Lust an item that needs to be addressed as part of the ride unnertation unless they already have actual evolution.
Haardous material & encountered	UPRR rail within corridor Existing bridge structures	Active	Mitigate	Very Low	S250K	ŞSTSK	yooss	owo	1 MO	2 MD	Same	Same	Conduct Phase 1 54, Perform desnoy aligned with EXH requirements module on this and sector proper contractor and more arrange and herm. Miligentian: Be early evolvation of colologi bridges for proteinal externation action and and contractioners. Econological with Environmental.
Project/phrane of the project rol included in the Regional PP/AG conforming model delaying completion of HEPA complaince.	Have line to get initial alterntive into TPD/AL Novever, any mistAke could have screatule inpacts	ACTIVE	Mitigate	tow				O YR	R YR	ITR		Same	Develop schedule of ingrovernetha in work value possibles to produce on regional PUXACS meeting updates when they ocur, <i>Mingeliebs</i> . Meet analogies and Deor Panning and Pooper Menagement to produce theoreally meeting on the PDAA decements and the southerspace of the
Public commenter complains outrade of comment window.	Very high profile property conners adjacent to coorded with fluctuating decision malier Upwiners	Active	Mitigate	Medium				OWE	DW 5-2	1 YR		Samo	Provide Lieu information and Vangaumti process to public to need to mean provide provingence devices active anexus can REM and LSS could had a port unitive beaution leaves. Need to elevelop a checkment Unitional and common statembolise impagement part to the part or mort propriet process. Development (environmental process.
Public commenter unes NDOT based on perceived impacts.	More of a cost risk than whedule Nav. Would occur poll project completions.	Active	Mitigate	Very Law	XOSTS	XOSS	51 MIL				Smc		Previde relear informarian and panagement process to public or closure your yonking benefacions. Several addive lawwith yon NEON and HS South and a you domination have an AMBgratiene. Design item last forward to malimite right of wey and increas investor.
Other agency coordination and permitting	Clark County permits	Active	Mitigate	Iow				OWO	1 MO	2 MD		Same	Mingeriou: Find stabilization and dust control plan. Pull in County worth for frequencia an entigentian efforts and include in plan sets.
							MANAGE	MANAGEMENT & FUNDING	DNING				
scope change		Active	Miligate	Medium	SIGOOK	TIMES	TIM 95	3 MO	6 M0	OW 6	Same	Same	Nould cault furth an PLA or Drain Phane. Mingation: Early contineation with statistical and heteroad Nethers on adjacant progret yonharements and using communityments (Net to minimize bas) nature score additions.
Projest must be phased due to limited funding		Active	Accept	High	52.5 MIL	35 MIL	510 MI	3 48	A VR	5'0	Samo	Samo	Project must be phased due to limited lunding and additional lunding must be elsentified. Would worked empacts to funding relation to CDMD. Cost imports moutper in April 2022 CBA applicates.
Ownge in NDOT Leader/Vip/personnel		Active	Accept	High				1 MO	ZMD	OWE		Same	May be able to mitigate by "shadowing" of accounts
Change in NDOT priorities		Active	Accept	Medium				TVE	25 48	5 VR		Same	
Change in NOOT Standards/Specifications/Policies		Active	Accept	High				1 MO	1.5 MD	2 MO		Same	
Ineffliectencles and resource impacts COVID		Active	Accept	Medium				BMG	4.5 MD	6 MD		Same	Air ady superforming this un this project and other projects
							RIG	RIGHT-OF-WA	~		-	-	Providence of the second data of
Duration of appuisition could exceed the subjecture duration - uncooperative property corner		Active	Accept	Medium				1 MO	2 MO	CIVI E		Same	container webenaarves en at erwei ene number/magnitude vil acquisitiann/vasteiments. Covers timefname fins reindemvestions.
Property transfers from previous project how not been executed and are in limbo		Retired											Work with not 2VW to indentify a pareta in or conventity owned or property transition and begin final proceed to leader in the WM offst and ownerhigh way care is primating or of install and have or inspect to owned inspect rotions from one.





DOT
SAFE AND CONNECTED

							-	RAILWOAD							
JPRP Coordination		ACINE	Accept	High				6 MO	DW 6	1 VR			Same		NDOT has been taying rawas with UPRR not being responsive Multiple bridges crossing UPRR
						1	TRUCTURE	STRUCTURES AND GEOTECH	FCH						
Experision of spans due to UPRE approval		Active	Accept	Very Low	SJ0 MIL	520 Mill	530 MIL								UP2B may require r/w to r/w space for existing progress
Replacement of existing MSE Walls		Active	Accept	law	SIMIL	525 MIL	35 MIL								Need to investigate another MSE walls and the patronish of error provision
							TU.	UTILITIES							
Undersoom untilities		Active	Mittigate	Medium	11W 55	\$10 Ma	\$15 Mil	3 MG	6M0	OM 6	Same		Same		Allow for additional costs in project leadget. Milliportion: During MPRA process confact more extensive utility coordination/measurals. At this point no date to justify reduced cost or delay risk.
Potential for NVE relocations/coordination		Active	Witigate	H@H	\$300K	\$12 MIL	SAML	3 MO	6 MO	DW6	Same		Same		Will identify prior rights during the prior rights research.
NVE Substation Infrastructure impacts		Active	Avoid	Low											
Utility relocations receiped do not happen ain yobadule fass line along UPIR. Kan Ingesching construction schedule.	Gas line along UPNR. Kem River or Kinder Morgan.	Active	Accept	Medium				3 MO	6 MO	0W6			Same		Up first and untimuel capitolication with unling companies to equality the impact of the responsibility on CMAN/Uneign Sudder to evoid or coordinate early with unlines.
Utility undergraund is damaged	UsBIN hit during construction	Active	Vitigate	low		Minor		3 MO	6 MO	ow 6	Same		Same		Work with utilities to subsurve to identify potential damaged focations. Document there is project specifications. Follow up with utility comparies RE- repair work.
femporary ME planned connection	There was a planard temporary fine this house in open or the temporary fine proposed improvements due to construction of the morecall.	Active	Monitor Very Low	Very Low					N/A			QWO	OWE 0	640	Morrisal schedule in finition. Need to continue mentioning and coordinations with Morrisal Coordin, Mildettion (MID) will have temporary point argeneral antimetry. Work with permits to most were Physical Monsegment in coefficiel (for premit by enablished are availed project coordination).

Figure C-1 – Risk Register – Post Response (Cont.)







APPENDIX D Additional Risk Output



Cost Risk Assessment

APPENDIX D - D-1 JUNE 2021





NDOT Risk Breakdown	I-15 — F	lamingo Road to S	ahara Avenue Ri	sk Count
Structure Category	Active	Inactive	Retired	Total
Environmental & Hydraulics	6	0	0	6
Right-of-Way	1	0	1	2
Utilities	6	0	0	6
Railroad	1	0	0	1
Design/PS&E	7	0	2	9
Structure & Geotech	2	0	0	2
Management/Funding	6	0	0	6
Contracting & Procurement	5	0	0	5
Construction	5	0	0	5
Total	39	0	3	42

Table D-1 – I-15 – Flamingo Road to Sahara Avenue Risk Count Detail



Cost Risk Assessment





APPENDIX E September 2020 Cost Risk Assessment



Cost Risk Assessment

APPENDIX E - E-1 JUNE 2021



I-15 Flamingo Road to Sahara Avenue

Risk Assessment Workshop Report

Prepared for:

Nevada Department of Transportation

September 2020





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I-15 – FLAMINGO ROAD TO SAHARA AVENUE COST RISK ASSESSMENT



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I. EXECUTIVE SUMMARY

The attached Cost Risk Assessment report for the Nevada Department of Transportation's (NDOT) proposed improvements to the Interstate 15 (I-15) corridor from Flamingo Road to Sahara Avenue identifies project threats and opportunities that could affect project cost and/or budget. The feasibility study is currently evaluating two potential locally preferred alternatives, which are both included in this Cost Risk Assessment (CRA).

In preparing the CRA, a risk-based estimate was prepared to model project risks assuming all risks would be accepted (pre-response) and preparing the post-response estimate assuming a proactive risk management plan was implemented. The CRA evaluated two different alternatives to identify if the risks may cause significantly different potential outcomes.

The following tables present the August 2020 CRA results and are intended as a quick summary for NDOT Management and Executive Leadership Team (ELT).

	Risk-Adjusted	Cost Results (in Mill	ions – YOE \$'s)	
Scenario	Base Cost		Cost Range	
Scenario	Dase Cost	10 th Percentile	70 th Percentile	90 th Percentile
		Alternative 1		
Pre-Response	\$227.7	\$322.2	\$364.1	\$380.5
Post-Response	\$221.1	\$315.1	\$356.8	\$371.2
		Alternative 2		
Pre-Response	\$364.5	\$414.5	\$470.7	\$505.8
Post-Response	Ş304.5	\$409.6	\$461.1	\$483.7

Table E-1 – Risk Adjusted Cost Results (in Millions – YOE \$'s)

	Risk-Adju	isted Project Comple	tion Date	
Scenario	Base Completion	Proje	ct Completion Date F	Range
Scenario	Date	10 th Percentile	70 th Percentile	90 th Percentile
Pre-Response	Dec 2028	June 2031	December 2035	December 2036
Post-Response	DEC 2028	February 2031	August 2035	June 2036

Table E-2 – Risk Adjusted Project Completion Date

Figure E-1 on the attached page presents a one-page snapshot of I-15 Flamingo Road to Sahara Avenue project with respect to overall benefits, costs, and schedule based on the outcomes of the two alternatives.



