CE-4

APPENDIX K: FINAL ENGINEER'S REPORT EXCERPT

Excerpt

Final Engineer's Report

October 2021

INDOT Seymour District • Floyd County, IN • DES No: 1900162

I-64 Added Travel Lanes From US 150 to Spring Street I-265 Added Travel Lanes From I-64 to Green Valley Road

Prepared For
INDOT Seymour

Prepared By
111 Monument Circle, Suite 1200
Indianapolis, IN 46204
Phone: (317) 636-4682
Contact: Dan Thatcher, PE

Approved: Dan Thatcher Date: 10-22-2021
Dan Thatcher, PE
HNTB, Project Manager

Approved: Greg Prince Date: 10/28/2021
Greg Prince
INDOT, Project Manager

Approved: Robert F. Tally Jr. Date: 10/28/2021
Robert F. Tally Jr.
INDOT, System Asset Manager

IMPROVE 64 CONNECTING COMMUNITIES

NextLevel

Executive Summary

Introduction

The *Improve 64* project is needed is due to insufficient freeway capacity and aging infrastructure.

Insufficient capacity near the I-64/I-265 system interchange causes recurring freeway congestion along I-64 between SR 62/64 and the Indiana/Kentucky state line and along I-265 between I-64 and Grant Line Road. This results in peak period travel speeds below 20-mph, intermittent queueing, and a high frequency of rear end and sideswipe crashes.

Highway capacity levels of service along the project corridor do not meet INDOT standards in current conditions or the design year. Recurring congestion occurs on eastbound I-64 during typical weekday morning peak periods, beginning near the SR 62/SR 64 interchange. This is a result of the high-volume of traffic that enters eastbound I-64 from the US 150 entrance ramp. On westbound I-64, congestion occurs during typical weekday afternoon peak periods. Westbound I-265 experiences congestion during both the typical weekday morning and afternoon peak periods. In all three corridors, congestion problems are expected to become more acute as demand increases. More detail regarding congestion in the existing and design year is provided in **Sections 2.10** and **5.9**, respectively.

Freeway pavement throughout the project area is due for rehabilitation in the near future. I-64 was initially constructed with concrete pavement in the 1960's and overlaid with asphalt in 1991. I-265 was built in 1970 with concrete pavement. Additional detail on existing pavement is provided in **Section 2.3**. Over the next decade, pavement on I-64, I-265, and US 150 will require investment to maintain. Syncing rehabilitation efforts, rather than addressing each segment individually, will simplify asset management and reduce interruptions to motorists.

The purpose of the *Improve 64* project is to reduce traffic congestion such that peak hour operating conditions of LOS D or better are provided within the area of need, where possible, and to address deteriorating infrastructure. This project will also allow INDOT to synchronize its asset management plans for aging infrastructure.

The purpose of this report is to document the engineering assessment phase of the project. It is intended to serve as a guide for subsequent survey, design, environmental, right of way, and other project activities leading to construction. This report also provides an analysis of evaluated alternatives and serves as the Alternatives Evaluation Report (AER) for the Interstate Access Document (IAD) required by the Federal Highway Administration (FHWA). The Recommended Alternative identified in this report is considered pre-decisional, pending the outcome of environmental studies.

Description of Alternatives

Previous project studies evaluated multiple alternatives. The Recommended Alternative from the previous studies was carried forward to this study as Alternative 1 in this study. This calls for retaining the existing alignments and adding travel lanes to achieve the desired levels of service. Alternative 2 was developed by the study team to reduce construction cost without sacrificing traffic operations or safety. The following major differences between Alternatives 1 and 2 are at the US 150 and I-265 interchanges:

- Alternative 2 avoids widening of the ramp from eastbound US 150 to eastbound I-64 by providing a longer merge area for this ramp.
- Alternative 2 moves the exit ramp from eastbound I-64 to eastbound I-265 to the right side to better meet driver expectation and improve conditions in the upstream weaving segment. Based on past studies, this modification is expected to reduce crashes by up to 49%. By moving this ramp to the right, congestion between SR 62/64 and US 150 is expected to be relieved thereby allowing construction of added travel lanes to the west to be deferred.