I-15 – FLAMINGO ROAD TO SAHARA AVENUE COST RISK ASSESSMENT



Project Summary	I-15 Flamingo Road to Sahara Avenue September 2020	VEVADA DOT
Project Description	CRA Cost Range	\$322.2 M \$505.8 M
• Widen I-15		80% chance the cost will be in
• Improve Flamingo Road Interchange		this range
 Improve Spring Mountain Interchange Improve I-15 Operations 	2 10% chance the cost will be le	
	10% chance the cost will be less	st-Response 70 th percentile=\$409.9 M 10% chance 80% chance the cost will be more the cost will be in this range 815.1 M \$483.7 M
Project Benefits	CRA Schedule Range	June 2031 80% chance Dec 2036
 Increase capacity 		the cost will be in this range
 Reduce overall interchange delay Enhance safety 	10% cha the cost will	ince 10% chance
	10% chanc the cost will be	
Key Project Schedule Risks	Key Project Cost Risks	
<u>Threats</u>	Threats	
 Funding Availability 	Acquisition allocation of shared	d right-of-way with Project NEON
UPRR Coordination	• Expansion of bridge spans due	
Utility Relocations	Phasing due to funding availab	
Scope Changes	Unknown utilities	
• NEPA	 Additional sidewalk and bicycle 	e connectivity
<u>Opportunities</u>	 Right-of-way 	
 Design-Build Procurement Use of Incentive/Disincentive Clauses 	UPRR coordination	
Level of Project Completion:		September 2020

Figure E-1 - I-15 Flamingo Road to Sahara Avenue Project Summary



RISK ASSESSMENT REPORT

PAGE – II SEPTEMBER 2020



1. INTRODUCTION

The report summarizes a risk-based cost and schedule analysis completed by CA Group for the NDOT's proposed improvements to the I-15 corridor from Flamingo Road to Sahara Avenue. Two potential options have been identified that will provide improvements to the interstate and interchanges to enhance interchange and freeway operations, capacity, and safety. The following study documents the Risk Assessment Workshop that was conducted by CA Group on August 24-25, 2020. Due to restrictions related to the on-going COVID-19 pandemic, the workshop was held virtually utilizing Microsoft Teams.

The purpose of the workshop was to:

- Analyze and document the potential range of uncertainty in both project cost and schedule due to risks (threats and/or opportunities) to assist in selecting a locally preferred alternative;
- Identify any significant risks or opportunities unique to the different alternatives which would be considered in the selection of the preferred alternative; and
- Identify and prioritize key cost and schedule risks and opportunities for the proposed alternatives.

The workshop and subsequent statistical analysis followed an approach very similar to the Washington State Department of Transportation's Cost Estimate Validation process (CEVP[®]) and in accordance with the Nevada Department of Transportation's (NDOT) Risk Management and Risk-Based Cost Estimation Guidelines.

The Risk Assessment Workshop consisted of several subject matter experts that are familiar with the project and potential risks and opportunities. Workshop attendees included the following individuals:

- Facilitator Chad Anson, CA Group
- Jeff Lerud NDOT Project Management
- Lynette Russell NDOT Project Management
- Mike West NDOT Construction
- Mike Mayberry NDOT Structures
- Bill Grennan NDOT Right-of-Way
- Casey Sylvester NDOT Traffic Operations
- Jason Love NDOT Planning
- Joselio Ramirez NDOT Hydraulics
- Laura Wiggins NDOT Roadway
- Sonja Long NDOT Utilities/Right-of-Way
- Tom Perez NDOT Right-of-Way
- Jacob Waclaw FHWA
- Iyad Alattar FHWA
- Greg McDermott City of Las Vegas





- Humberto Rivas Clark County Public Works
- Jack Sjostrom CA Group
- Jim Mischler CA Group
- Anita Busch CA Group
- Ghirmai Eman CA Group
- Jim Caviola CA Group
- Tammy Michels CA Group

The outcomes of the workshop and Risk Assessment Report are intended to assist in providing NDOT Project Management and ELT an estimated overall project cost as well as recommend a schedule and risk management strategies.





2. PROJECT DESCRIPTION AND ASSUMPTIONS

2.1. Project Scope and Phasing

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 significant 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 existing corridor I-15 from Flamingo Road to Sahara Avenue can only accommodate five through lanes in each direction, while future traffic demands are expected to further breakdown I-15 in this segment. The I-15 from Flamingo to Sahara Feasibility Study (Feasibility Study) was initiated by NDOT to develop and evaluate alternatives primarily focusing on improving I-15 safety and traffic operations and identifying right-of-way needs to accommodate future traffic demands. The on-going Feasibility Study is being 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 of 1969 (NEPA), and its implementing regulations, as contained in 23 Code of Federal Regulations (CFR) 771.

This project study area covers 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 the I-15/I-215/CC-215 system interchange. These endpoints form the logical termini of this study, allow for the development of a project that can be constructed alone, serve a significant purpose, and address environmental impacts on a sufficient scale. The area also 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).

Currently two different options are being proposed by NDOT and the project team. Alternative 1 consists of widening I-15 in each direction, reconfiguring of the Flamingo Road interchange (southbound ramps and cross street widening over I-15) and reconstructing the Spring Mountain Road flyover from southbound I-15 to eastbound Spring Mountain Road. Ramp braids would also be constructed between the southbound Spring Mountain Road on-ramp and Flamingo Road off-ramp and Flamingo Road on-ramp and Tropicana Avenue off-ramp.





Alternative 2 entails constructing the improvements identified in Alternative 1 and also includes the northbound Russell Road on-ramp and the Tropicana off-ramp and northbound Tropicana on-ramp and Flamingo off-ramp.



Figure 1 – Feasibility Study Limits





Additional details on the alternative layouts can be found in the *I-15 Flamingo Road to Sahara Avenue Interchange Feasibility Study*.

2.2 Strategy, Key Conditions and Assumptions:

The following is a compilation of assumptions, existing conditions, analyzed forecasts and project strategies at the time of the workshop.

- Funding
 - Funding has not fully been identified or incorporated into a short-range funding plan.
- > Design
 - o Design Level
 - Design for the project is currently at 15-20%
 - There are a handful of possible options that will need to be evaluated further during NEPA and final design to address public and stakeholder concerns.
 - o Landscaping
 - Maximum budget of 3% of construction. Minimal design completed at time of workshop.
 - o Structural
 - Standard bridge types (cast-in-place post tensioned and steel girders) and construction techniques are assumed.
 - $\circ \quad \text{Geotechnical}$
 - No project specific borings have been performed.
 - o Pavement
 - NDOT Wizard was utilized for roadway costs, including pavement section costs.
 - o Design Deviations or Exceptions
 - No design deviations for NDOT policies or FHWA design exceptions are anticipated at this time.
- Environmental Documentation
 - Project will require a NEPA process.
- Permitting
 - No significant environmental permits are anticipated (excluding USACOE 404).
 - o Contractor will obtain necessary construction permits.
- Right-of-Way
 - Right-of-way acquisitions are anticipated.
- > Utilities
 - Several utility impacts anticipated.
 - NVEnergy substation located near T-Mobile Arena will not be impacted.
- Other Stakeholders





- o NDOT
- City of Las Vegas
- o Clark County
- o RTC
- o Adjacent business and property owners
- Procurement
 - o Delivery Method
 - One phase of design-bid-build delivery.
 - The Project Delivery Selection Approach (PDSA) process will used to determine the delivery method. The PDSA is not yet scheduled.
 - o Market
 - A very competitive bidding environment is assumed.
- Construction

0

- o Maintenance of Traffic
 - A detailed maintenance of traffic plan has not yet been developed.
 - **Construction Phasing**
 - Constructed as one project.
- > Priority
 - Project will be prioritized per the NDOT's statewide prioritization process.





3. INPUTS

3.1 Base Project Schedule/Flow Chart

A cost-based schedule model was utilized to provide an inclusive cost and schedule quantitative risk assessment that allows for costs to be developed on a year of expenditure basis. A duration "flow chart" was developed for the project to graphically depict key project milestones at a level of detail appropriate for the workshop. The flow chart identified key activities and predecessor relationships that exist between key milestones and is the basis for modeling the project schedule (including delays and opportunities due to risk events) and to calculate inflated, year-of-expenditure costs for each activity identified. Appendix B provides the risk assessment workshop flow chart for the project, as evaluated in this report.

3.2 Scenarios

A scenario was run for pre-response and post-response mitigation in current year costs for each option. It was assumed that the project phasing would be similar for either scenario. The pre-response scenario assumes no mitigation strategies are developed or implemented. The post-response strategy assumes NDOT is proactive in mitigating or monitoring risks. The difference in costs of the two strategies helps NDOT develop a cost/benefit of the level effort that should be applied to mitigating and monitoring risks for the project. A significant difference between scenario costs indicates a considerable effort should be made. In contrast, a minor difference in costs between the scenarios may warrant less effort in risk mitigation and monitoring.

3.3 Exclusions from the Risk Assessment

This Risk Assessment Workshop was conducted to provide the best information available for NDOT ELT and Project Management to make educated decisions on the project and alternatives during this phase. When reviewing the results, it is crucial to consider that this is a snapshot of the project and that the project is still in the early phases of development, requiring some items to be excluded. For this analysis, significant exclusions include:

- The potential for substantial changes to the current design (including additional lanes, ramps, project limits) were not considered. It is recognized that such changes might occur as a result of funding delays, shift in prioritization, and/or changes in regional development and economics.
- > Significant changes to the phasing of the project were not considered.
- > Other significant changes to the scope of this project were not considered.

3.4 Base Project Cost

A base cost estimate was developed for the project through NDOT's Wizard cost estimation program. The base estimate was developed by calculating the length and laneage of the new roadway and bridge work area. Other items such as traffic control, signing, ITS, and incidentals (based on NDOT WIZARD Guidance) were assigned a percentage of construction cost. Once this percentage was assigned, the overall cost was checked for reasonableness and the percentage modified, as necessary. Tables 1 and 2 provide a summary





of the base cost estimate for each alternative. It should be noted, that since this is a base estimate, no contingencies were added.

Description	Baseline Cost
Roadway	\$27,301,288
Structures	\$42,758,918
Traffic	\$2,000,000
Drainage	\$7,087,193
Additional Items (Miscellaneous Items)	\$17,185,647
Bid Item Subtotal	\$96,333,046
Landscaping and Aesthetics (3%)	\$2,889,991
Traffic Control (10%)	\$9,633,305
Roadside Safety (3%)	\$2,889,991
Erosion Control (1%)	\$892,459
Subtotal	\$112,638,792
Mobilization (7%)	\$7,884,715
Contract Total	\$120,523,507
NEPA (1%)	\$1,205,235
Preliminary Engineering & Design (4%)	\$4,820,940
Final Engineering & Design (4.0%)	\$4,820,940
Construction Engineering (15%)	\$18,076,526
Administration (1%)	\$1,205,235
Legal (1%)	\$1,205,235
Subtotal	\$151,859,619
Right-of-Way Acquisition	\$29,500,000
Environmental Considerations (3%)	\$4,555,789
Project Total (Base Cost)	\$185,915,408

Table 1 – Alternative 1 Overall Base Cost Estimate Summary (2020 Dollars)





Description	Baseline Cost
Roadway	\$41,599,705
Structures	\$82,201,742
Traffic	\$2,000,000
Drainage	\$11,227,238
Additional Items (Miscellaneous Items)	\$23,813,828
Bid Item Subtotal	\$160,842,513
Landscaping and Aesthetics (3%)	\$4,825,275
Traffic Control (10%)	\$16,084,251
Roadside Safety (3%)	\$4,825,275
Erosion Control (1%)	\$1,496,153
Subtotal	\$188.073,468
Mobilization (7%)	\$13,165,143
Contract Total	\$201,238,611
NEPA (1%)	\$2,012,386
Preliminary Engineering & Design (4%)	\$8,049,544
Final Engineering & Design (4.0%)	\$8,049,544
Construction Engineering (15%)	\$30,185,792
Administration (1%)	\$2,012,386
Legal (1%)	\$2,012,386
Subtotal	\$253,560,649
Right-of-Way Acquisition	\$36,450,000
Environmental Considerations (3%)	\$7,606,819
Project Total (Base Cost)	\$297,617,469

Table 2 – Alternative 2 Overall Base Cost Estimate Summary (2020 Dollars)

All project costs are currently anticipated to be borne by NDOT through various funding sources, including Federal funding. A more detailed summary of the base cost estimates prepared for each alternative is presented in Appendix A.

Uncertainty

A cost estimate is a "snapshot" of the anticipated project costs based on the preparer's perception of construction costs at that given time. Many factors will dictate the estimate, including the detail available, current construction market, and size of the project and/or quantities. Nevertheless, there will always be uncertainty in a base cost estimate due to these factors. Uncertainty can be applied to a project cost estimate by giving range of costs and quantities.





The estimator may establish this uncertainty range by analyzing unit costs and quantities based on project location, the scale of quantities, the construction market, and material availability. Depending on the level of design, other factors may play into uncertainty such as available geotechnical information, NEPA constraints, right-of-way, and type of project delivery. Tables 3 and 4 shows the Base Project Cost Uncertainty by crucial project components.

In establishing the uncertainty ranges for each item, consideration was given to factors that might affect quantities or bid prices, such as project location (rural vs. urban), quantities (large or small), items that are difficult to construct or site constraints, methods of payments, timing of advertisement, specialty work, geotechnical, and project delivery methods. Uncertainty is typically expressed in terms of a percentage (of the quantity and/or unit cost) lower or higher than the base.

Activity	Project Cost			
Activity	Low	Base	High	
NEPA	\$1,086,646	\$1,205,235	\$1,358,270	
Preliminary Engineering & Design	\$4,346,584	\$4,820,940	\$5,433,079	
Final Engineering & Design	\$4,346,584	\$4,820,940	\$5,433,079	
Construction Engineering	\$16,299,689	\$18,078,526	\$20,374,046	
Administration	\$1,086,646	\$1,205,235	\$1,358,270	
Legal	\$1,086,646	\$1,205,235	\$1,358,270	
Right of Way Acquisition	\$28,025,000	\$29,500,000	\$36,875,000	
Environmental Considerations	\$4,107,522	\$4,555,789	\$5,134,260	
Construction	\$108,664,596	\$120,523,508	\$135,826,974	
Total	\$169,049,913	\$185,915,408	\$213,151,248	

Table 3 – Alternative 1 Base Cost Uncertainty by Activity (2020 Dollars)

Activity	Project Cost			
Activity	Low	Base	High	
NEPA	\$1,813,481	\$2,012,386	\$2,259,721	
Preliminary Engineering & Design	\$7,253,922	\$8,049,544	\$9,038,885	
Final Engineering & Design	\$7,253,922	\$8,049,544	\$9,038,885	
Construction Engineering	\$27,202,209	\$30,185,792	\$33,895,818	
Administration	\$1,813,481	\$2,012,386	\$2,259,721	
Legal	\$1,813,481	\$2,012,386	\$2,259,721	
Right of Way Acquisition	\$34,627,500	\$36,450,000	\$45,562,500	
Environmental Considerations	\$6,854,957	\$7,606,819	\$8,541,746	
Construction	\$181,348,058	\$201,238,612	\$225,972,118	
Total	\$269,981,011	\$297,617,468	\$338,829,115	

Table 4 – Alternative 2 Base Cost Uncertainty by Activity (2020 Dollars)





Escalation Rates

Escalation rates are a measurement of change (usually increase) in project costs due to inflation, market costs, and the regional and national economy over a project's lifetime. In this analysis, escalation is applied to key project activities outlined in the project schedule, including NEPA, final design, utilities, and construction costs. With escalation, not only do project delays extend the duration of the project, they will typically increase final project costs. This project's escalation is per NDOT's Escalation Rates Forecast Technical Memorandum dated June 18, 2020. Those rates are shown in Table 5.

		Engineering		F	Right-of-Way	y	(Constructior	ı
Year	10%	50% (Median)	90%	10%	50% (Median)	90%	10%	50% (Median)	90%
2019	1.15%	1.15%	1.15%	4.75%	4.75%	4.75%	-0.47%	-0.47%	-0.47%
2020	-0.05%	1.23%	2.52%	-3.11%	1.81%	6.72%	-4.85%	0.03%	4.91%
2021	-0.06%	1.73%	4.00%	-3.69%	2.64%	9.81%	-3.11%	1.95%	8.46%
2022	0.19%	2.46%	4.72%	-4.80%	3.19%	11.59%	-1.40%	4.00%	10.16%
2023	0.61%	2.70%	4.76%	-4.33%	4.12%	12.62%	-1.30%	3.82%	9.51%
2024	0.66%	2.68%	4.76%	-4.16%	4.23%	12.57%	-1.50%	3.31%	8.74%
2025	0.40%	2.44%	4.46%	-4.28%	4.31%	12.90%	-1.78%	3.07%	8.45%
2026	0.11%	2.23%	4.29%	-4.42%	4.52%	13.70%	-2.38%	2.87%	8.84%
2027	-0.02%	2.16%	4.35%	-3.26%	5.37%	13.99%	-2.38%	2.82%	8.83%
2028+	-0.08%	2.21%	4.50%	-4.28%	4.31%	12.90%	-3.06%	2.81%	9.50%
Average		2.21%			3.83%			2.74%	

Table 5 – Escalation Rates per NDOT's Escalation Rates Forecast Technical Memorandum

3.5 Risks

During the Risk Assessment Workshop, uncertainty in the base project costs and schedule were identified and characterized. This uncertainty included both threats and opportunities that could impact the project scope, schedule, or budget. These threats and opportunities have been compiled into a risk register, which is presented in Appendix C. Minor items have still been noted in the Risk Register for monitoring throughout the project in the event they become significant risk/opportunity factors. The Risk Register provides the Department more than a summary of potential events that have been considered in the riskbased estimate and schedule; it provides the Project Manager a list of items that need to be monitored and potential strategies that should be implemented to reduce the risk and hopefully avoid significant events impacts to the project.





4. ANALYSIS

4.1 Model

The inputs developed in the workshop (including base cost, schedule, risk, opportunities and uncertainties) were entered into @RISK software. @RISK is a probabilistic, integrated model which utilizes Monte Carlo simulation techniques to generate probability distributions of cost and schedule while also prioritizing risk rankings. The simulation generates 5,000 independent potential outcomes and provides a statistical compilation of selected results. In order to accommodate inflation and true year-of-expenditure dollars; the cost of each flowchart activity was escalated from the estimate reference date to the activity mid-point (including consideration of delays or accelerations due to events) according to the specified escalation rate.

4.2 Pre-Response Results

The following section summarizes various significant cost results from the workshop and risk-based analysis based on the pre-response scenario. The pre-response scenario assumes no risk management strategies are implemented.

It should be noted that the following is a "snapshot" of the project based on information available at the workshop. As the project evolves and more information is developed, identified risks should be mitigated, therefore reducing or "retiring" those risks that could impact the project. However, it is likely as the project progresses, new uncertainties may present themselves and will need to be recognized as part of the risk-based estimate and schedule. There is an adherent opportunity in implementing risk management strategies that, as the project progresses and risks are retired, the risk-based estimate standard deviation will decrease, thereby reducing the seventy-percentile cost and increasing confidence level.

Probability distributions for Alternative 1 total overall project cost pre-response (current year dollars) are shown in Figure 2 in probability mass functions (PMFs) and cumulative distribution functions (CDFs)

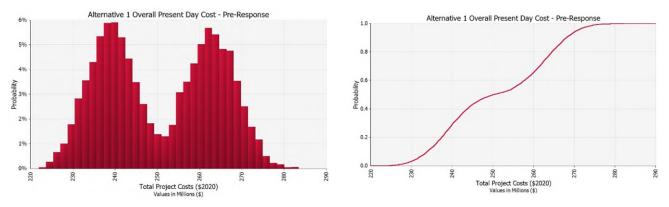


Figure 2 – Alternative 1 - Probability Distribution for Overall Total Present Day Cost (\$2020) – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)





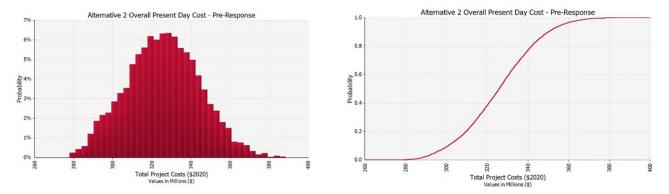


Figure 3 – Alternative 2 - Probability Distribution for Overall Total Present Day Cost (\$2020) – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

format. These probability distributions reflect the base cost combined with identified project risks and opportunities with no mitigation or on-going risk or opportunity management activities.

The PMF portrays a graphical measure of the range of values, including the most likely value, as represented by the tallest bar on the graph. Alternative 1 suggests a unique circumstance in which one risk can substantially influence the outcome of the most likely project cost. The risk of a significant portion of right-of-way not being purchased by NDOT's Project NEON prior to this project is resulting in two most likely project costs. Should Project NEON acquire shared right-of-way between NEON and this project, the most likely project in 2020 dollars would be approximately \$238 million. However, if the shared right-of-way is not acquired by Project NEON, the most likely project cost in 2020 dollars would be approximately \$264 million.