The Build Alternatives are summarized in **Table ES-1**.

Table ES-1 – Description of Alternatives

Segment	Alternative 1	Alternative 2
I-64 / US 150 Interchange	Add 1 lane to EB I-64 exit ramp Add 1 lane to WB I-64 exit ramp	Extend merge area of US 150-EB I-64 ramp Add 1 lane to WB I-64 exit ramp
I-64 from US 150 to I-265	Add 1 lane to EB and WB I-64	Add 1 lane to EB and WB I-64
I-64 / I-265 Interchange	Maintain EB I-64 left-side exit to I-265 Add 1 lane to all ramps Add 1 lane to EB and WB I-64 through the interchange	Reconfigure EB I-64 to EB I-265 ramp to a right-side exit Add 1 lane to all ramps Shift the alignment of EB I-64 to allow for new right-side exit ramp Maintain 2 lanes on EB I-64 and 3 lanes on WB I-64 through the interchange
I-64 from I-265 to Spring St	Add 1 lane to EB I-64	Add 1 lane EB to Cherry St No added capacity on WB I-64
I-64 / Spring St Interchange	Drop 1 lane on EB I-64 Add 1 lane on WB I-64 from entrance ramp	No added capacity
I-265 from I-64 to State St	Add 2 lanes to EB I-265 Add 1 lane to WB I-265	Add 2 lane to EB I-265 Add 1 lane to WB I-265
I-265 / State St Interchange	No added capacity	No added capacity
I-265 from State St to Grant Line Rd	Add 1 lane to EB I-265 ending south of Green Valley Rd overpass	Add 1 lane to EB I-265 ending south of Green Valley Rd overpass

Comparison of Alternatives

The Build Alternatives were compared based on geometrics, traffic operations, safety, structures, constructability, and construction cost. The following sections describe the findings of this comparison.

Geometrics

Alternative 2 requires five fewer design exceptions than Alternative 1. It also satisfies criteria for a higher design speed (70-mph) along I-64 than Alternative 1 (55-mph). By minimizing the number of design exceptions and improving the design speed, Alternative 2 is recommended from a geometric standpoint.

Traffic Operations

Alternatives 1 and 2 are expected to produce acceptable operating conditions of LOS D or better along I-64 and I-265 through the peak hours of the design year; therefore, both alternatives are viable from a traffic operations perspective. Alternative 2 allows for fewer lanes on the ramp from eastbound US 150 to eastbound I-64, along eastbound I-64 through the I-265 interchange and along eastbound I-64 between I-265 and Spring Street. While the analysis results indicate there is no operational advantage to fewer lanes in these areas, fewer lanes are preferred as they result in lower life cycle costs.

Safety

The historical crash analysis identified several segments of I-64 that have a high crash frequency or high number of severe crashes. Crash types in these areas are largely associated with congestion and therefore are expected to be significantly reduced by either of the Build Alternatives.

The predictive safety analysis performed using IHSDM identified only marginal differences between Alternatives 1 and 2. For this reason, both alternatives are considered viable from a safety perspective.

The IHSDM predictive method focuses on the safety implications of geometric design. It does not appear to adequately consider the safety implications of reduced queueing and congestion within the project limits. Of the 656 freeway mainline crashes that occurred in the analysis limits during the 2017-2019 time period, approximately half (323) occurred within the peak commuting hours of 7-10 am and 4-7 pm when congestion levels peak. The capacity analysis indicated that congestion, defined as 15-minute average speeds less than 45-mph, will be reduced by 70% by Alternative 2. This is expected to significantly improve safety by reducing congestion-related crashes.

While the predictive safety analysis showed no significant difference in safety between the existing left-side exit and the proposed right-side exit from eastbound I-64 to eastbound I-265, studies have shown that crash rate reductions of up to 49% can be achieved by reconfiguring a left-side exit ramp to a right-side exit ramp.[1] Additional benefits associated with the right-side exit ramp include the fact that driver

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[1] Zhou, H., Chen, H., Zhao, J., and Hsu, P., "Operational and Safety Performance of Left-Side Off-Ramps at Freeway Diverge Areas." Presented at the 89th Annual Meeting of the Transportation Research Board, Washington, D.C., (2010)

expectations are better met with right-side exits. Weaving from the US 150 entrance ramp and the left side exit to I-265 will also be eliminated. These reasons result in the Alternative 2 right-side exit being a positive differentiator from Alternative 1.