Alternative 2 demonstrates a more typical bell curve since the overall project cost is more. The risk of shared right-of-way not being purchased by Project NEON has a less significant overall impact to the project costs. Figure 3 shows the most likely project cost for proposed Alternative 2 in 2020 dollars to be approximately \$328 million.

A CDF represents the cumulative probability of not exceeding a particular value (also known as a percentile or confidence level). For example, from the CDFs shown for Alternative 1 in Figure 2(b), the 70th percentile means that there is a 70 percent likelihood that the total cost for the entire project will be less than or equal to approximately \$261.6 million in 2020 dollars. Likewise, the CDF shown in Figure 3(b) indicates a 70th percentile likelihood that the total cost for Alternative 2 would be less than or equal to \$335.9 million in 2020 dollars.

Year of expenditure costs for each alternative are calculated based on an anticipated pre-response riskbased schedules are shown in Figures 4 and 5. Figure 6 identifies the project's overall pre-response riskbased schedule with the most likely completion to be on or before December 2035 based on pre-response activities.





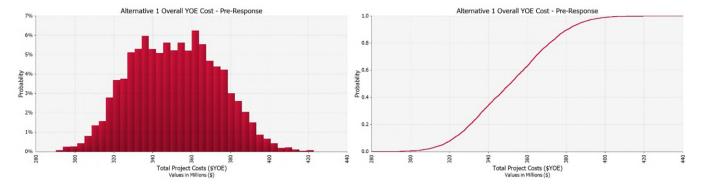


Figure 4 – Alternative 1 - Probability Distribution for Overall Total Year of Expenditure Cost – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

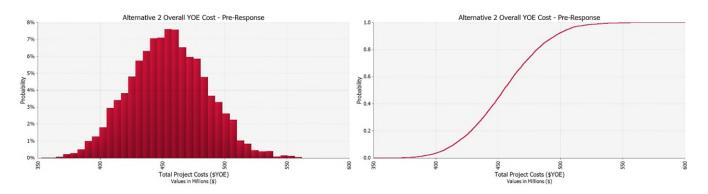


Figure 5 – Alternative 2 - Probability Distribution for Overall Total Year of Expenditure Cost – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

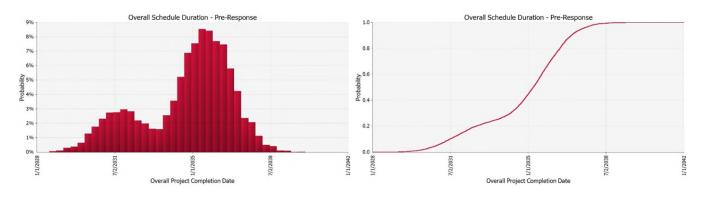


Figure 6 – Probability Distribution for Overall Schedule Duration – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)





4.3 Post-Response Results

Sound project management execution consists of the agencies and those involved to proactively manage risk and opportunities; thereby, reducing potential increases and costs and schedule duration. As part of the workshop, the group identified the potential reduction in risks based on proactive management (Post-Response) and is shown in Figures 7 through 11.

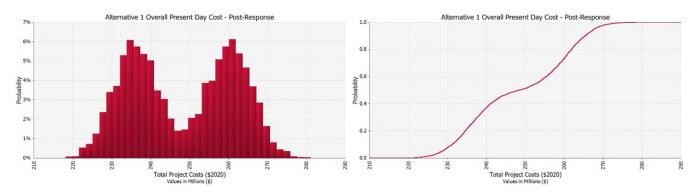


Figure 7 – Alternative 1 - Probability Distribution for Overall Total Present Day Cost (\$2020) – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

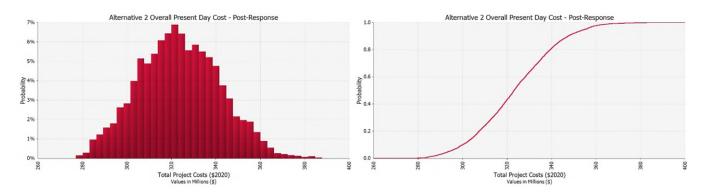


Figure 8 – Alternative 2 - Probability Distribution for Overall Total Present Day Cost (\$2020) – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

Similar to the pre-response graphs in Section 4.2, Alternative 1 develops two likely scenarios depending on whether the right-of-way is purchased as part of Project NEON. Should Project NEON acquire shared right-of-way between NEON and this project combined with proactively managing risks, the most likely project in 2020 dollars would be approximately \$236 million. However, if Project NEON does not acquire the shared right-of-way, the most likely project cost in 2020 dollars would be approximately \$262 million. Alternative 2 will most likely have an overall project cost of \$317.9 million in 2020 dollars by utilizing postresponse activities and mitigation management.





Figures 9 and 10 show the project would most likely cost \$356.8 million for Alternative 1 and \$461.1 million for Alternative 2 in YOE dollars. Anticipated completion through the use of pro-active risk management would most likely be in May 2035 as shown in Figure 11 on page 17.

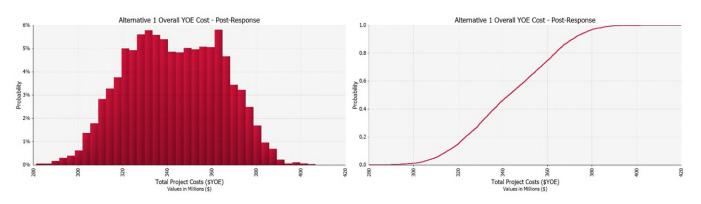


Figure 9 – Alternative 1 - Probability Distribution for Overall Total Year of Expenditure Cost – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

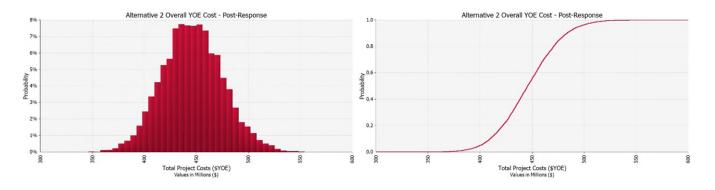


Figure 10 – Alternative 2 - Probability Distribution for Overall Total Year of Expenditure Cost – Post-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

Another method of presenting the project budget and schedule expectations to the general public and outside project stakeholders is by using the mid-80 percent confidence level. This range of cost and duration is bounded by the 10th percentile on the lower end and the 90th percentile on the higher end. This will provide an 80 percent likelihood that the project costs and schedule will be completed within this range, and only a 20 percent likelihood that it will not. Table 6 provides a summary of the mid-80 percent confidence level range post-response.





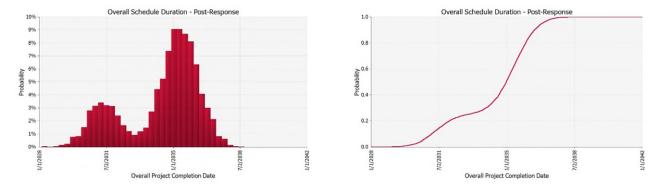


Figure 11 – Probability Distribution for Overall Schedule Duration – Pre-Response, presented in two ways: a) probability mass function (PMF); b) cumulative distribution function (CDF)

10 th Percentile (Lower Limit)	90 th Percentile (Upper Limit)
Alternative 1	
\$231.2 million	\$265.4 million
\$315.1 million	\$371.2 million
Alternative 2	
\$300.0 million	\$347.3 million
\$409.6 million	\$483.7 million
February 2031	June 2036
	Alternative 1 \$231.2 million \$315.1 million Alternative 2 \$300.0 million \$409.6 million

Table 6 – Mid-80 Percent Confidence Level Range for the Overall Project Post-Response

Table 7 provides a summary of various post-response probability distributions (i.e. confidence levels) for the overall project including current year cost, year of expenditure and project duration.





	Altern	ative 1	Altern	ative 2	Overall
	Total Project Cost (2020 \$ Mil)	Total Project Cost (YOE \$ Mil)	Total Project Cost (2020 \$ Mil)	Total Project Cost (YOE \$ Mil)	Completion Date
Base	\$185.9	\$227.7	\$297.6	\$364.5	Dec 2028
Mean	\$248.3	\$343.2	\$323.7	\$446.4	May 2034
Standard Dev.	\$13.4	\$21.2	\$18.2	\$28.9	723 Days
5%	\$228.6	\$309.5	\$293.8	\$400.0	Aug 2030
10%	\$231.2	\$315.1	\$300.0	\$409.6	Feb 2031
15%	\$233.1	\$320.0	\$304.4	\$416.4	Jul 2031
20%	\$234.6	\$323.3	\$307.4	\$421.7	Jan 2032
25%	\$236.1	\$326.9	\$310.6	\$426.9	Dec 2032
30%	\$237.7	\$330.0	\$313.5	\$430.9	Dec 2033
35%	\$239.3	\$333.0	\$316.1	\$434.6	Apr 2034
40%	\$241.1	\$336.0	\$318.6	\$438.4	Aug 2034
45%	\$243.6	\$339.0	\$321.0	\$441.9	Oct 2034
50%	\$248.3	\$342.7	\$323.1	\$445.7	Dec 2034
55%	\$253.0	\$346.2	\$325.5	\$449.7	Feb 2035
60%	\$255.4	\$349.9	\$328.2	\$453.5	Apr 2035
65%	\$257.2	\$353.3	\$330.8	\$457.2	Jun 2035
70%	\$258.9	\$356.8	\$333.6	\$461.1	Aug 2035
75%	\$260.4	\$360.2	\$336.4	\$465.9	Oct 2035
80%	\$261.9	\$363.5	\$339.4	\$470.7	Dec 2035
85%	\$263.5	\$366.7	\$342.8	\$476.2	Mar 2036
90%	\$265.4	\$371.2	\$347.3	\$483.7	Jun 2036
95%	\$267.8	\$377.1	\$355.1	\$494.6	Nov 2036

Table 7 – Summary of Probability Distributions for Overall Cost and Schedule – Post Response

As Table 7 indicates, completion of the project could extend out to November 2036, if not longer. Based on the above information, there is 70th percentile confidence level that the project could be delivered by August 2035 with a maximum cost of \$461.1 million (Alternative 2).

4.4 Significant Risks, Uncertainties and Strategies

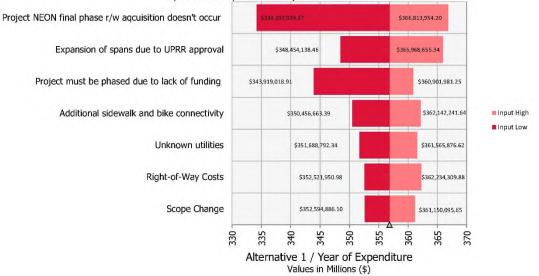
Cost Risks

The tornado tables in Figures 12 and 13 show the potential impacts of the top ten post-response cost risks for Alternatives 1 and 2 respectively. Additional information about the risks is provided in Appendix C – Risk Register. The risk names are listed on the vertical axis with expected cost impact identified. Risks in the tornado diagram are ranked in descending order showing the greatest risk to cost on top.





I-15 - FLAMINGO ROAD TO SAHARA AVENUE **COST RISK ASSESSMENT**



Alternative 1 / Year of Expenditure Inputs Ranked By Effect on Output 70% Percentile



For Alternative 1 costs, the largest risk and opportunity is determining which project, NEON or I-15 Flamingo to Sahara, will purchase the shared right-of-way. The other primary risk which NDOT has control over is identifying the funding timing for the project and if the project will need to be phased.

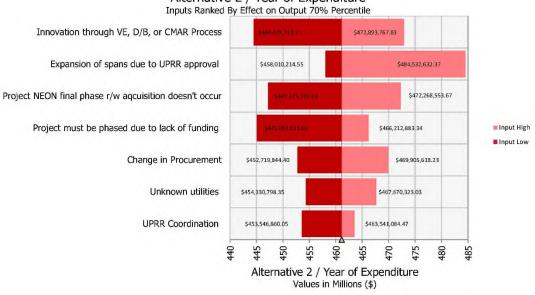




Figure 13 – Alternative 2 Post Response Cost Tornado Diagram





For Alternative 2 costs, the largest risk/opportunity item affecting the 70th percentile cost will be innovation developed through the value engineering, design-build, or CMAR process. UPRR guidance of mainline I-15 bridge structures can have a significant impact to both Alternative 1 and 2. Coordination with UPRR will be a high priority as the project moves into preliminary design. Funding and right-of-way cost allocation may also have a significant impact to Alternative 2.

Schedule Risks

The tornado table in Figure 14 shows the most significant potential impacts of the schedule risks for the project. Currently, the most significant item driving the project schedule is if the project must be phased over a substantial time frame due to lack of funding. Once the timing of funding has been solidified, other risks may play a more significant role in the 70^{th} percentile project completion date. Additional information about the risks is provided in Appendix C – Risk Register. The risk names are listed on the vertical axis with expected schedule impact identified. Risks in the tornado diagram are ranked in descending order showing the greatest risk to schedule on top.

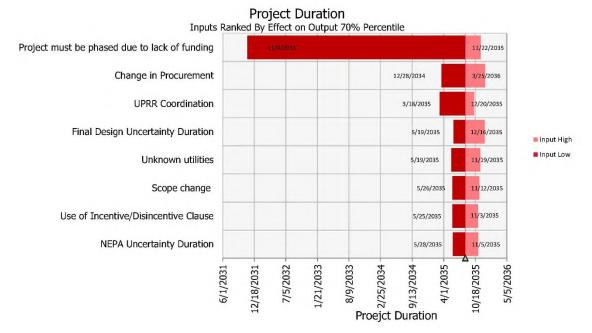


Figure 14 – Post Response Schedule Tornado Diagram





5.0 CLOSING

Based on the results of discussions during the Risk Assessment Workshop and this report, the following recommendations are made:

- 1. When possible, based on the above described uncertainties, it is best to provide project costs and durations in a range based on the mid-80 percentile confidence level as shown in Table 2 to help manage stakeholder expectations.
- 2. Recognize and communicate that this report is a snapshot into the project at the time of the Risk Assessment Workshop. As the project progresses various uncertainties will be retired, while new uncertainties may surface. In general, as time moves on the range between various confidence levels should diminish. NDOT should consider updates to the risk-based estimate at various milestones including preliminary and intermediate design submittals.
- 3. Utilize the 70th percentile confidence level estimates to help establish reasonable budgets and schedules, and then strive through risk management strategies identified in the risk register to bring the project in under budget and schedule.
- 4. Implement the strategies discussed in Section 4.3 to reduce the uncertainties in the top threats and opportunities. As the risks are retired or mitigated, update the risk-based estimate to identify the next 5-10 risks that the project team should focus on. By focusing resources on the most significant risks the project team will be able to efficiently retire those risks and reduce the mid-80th percentile confidence range.
- 5. By implementing a proactive risk management plan, it is safe to assume that NDOT will be able to reduce the 70th percentile project cost by approximately \$3 million and reduced the project duration by approximately 5 months. However, there are several major risks and opportunities that once retired and an overall outcome is known, significant impacts to the 70th percentile cost and schedule will most likely occur.

These results are intended to provide NDOT and the Project Team with the information needed to aid in making educated decisions about the project scope, schedule, and budget. In addition, this report should aid in developing risk management strategies to ensure a successful project is developed and implemented within publicized schedules and budgets.