Structures

Alternative 2 requires more extensive bridge work than Alternative 1, as well as the addition of a new bridge along the proposed right-side exit ramp from eastbound I-64 to eastbound I-265. Despite this, Alternative 2 is recommended as the new or replaced bridges of Alternative 2 will have a longer life span than the rehabilitated bridges of Alternative 1. This is expected to result in fewer repairs and lower user costs from work zones delays over the design life of the project.

Constructability

The design team and INDOT have defined traffic mobility, work zone safety, constructability, schedule, and cost goals to be achieved during construction of this project. Alternative 1 essentially maintains existing alignments which requires extensive and costly temporary pavement widening, retaining walls and possibly temporary bridges to maintain traffic mobility during construction. The horizontal and vertical alignments for Alternative 2 were refined from those of Alternative 1 to allow pavement, bridges, and walls to be more constructable, reduce and/or eliminate the need for temporary widening, and allow all ramp movements and mainline lanes to remain open while reducing overall MOT costs. To maintain traffic throughout construction, some bridges must be overbuilt. Maintenance of traffic costs and adverse traffic mobility impacts for Alternative 2 are expected to be substantially lower than that of Alternative 1.

Estimated Costs

The Preliminary Scoping Report (PSR) estimated the cost of Alternative 1 at $137.5M in 2020 dollars, or $142.5M when escalated to 2021 dollars. Updates to unit prices, particularly those for rock excavation and retaining wall construction, have increased this estimate by $17.6M.

The 10% contingency used in the Preliminary Scoping Report has been updated to 25% for the Engineer's Report, resulting in a cost increase of $23.5M. Collectively, these changes have resulted in updated Alternative 1 and 2 cost estimates to be $184.0M and $162.2M, respectively, as shown in **Table ES-2**.

Table ES-2 Construction Cost Estimates – Year 2021 Dollars

	Alternative 1	Alternative 2
Engineer's Report	$ 184,006,000	$ 162,191,000

The project is programmed to let in March 2024. These estimates were escalated to 2024 dollars at 3% and 4% inflation, as shown in **Table ES-4**.

Table ES-4 Construction Cost Estimates – Escalation to 2024 $'s

	Alternative 1	Alternative 2
2024 $'s with 3% Inflation	$ 201,069,000	$ 177,230,000
2024 $'s with 4% Inflation	$ 203,021,000	$ 178,951,000

Alternative 2 represents a $24.1M cost savings over that of Alternative 1 and is therefore recommended from a cost perspective.

Recommended Alternative

The purpose of the *Improve 64* project is to provide peak hour operating conditions of LOS D or better within the area of need, where possible, and to address deteriorating infrastructure. This project will also allow INDOT to synchronize its asset management plans for aging infrastructure.

Since the purpose of the project is satisfied by both alternatives, the recommendation is based on various project goals for geometrics, constructability, and construction cost. Alternative 2, depicted in **Figure ES-1**, is the Recommended Alternative as it achieves more of these goals than Alternative 1. In summary, Alternative 2:

- Achieves acceptable traffic operations through the design year
- Is expected to improve safety by reducing congestion related crashes
- Provides for a higher design speed and fewer design exceptions
- Achieves maintenance of traffic goals
- Is the least expensive Build Alternative by $24.1M (12%) in 2024 dollars

Figure ES-1 – Recommended Alternative

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1 INTRODUCTION

1.1 Purpose of Report

The purpose of this report is to document the engineering assessment phase of the project and is intended to serve as a guide for subsequent survey, design, environmental, right of way, and other project activities leading to construction.

This report also provides an analysis of evaluated alternatives and serves as the Alternatives Evaluation Report (AER) for the Interstate Access Document (IAD) required by FHWA. The recommended alternative identified in this report is considered pre-decisional, pending the outcome of environmental studies.