APPENDIX A Base Cost Estimate



RISK ASSESSMENT REPORT

APPENDIX A - A-1 SEPTEMBER 2020

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1 0% 1 1% 0% 1 1% 0.00% \$3.301.214 10.00% \$3.361.401 0.00% \$3.361.401 0.00% \$3.361.401 0.00% \$3.361.401 0.00% \$3.361.401 0.00% \$3.361.401 0.00% \$3.471.352 0.00% \$3.744.105 0.00% \$3.747.352 0.00% \$3.747.352 0.00% \$3.743.105 </td <td>SPRING MOUNTAIN FLYOVER BRIDGE OVER 1-15</td> <td></td> <td>9%0</td> <td>÷</td> <td>960</td> <td></td> <td>5</td> <td>\$4,004,487</td> <td>-10.00%</td> <td>\$4,449,430</td> <td>15.00%</td> <td>\$5,116,845</td> <td>\$4,449,430</td>	SPRING MOUNTAIN FLYOVER BRIDGE OVER 1-15		9%0	÷	960		5	\$4,004,487	-10.00%	\$4,449,430	15.00%	\$5,116,845	\$4,449,430
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	WIDEN FLAMINGO OVER 1-15		30		0%	-	5	\$2 971 147	-10.05%	\$13.301.774	10.00%	S3 631 401	\$3.301.274
1 0% 1 1% 1 1%	WIDEN FLAMINGD DVER FRANK SINATRA		044		Univ		1	\$2 016 086	10 000	\$2 240 046	10.00%	S2 484 105	\$2 240 096
1 0% 1 0% 1 1 0% 51,377,532 10,00% 51,515,351 31515 31515,351 3151515,351 3151515,351 <t< td=""><td>WIDEN 1-15 NB OVER UPBR</td><td>-</td><td>0%</td><td></td><td>10%</td><td></td><td>S.</td><td>S1 791 186</td><td>-10.00%</td><td>\$1.434 B51</td><td>20.00%</td><td>S1 721 581</td><td>\$1.434.651</td></t<>	WIDEN 1-15 NB OVER UPBR	-	0%		10%		S.	S1 791 186	-10.00%	\$1.434 B51	20.00%	S1 721 581	\$1.434.651
1 0% 1 1% 5 54,718,739 10,00% 55,787,347 57,7347 1 0% 1 0% 1 15 54,706 55,703,94 10,00% 55,703,94 10,00% 55,713,259 1 0% 1 15 51,783,103 -10,00% 53,957,034 10,00% 53,173,259 1 0% 1 15 53,667,331 -10,00% 53,267,324 50,00% 53,173,259 1 0% 1 15 53,667,331 -10,00% 53,267,324 50,00% 54,300,156 54,300,166 <	WIDEN I-15 SB OVER SPRING MOUNTAIN		0%		960		5	\$1239.833	-10.00%	\$1.377.592	10.00%	\$1,515,351	\$1377.592
1 0% 1 LS 54,186,415 :10,00% 55,120.397 51,120.397 1 0% 1 0% 1 LS 51,180.415 :10,00% 55,120.397 51,20.397 1 0% 1 0% 1 LS 51,80.135 :10,00% 53,51.331 :10,00% 53,51.335 1 0% 1 LS 51,80.135 :10,00% 53,51.335 :51,00% 53,51.335 1 0% 1 LS 51,80.135 :10,00% 53,51.335 :51,00% 53,51.335 1 0% 1 LS 53,66.330 :10,00% 52,30.52 51,00% 53,51.33 :50.06% 54,035.766 :51,31.256 1 0% 1 LS 52,066 51,00% 53,61.316 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.26 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 :51,61.56 <td>1-15 SB (SBCD) BRIDGE OVER DEAN MARTIN</td> <td></td> <td>0%0</td> <td>+</td> <td>950</td> <td>+-</td> <td>S</td> <td>\$4,718,739</td> <td>-10.00%</td> <td>\$5,243,043</td> <td>10.00%</td> <td>\$5,787.347</td> <td>\$5243.043</td>	1-15 SB (SBCD) BRIDGE OVER DEAN MARTIN		0%0	+	950	+-	S	\$4,718,739	-10.00%	\$5,243,043	10.00%	\$5,787.347	\$5243.043
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1 0% 1 1% 53,557,034 10,00% 53,557,034 10,00% 53,557,034 10,00% 53,557,034 53,567,034 53,567,035 53,567,035 53,567,035 53,567,035 53,567,035 53,567,035 53,367,035 53,357,036 53,357,035 53,356,539 53,000 53,253,035 53,010 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 53,026 5	115 SB (SECDI BRIDGE OVER SPRING MOUNTAIN		0%	1	0%0		S	\$1.728.103	-10.000%	\$1,920.114	10.00%	S2.112.125	\$1,920,114
1 0% 1 1% <td>(BCD) BRIDGE OVER SPRING MOUNTAIN ON RAMP</td> <td></td> <td>0%</td> <td></td> <td>0%0</td> <td></td> <td>S</td> <td>\$3,561,331</td> <td>-10.00%</td> <td>\$3.957.034</td> <td>10.00%</td> <td>S4 352 737</td> <td>\$3,957,034</td>	(BCD) BRIDGE OVER SPRING MOUNTAIN ON RAMP		0%		0%0		S	\$3,561,331	-10.00%	\$3.957.034	10.00%	S4 352 737	\$3,957,034
1 0% 1 1% 1% 1% 25.602.564 59.00% 52.602.564 59.00% 52.602.564 59.00% 50.00% 59.00% 59.00% 59.00% 59.00% 59.00% 59.00% 50.00% 59.00% 59.00% 50.00% 59.00% <	WIDEN FLAMINGO OVER DEAN MARTIN	e	0%		160	-	S	\$1,891,959	-10.00%	\$2,102,177	10.00%	\$2,312,305	\$2,102,177
1 0% 1 1S 5655,309 -10.00% 5728.121 25.00% 5910.151 1 0% 1 0% 1 1S 55.0% 5.0%	SPRING MOUNTAIN OVER LOOP RAMP	*	%0	+	000	-	SI	\$2,096,390	-10.00%	\$2,329,322	10.00%	\$2,562,254	\$2,329,322
1 0% 1 LS \$655,309 :10,00% \$728,121 25,00% \$810,151 1 0% 1 LS \$2,966,472 :10,00% \$32,29,113 25,00% \$4,063,166 1 0% 1 LS \$2,866,472 :10,00% \$32,82,00 \$1,030% \$438,200 1 0% 1 LS \$336,000 :500% \$430,000 \$1,030% \$438,000 1 0% 1 LS \$336,000 :500% \$430,000 \$100% \$480,000 1 0% 1 LS \$336,000 :500% \$430,000 \$100% \$480,000 1 0% 1 LS \$336,000 :500% \$430,000 \$100% \$480,000 1 0% 1 LS \$338,000 \$100% \$480,000 \$100% \$480,000 1 0% 1 LS \$338,000 \$100% \$100% \$100% \$100% 1	Walls												
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1 0% 1 LS \$336,560 -10.00% \$338,400 10.00% \$438,240 Image: Subodial structures Subodial str	RETAINING WALLS AT SPIRING MOUNTAIN		35	+	950	+-	S	\$2.906.472	-10.00%		25.00%	\$4.036.766	\$3,229,413
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1 0% 1 LS \$330,000 5.00% \$400,000 <t< td=""><td>FLAMINGD RD WG WITH F15 SB ON PAMP</td><td>1</td><td>350</td><td>1</td><td>960</td><td>-</td><td>S</td><td>\$380,000</td><td>-5.00%</td><td>S400.000</td><td>20.00%</td><td>\$480,000</td><td>\$400.000</td></t<>	FLAMINGD RD WG WITH F15 SB ON PAMP	1	350	1	960	-	S	\$380,000	-5.00%	S400.000	20.00%	\$480,000	\$400.000
1 0% 1 LS \$380,000 5.00% \$490,000 \$480,000 <t< td=""><td>FLAMINGO RD WB WITH 1-15 SB OFF-RAMP</td><td>F</td><td>350</td><td>1</td><td>9%0</td><td>-</td><td>S</td><td>\$330,000</td><td>-5.00%</td><td>\$400,000</td><td>20.00%</td><td>\$430,000</td><td>\$400,000</td></t<>	FLAMINGO RD WB WITH 1-15 SB OFF-RAMP	F	350	1	9%0	-	S	\$330,000	-5.00%	\$400,000	20.00%	\$430,000	\$400,000
1 0% 1 LS \$330,000 < \$430,000 \$440,000 \$430,000 \$430,000 \$430,000 \$440,000 \$4	SPRING MOUNTAIN W/ 1-15 SB OFF RAMP	-	360	+	960	-	S	\$380.000	-6.00%	S400.000	20.00%	\$480,000	\$400.000
ADDITIONAL ITEWS Traffic Subrotal aDDITIONAL ITEWS 10% 1 10% 1 150% 517,185.647 150% 519,753.434 Additional tems Subrotal Additional tems Subrotal DRAINAGE 1 0% 1 LS \$15,467,082 17,185.647 15.00% \$19,753.434 Image Subrotal 1 0% 1 LS \$15,467,082 10.00% \$19,753.434	SPRING MOUNTAIN W/ 1-15 SB ON RAMP	L	350	1	0%0	1	SJ	\$330,000	-5,00%	S400,000	20.00%	\$450,000	\$400,000
ADDITIONAL ITEMS ADDITIONAL ITEMS is 1 0% 1 15,00% 517,165,647 15,00% 519,763,494 1 DRAINAGE DRAINAGE 0% 1 LS 515,467,082 -10.00% 517,165,647 15,00% 519,763,494 1												Traffic Subtota	
Image: Second state Image Subtrain Second state Seco			1		ADD/MO	NAL ITEMS		A CONTRACTOR OF A		The second second		Contraction of the local distance	No. of Lot of Lo
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e 1 0% 1 10.520.790 51.520.790 0% 57.087.193 50.00% 510.520.790 0% 10.5200											Addition	al Items Subtota	
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Dramage Subtotal		F	30		00%		S	\$6,378,474	-10.00%	\$7,087,193	50.00%	\$10,630,790	
											-	raînage Subtota	Ĩ.
Sub-Total Present Day Construction Cost			2	11111111111	114 - A.	and the second se							Por one off

Table A-1 – Alternative 1 Baseline Cost Estimate



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I-15 Flamingo to Sahara - Alternative 1

		unanny or recentage	81	1		Current Year Unit Cost		Current rear
Item	(Low) Under (%)	Base	(%) Over (High)	Unit	(Low) Under (%)	Base	(%) Over (High)	Base Total Cost
Landscaping and Aesthetics		3.0%				\$2,889,991		\$2,889,991
Erosion Control		1.0%				\$892,459		\$892,459
Traffic Control		10.0%				\$9,633,305		\$9,633,305
Roadside Safety		3.0%				\$2,889,991		\$2,889,991
Additional Items		0.0%				\$0		\$0
						Sub-Total		\$112,638,792
Mobilization		7.0%			_	\$7,884,715		\$7,884,715
		Total Present	Total Present Day Construction Cost					\$120,523,507
Construction Engineering/Inspection	-	15.0%	-	Ľ	-	\$18,078,526		\$18,078,526
NEPA		1.0%				\$1,205,235		\$1,205,235
Preliminary Engineering & Design		4.0%				\$4,820,940		\$4,820,940
Final Engineeering		4.0%				\$4,820,940		\$4,820,940
Administration		1.0%				\$1,205,235		\$1,205,235
Legal		1.0%				\$1,205,235		\$1,205,235
		SOF	SOFT COST RISK SPECIFIC ITEMS	ITEMS			and the second se	
Public commenter sues NDOT		1		ST	\$500,000	\$1,000,000	\$2,000,000	
Project NEON final phase r/w agcuisition doesn't occur		-		R	\$23,500,000	\$23,500,000	\$23,500,000	
						Soft	Soft Cost Risk Specific Subtotal	al \$0
	Total	Present Day Con	Total Present Day Construction and Engineering Cost	ng Cost				\$151,859,619
			RIGHT-OF-WAY					
Right-of-Way		1		ST	S28,025,000 -5.00%	% \$29,500,000	25.00% \$36,875,000	\$29,500,000
							Right-of-Way Subtotal	al \$29,500,000
Environmental Consideration		3.0%				S4,555,789		\$4,555,789
	0	verall Total Prese	Overall Total Present Day Cost - Alternative 1	/e 1				\$165,915,408

Table A-1 – Alternative 1 Baseline Cost Estimate (Cont.)



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litem	(Lew)	(Low) Under (%)	Base	(%)	To) Over (High)	TUUT	(%) nuder (%)	er (%)	Base	(%)	(%) Over (High)	Base Total Cost
				RO	ROADWAY							
Roadway												
	-	80	1	350	~	rs	\$35,629,552	-10.00%	\$39,588,391	15.00%	\$45,526,680	\$39,588,391
Demolition									_			
	-	%0	-	9%0	-	IS	\$1,810,183	-10.00%	\$2,011,314	15.00%	\$2,313,011	\$2,011,314
				CTDI	000000000000000000000000000000000000000	I						CU1, 885, 195 0
				NUC .	ICI UKCO							
Bridges						10						
RUSSELL RD OVER NECO		%0	1	560	1	LS I	\$4,914,138	-10.00%	\$5,460,209	10,00%	\$6,006,230	\$5,460,209
TROPICANA ON RAMP OVER FLAMINGO OFF RAMP	-	%0	+	940	+	R	\$7,249,442	-10.00%	\$8,054,935	20.00%	\$9,665,922	S6,054,935
TROPICANA OFF RAMP OVER FLAMINGO ON RAMP	-	%0	+	%0	+	LS I	\$4.264.025	-10.00%	\$4 737,805	10.00%	\$5,211,586	\$4.737.805
SPRING MOUNTAIN BIRIOGE OVER THE LOOP RAMP	-	%0	-	80	-	LS.	\$3.103.475	-10.00%	\$3,448,306	10.00%	\$3.793.137	\$3.448.306
WIDEN FLAMINGO DVER I-15	-	%0	-	20%	-	S	52,971,147	-10.00%	\$3.301.274	10.00%	\$3,631,AD1	\$3,301.274
WIDEN FLAMINGO OVER FRANK SINATRA	-	940	-	960	+	LS I	\$2.016.086	-10.00%	\$2,240,096	10.00%	\$2,464,106	\$2.240.096
WIDEN 1-15 NB OVER UPRR	1	360	1	960	-	LS I	\$1,291,186	-10.00%	\$1,434,651	20.00%	S1.721.581	S1,434,661
WIDEN I-15 SB OVER SPRING MOUNTAIN	-	%0	-	20	-	SI	\$1,239,833	-10.00%	\$1,377,592	10.00%	\$1,515,351	\$1,377,592
SPRING MOUNTAIN OFF RAMP OVER FLAMINGO ON RAMP	+	%0	+-	%0	+	LS LS	\$3.965.774	-10.00%	\$4,406,416	10.00%	\$4,847,058	S4,406,416
I-15 SB (SBCD) OVER SPRING MOUNTAIN ON-RAMP	-	%0	-	%0	+	ST	\$3,561,331	-10.00%	\$3,957,034	10,00%	\$4,352,737	\$3,957,034
1-15 SB (SBCD) BRIDGE OVER DEAN MARTIN	1	0%	1	Ś	+	LS I	\$4,718,739	-10.00%	\$5,243,043	10.00%	55,767,347	\$5,243,043
115 SB (SBCD) BRIDGE OVER TWAIN	-	%0	-	%0	+	rs	\$4,189,415	-10.00%	\$4,654,906	10,00%	\$5,120,397	S4,654,906
1-15 SB (SBCD) BRDIGE OVER SPRING MOUNTAIN	-	960	1	%0	1	SJ	\$1,728,103	-10.00%	\$1,920,114	10.00%	\$2,112,125	\$1,920,114
SPRING MOUNTAIN FLYOVER BRIDGE	-	%0	-	35	-	LS LS	\$4,548,640	-10.00%	\$5,051,822	10.00%	\$5,557,004	\$5,051,822
HACIENDA BRDIGE OVER 1-15 NB/SB	-	%0	+	80	-	SI	\$6,638,703	-10.00%	\$7,376,337	10.00%	\$8,113,971	S7,376,337
WIDEN FLAMINGO OVER DEAN MARTIN	-	%0		%0	+	IS	\$1,891,959	-10.00%	\$2,102,177	10.00%	\$2,312,395	\$2,102,177
HARMON BRIDGE OVER 1-15 NB/SB	+	%0	1	0.50	1	SI	S10,978,788	-10.00%	\$12,198,653	10.00%	\$13,418,518	\$12,198,653
Walls												
RETAINING WALLS AT RUSSELL	-	%0	1	60%	+	LS LS	\$689,119	-10.00%	\$766,685	25.00%	L	\$765,688
RETAINING WALLS AT TROPICANA	-	20%	1	9%O	+	SI	\$277,861	-10.00%	\$308,734	\$00.92		\$306,734
RETAINING WALLS AT FLAMINGO	-	960		%0	1	LS I	\$480,723	-10.00%	\$534,137	25.00%		\$534,137
RETAINING WALLS AT SPRING MOUNTAIN	-	%0	1	50	+	LS I	\$2,906,472	-10.00%	\$3,229,418	25.00%	\$4,036,766	\$3,229,413
SOUNOWALL ALONG 1-15 SB BETWEEN SPRING MOUNTAIN		OB		- Disc	,	0	6369 660	AD DOG	OUV BUSS	10 0001	010 010	6306 400
LA L				200		3	0000000	BU OD OD	antinone	Str	Structures Subtotal	5
				Τġ	TRAFFIC							1
Traffic Sinnals				-	-	ŀ						
Chicken and a turning of the lines of		780		- UK	ŀ	1	00000000	2000	2400.000	20,000	C.620.000	\$ 400 DOD
TODORELL RU CO WITH 1 36 NO DAMO		arn a	-	00	-	20	Cash nnn	NUDE -	CALIN DOOL	20.0002	Capit City	\$400 000
SQUARE NOTED TO WATE OF DAMAGE	-	200		ON.		n u	\$380.000	200%	\$400.000	20,000	5480 000	\$400,000
FLAMINGO RD FR W/ LTS NR DN PAMP		190		20	-	51	\$380.000	-5 00%	S400.000	20.00%	\$480,000	\$400 000
SPRING MOUNTAIN W/ 1-15 SB ON RAMP	-	9%0	-	35	+	S	\$360.000	-5.00%	\$400,000	20.00%	\$480.000	\$400,000
											Traffic Subtotal	0
				ADDITIC	ADDITIONAL ITEMS		And the second			l		
Additional Items	-	960		%0	+	SI	\$21,432,445	-10.00%	-10.00% \$23,813,828	15 00%	\$27,385,902	\$23,813,828

Table A-2 – Alternative 2 Baseline Cost Estimate



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Item	(Low) Under (%)	Base	(%) Over (High)	igh) Unit	(1) (Low) Under (%)	Base Base	(%) Over (High)	Base Total Cost
A LOU ALL AND A LOU AND			DRAINAGE					
Drainage								
	1 0%	+	0%0	1 LS	S10,104,514	-10.00% \$11,227,238	50.00% \$16,840,857	\$11,227,238
							Drainage Subtotal	\$11,227,238
	Sub-	Total Present D	Sub-Total Present Day Construction Cost	n Cost				\$160,842,513
Landscaping and Aesthetics		3.0%				\$4,825,275		\$4,826,275
Erosian Control		1.0%				\$1,496,153		\$1,496,153
Traffic Control		10.0%				\$16,084,251		\$15,084,251
Roadside Safety		3.0%				\$4,825,275		\$4,825,275
Additional Items		0.0%				\$0		\$0
						Sub-Total		\$188,073,468
Mobilization		7.0%	-	_		\$13,165,143		\$13,165,143
	To	otal Present Day	Total Present Day Construction Cost	tso:				\$201,238,611
Construction Engineering/Inspection		15.0%		-		\$30,185,792		\$30,185,792
NEPA		1.0%				\$2,012,386		\$2,012,386
Preliminary Engineering & Design		4.0%				S8,049,544		\$8,049,544
Final Engineeering		4.0%				\$8,049,544		\$8,049,544
Administration		1.0%				\$2,012,386		\$2,012,396
Legal		1.0%				\$2,012,386		\$2,012,386
A REAL PROPERTY AND A REAL		SOFTC	SOFT COST RISK SPECIFIC ITEMS	CIFIC ITEMS	the second se		and the second s	
Public commenter sues NDOT		F		LS.	\$ \$500,000	\$1,000,000	\$2,000,000	
Project NEON final phase r/w agcuisition doesn't occur		1		SJ	\$ \$19,200,000	\$19,200,000	\$19,200,000 \$19,200,000	
						Soft	Cost Risk Specific Subtota	\$0
	Total Prese	ant Day Constru	Total Present Day Construction and Engineering Cost	reering Cost				\$253,560,649
		San 2 mg	RIGHT-OF-WAY	AX	Service of the service of	and the second	- Carlow	
Right-of-Way		1	_	S1 LS	\$34,627,500	-5.00% \$36,450,000	25.	
							Right-of-Way Subtotal	
Environmental Consideration		3.0%	_	_		\$7,606,819		\$7,606,819
	Overal	I Total Present	Dverall Total Present Day Cost - Alternative 2	native 2				\$297,617,469

Table A-2 – Alternative 2 Baseline Cost Estimate (Cont.)





APPENDIX A - A-5

SEPTEMBER 2020



APPENDIX B Workshop Baseline Flow Chart



RISK ASSESSMENT REPORT

APPENDIX B - B-1 SEPTEMBER 2020



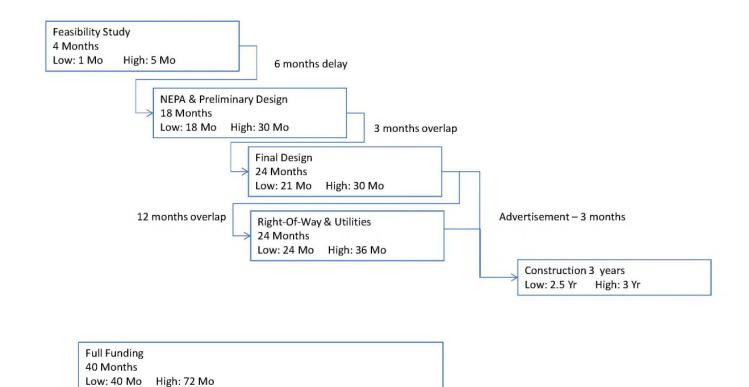


Figure B -1 – Baseline Flow Chart





APPENDIX C Post Response Risk Register



RISK ASSESSMENT REPORT

APPENDIX C - C-1 SEPTEMBER 2020

I-15 – FLAMINGO ROAD TO SAHARA AVENUE COST RISK ASSESSMENT



						Alte	Alternative 1						Alternative 2	2 3		
Threat/Oppurtunity	Description	Status	Strategy	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Cost Impact		Sch	Scheelule Impact	-		Cost Im	Cost Impact	L	Schedule Impact	Notes
			-	Desilhood	Low N	Most Likely	High	Low A	Low Mast Likely High	-	Timeli hood	Low Most Li	vely High	1	cat Likely Nigh	
							CONS	CONSTRUCTION						4.		
Diglaces persons rescing in cornair (Contruction)		Active	Arrept													Unitze HOOT's Dississed Re-sous Policy to prepare das yon risteria to accreate e sp and presare. Mai renarence with easy if w connecting prior to consistent diverse. Other of Mile Parles on how the could consist active Connection.)
Minor Change Orders	NDOT averages approximately 3% of construction cost	Active	Accept	Madium	10	x	N.					Same				NDOT has an excellent performing program that needs to continue.
Drilled Shafts	0/6 × rore challe girg due to expedited schedule, related to 0-8 convery methad	Active	Mitigate	tow				-CIW 1-	*OM C	-3 MO*					Same	Lot of s-mown site concitions for chilled snafts. Mitrgaled through santroning
Increment weather	Average 5% of working days	Active	Arcept	High					浙						Same	
Contractor resources/quality		Active	Accept	Low (D-5- B)(CMAN) Very Low (D-B)	SIOOK	\$250%	\$500K	1 MO	2 MO	OWE		Same	4		Same	Poor performance or last of resources from Contractive or Sockontractors. More lively under Design-Bio-Build Incera no or CMAR
						CON	TRACTING	CONTRACTING AND PROCUREMENT	TNBINBIT							
Algor reconstruction attants recurs dosure of 1-15																Develop phacing plan to limit or incrementally upgrade the project based on the alternative(p).
Change in Procuramers (CMAR/D-R)		Active	Arrant	Medium	18	7.50%	10%	CIM 5-	OW Sr	HV 1-		Same	r.		Same	Combining design with early spectruction activities.
Innevation (r-bugh VE, D/B - CMAR process		Active	Accept	Medium	-10%	-12,5%	-15%					Same	0			
Rocient of Foderal Grant		Active	Manitor	Wery Low				-î va	-2 YR	≓ YR					Same	Difficult to access right row. Once an alternative, cost and fuding nources, priorit such an fretty and Built2 could be applied for and potentiary work.
Use of Incurring/Districtorbue classes.		Active	Accept	Medium	S1 MIL	S2 MIL	SAMIL	н	45M0	OW9-	H	Same			Same	
							DESH	DESIGN/PS&E								
traffic projections sees for laccilles Unid are not Gastible within the adding bortarint		Relived														Traffle model "its process must careform to regional programmy monowing to make the other than the test programmer and the level data in the determine feature planet model. Any grand and reford as part of the Frankhilly Study.
Scheck z of Project NECKS Tub scheck 3 university		Retired														Need to work with MDOT to quizemine schedule of the conversion and about shall structure to KDA Provide proceeds of a link or match surrow MSON place and assumed the throw away work to future propert is constructed. "Motode alone defore this propert is constructed. "Motode"
Landonupe plun creation aroas for displaced persons to occupy project R/W						Minor						Same				Work with NDDF LKA to develop LS-6 concepts that discourage accupancy of the R/W.
Coordination with adjacent City of Las Vegas MLK betamion.		Active	Mitigate	Medum	\$3006	51.5 MIL	S3 MIL	2 MO	4 MD	6 MD		Same			Same	Could have an impart to alternative development during the NEPAVPreliminary Design phase
CLV MUX Extension project canourcent construction.		Active	Manitar	Low				1 MO	2 MO	0 MCD					Samo	This would be ouring Construction.
Stewarts do not exist on both sides of all neidowys umough the KNOF NVN, but do on adjacent streets. Bills correctively will also need to be evaluated.	Plimary movements have been incorporated into alto mattwes Connectivity to CLV MIX Extension will need to be evaluated.	Active	Accept	1 CW	\$300%	\$1.5 Mit	535 8011					Same				Developi Joses and alternatives that provide petiter pedestrian connectivity through the confidence counting roadways.
HOV System	to HOV 1 are/7 tare, will re niserative? 24/77	Active	Assept	Low				3400	6 MO	S MD					Same	If HOV system is multified during the center process, core of impact schreckues haved on more thank on schreuk settems.
High Speec Kail		Active	Manltor	Low												Cox or blange traffic solferios. With red anow one Impacts IIII implemented which cox or pe in 2024. Cox or be additional funding counce