1.2 Project Location

The project is in Floyd County near New Albany, Indiana and lies within the INDOT Seymour District. The Kentuckiana Regional Planning & Development Agency (KIPDA) is the region's metropolitan planning organization. As noted in **Figure 1-1**, the project limits include I-64 from the US 150 interchange (RP 117+94) to Main Street (RP 123+71) , US 150 from Old Vincennes Rd (RP 171+59) to I-64 (RP 172+06), and I-265 between I-64 (RP 0+00) and the Green Valley overpass (RP 1+82), including the I-64/I-265 system interchange. The geographic extents of potential project impacts, known as the "area of influence," were identified in coordination with INDOT and FHWA. The area of influence is also depicted in **Figure 1-1** and is discussed later in this document.

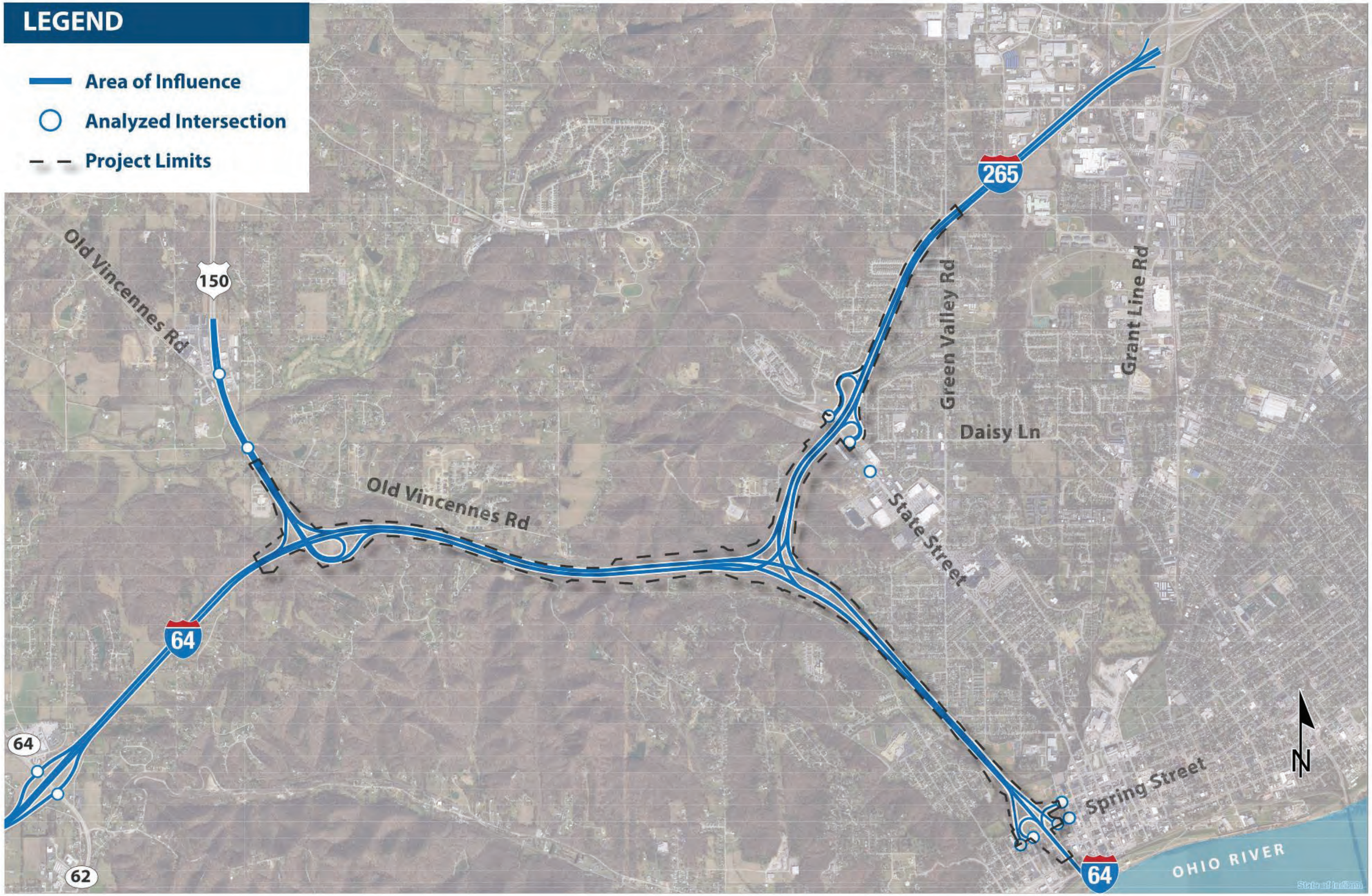
1.3 Project History/Alternative Screening