Figure C-1 – Risk Register – Post Response



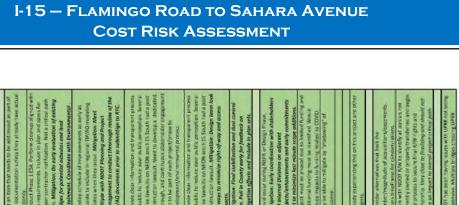


Figure C-1 – Risk Register – Post Response (Cont.)

	Just an item that needs to be addressed as own of the documentation unless they already have advar ractioncy.	Conduct Phase 1 ESA Perform dicarup aligned with Expressions to study and the and data and data proper contraction of the analysis (MA) and data for himm. Miligention: Do early evaluation of exacting brindings for performation sciences and least controlments. Contribute with Devisormental	Devolution screenistic of transmosteria as anity as prostation in inclusion transport and inclusion upper an inclusion transport and program multiple with NOOT proving and Program Monopariment to construct the inclusion of the TH/AG documents anite to a submitting to RTC.	Provide clear "Intrindition and transparent process for public to miscice awar mail is interpreted interview active aniwoust can HK OM annu 12 Acuth varia para active aniwoust can HK OM annu 12 Acuth varia para (conseque), maket to develop a dialogram (conseque) and continuous active oddr congeneticity plan to be part of each project/conset	Provide clear "Iternation and hange and process to abilit the recent case and abilit procession benefit active lawwills on NEO March 15 Schrift and a port construct on lawwall. MRRpatian. Design frem fash (to ways to minimize right-of-way and access impacts.	Mitigation Finel stelatization and dust control plan. Full in County early far feedback on mitigation efforts and include in yon vels.		Would extur during MERI or Devign Plinas Milligetion: Early coordination with ital-bolders and internal Dihibitons on addacent progetta/inhoncements and and somitimismite det to minimisch bast mixuue scope additions.	Project must se propoid due to limited functing and additional functing wust as inemitian. Winu is the new impasts to funding related to COVID.	May be able to mit gate by "shadowing" of periodine			A ready experiments one on the are open and one other	Consider alternatives that limit the	Curvers trivelrame for contents and the	Work with H001 R/M to donely at across red to monty optimal of an property Mathematic and ongo the process to secon brain WW r/Mts and ownersho. Were the formation production for home to impact to even brains or through each home to impact to even brains or through each		NPOT has peen noving, super with UPBE not being responsive. Multiplie bridges snowing UPBR
		Same	Same	amits		Samo		Same	Same	Same	Same	Same	Same	Grane	a Line			Sarre
the second se																		
		Same			Safrae			Sama	Same				-	-				
		2 MO	1 YR	RVI		DWC		DWG	5 VR	OWE	5 YR	2 MO	6 MD	OM L	-			1 VII
ENVIRONMENTAL & PTURAUULS		1 MO	0 YR	7.5 MD		1 MO	VDING	6 M 0	4 VR	DWIZ	2.5 VR	L5 MD	4.5 MD	OWE	-			9 MO
THE THE		OWO	OVR	OWE		OMO	MANAGEMENT & FUNDING	OME	3 VR	1 MO	1 VH	1 MO	3MO	OWL			RAILROAD	640
AVBILLING		\$300%			SIMIL		MANAGEI	11M 95	55 MIL				-				×	
		Sarsk			30005			IWN ES	\$2.5 MIL									
		\$250K			\$250K			\$500K	S1 MIL									
	iow	Very Low	I.DW	Medium	Very Low	Iow		Medium	HIGH	HEN	Medium	19,80	Medium	Mindow				1.8,0
	Monitar	Mittigate	Mingate	Mingate	Molgate	Mirgate		Miligate	Accept	Accept	Accept	Accept	Accept	Arrant	idana.			Accept
	Active	Active	Active	Active	Active	Adive		Active	BCTVE	NCLVC	ACTIVE	Active	Active No.	Action		Ratired		Acrive
		UPRR rail within corridor. Existing bridge structures	Have time to get initial allorative initio TTVAQ, however, any mittake could frave schedule impacts	Very high profile property owners. Biblicent to course or with functioning decision makery/owners.	More of a cold risk train utheol le risk. Would occur polt project completions.	Cark County permits												
	Displaced perions residing in corridor (NEPA)	Haordous material is snan-riced	Project (phases of the project not included (n.H.a. Projecta III) AGL automity model delaying completion of AUXA compliance.	la a i commerter la complans autoro ol commert Mitom	Public commerter auto MDOT based on automod Impacts	Other agency coordination and permitting		Scope change	Project must be whated due to limited funding	Change in NDDT Leadership/personnel	Change in WOOT predities	Change in NDOT Standards/Specifications/Policies	Inelflisciencies and recorde impacts COVID	Duratium of acculotition could exceed the schedula	ouration - uncooperative property pwmer	Property transfors from priverous project nave not been executed and and an initia		UPRB Coorcination





				-			STRUCTURI	STRUCTURES AND GEOTECH	TECH			0.0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
of spans due to UPAR approva		Activo	Arraph	Very Low	\$10 MIL	S20 MIL	330 MIL				_					0.P	UPBR may require r/w to s/w spans fur existing bridges
of of each of MGE Wars		Active	Accept	tow	ST MIL	52.5 Mil.	\$5 MIL									100	Meed to "overtigate externing MEF warm and the potential of sites training and sites training and sites of the second
							5	UTILITIES									
e'ten		Acrue	Mirigare	Medum	Ş5 Mill	\$10 Mil	ş15 MII	3 MO	6 MO	DW 6		Same			Samo	A REAL	A row for wald insured roots in project through Mitigation During NEPA process conduct more entenance utility coordination/research. At this point no date to justify reduced out or delay risk.
e NVE relacións/coordination		Active	MITGATO	нова	SROOK	JIM 5.12	TIM ES	OWE	6 MO	GIM 6		Same			Same	1M	Will tearstly prior rights overlig the prior rights revearen.
tion intrastructure impacts		ACTIVE	DIONN	Low				T						+			
ations reeeded on not his point on schedule. Gas i re-stand, UnHU, Kan ond ruction schedule. Kindler Mongan	Gas ire story UPRR. Kern River or Kindar Morgan	Active	Accept	Međum				3MO	6 MO	OW 5					Same	0.0	Upbrant and continued coordination with utility comparise to explain the impact, Put respectability or CMAA/Deliye funder to word or coordinates and with utilities.
ູ່ ກະອີສແປະຊາ V ມີມາດເສັ້ນ	UCHTy hit during construction	ACCYO	Morgano	LOW		Minor		3 MO	6 M O	OW 5		Some			Samo	WV and and and and and and and and and and	Work with utilities in advance to identify potential demaged local one. Document these in project appendications for ow up with utility companies REI (right work,
WE plan and connection	Then was a planned lumparuny line huh hua ito ito ito aran'ito wuh arapose improviments due hi centruction of the monoral.	Active	Manaco	Very Low					N/A					O M O	DINE	6 MO Ca	Monorpail severabule in limoto Mandi to contribute menticulta an constitutive in vito Notherusti Cempary Millipation MADT will have temperatin permit approximate advances y which and the permit make and the Polykold Monorpationesh is notified if the permit is submitted for anoid project confilts.

Figure C-1 – Risk Register – Post Response (Cont.)



I-15 – FLAMINGO ROAD TO SAHARA AVENUE COST RISK ASSESSMENT





APPENDIX D Additional Risk Output



RISK ASSESSMENT REPORT

APPENDIX D - D-1 SEPTEMBER 2020



NDOT Risk Breakdown	I-15 — F	lamingo Road to S	ahara Avenue Ri	sk Count
Structure Category	Active	Inactive	Retired	Total
Environmental & Hydraulics	6	0	0	6
Right-of-Way	1	0	1	2
Utilities	6	0	0	6
Railroad	1	0	0	1
Design/PS&E	6	0	2	8
Structure & Geotech	2	0	0	2
Management/Funding	6	0	0	6
Contracting & Procurement	5	0	0	5
Construction	5	0	0	5
Total	38	0	3	41

Table D-1 – I-15 – Flamingo Road to Sahara Avenue Risk Count Detail