In January 2019, INDOT issued a *Project Intent Report* which proposed work on I-64 from SR 62/64 to Spring Street and on I-265 from I-64 to State Street. This included the current and anticipated traffic operations as well as the need for comprehensive improvements. Due to budgetary constraints, INDOT issued an Addendum to the *Project Intent Report* in June 2019 which covered the same project limits but reduced the improvements to fit within the projected financial constraints.

Beam Longest & Neff (BLN) was tasked with preparing a *Preliminary Engineering Scoping Report* that examined both reports to find a solution that met the goals of the *Project Intent Report* while reducing the construction cost. The *Final Preliminary Engineering Scoping Report*, issued in October 2020, provided recommendations that improved the operation of the affected interstates but still exceeded the financial constraints.

In November 2020, INDOT selected HNTB to refine the recommendation for adding capacity to the I-64 corridor and the I-64/I-265 system interchange, which became commonly referred to as the *Improve 64* project. These efforts are documented in this report. Excerpts from the *Project Intent Report* and *Final Preliminary Engineering Scoping Report* are provided in **Appendix A** .

Figure 1-1 Project Location



1.4 Project Purpose and Need

The *Improve 64* project is needed due to insufficient freeway capacity resulting in congestion and the deteriorated condition of the pavement.

Insufficient capacity in the vicinity of the I-64 & I-265 system interchange causes recurring freeway congestion along I-64 between SR 62 / SR 64 and the Indiana / Kentucky state line and along I-265 between I-64 and Grant Line Road. This results in peak period travel speeds below 20-mph, intermittent queueing, and a high frequency of rear end and sideswipe crashes.

Highway capacity levels of service (LOS) within the project corridor do not meet INDOT standards in current conditions or the design year. Recurring congestion occurs on eastbound I-64 during typical weekday morning peak periods, beginning near the I-64 & SR 62 / SR 64 interchange, due to the high-volume US 150 entrance ramp upstream. On westbound I-64, congestion occurs during typical weekday afternoon peak periods. Westbound I-265 experiences congestion during both the typical weekday morning and afternoon peak periods. Congestion problems are expected to become more acute along all three corridors as demand increases in the future. More detail regarding congestion in the existing and design year is provided in **Sections 2.10** and **5.9**, respectively.

Freeway pavement throughout the project area is due for rehabilitation in the near future. I-64 was initially constructed with concrete pavement in the 1960's and overlaid with asphalt in 1991. I-265 was built in 1970 with concrete pavement. Additional detail on existing pavement is provided in **Section 2.3**. Over the next decade, pavement on I-64, I-265, and US 150 will require investment to maintain. Synchronizing these rehabilitation efforts rather than addressing each segment individually will simplify asset management and reduce interruption to motorists.

The purpose of *Improve 64* is to reduce traffic congestion such that peak hour operating conditions of LOS D or better are achieved within the area of need, where possible, and to address the deteriorating infrastructure. This project will also allow INDOT to synchronize its asset management plans for aging infrastructure.

2 EXISTING CONDITIONS

The following sections describe the existing land use, roadway, pavement, hydraulics, structures, utilities, geology, environmental resources, crash history, and traffic operations within the project area.

2.1 Land Use

Although I-64 falls within the Louisville, Clarksville, and New Albany urban area boundaries, land use immediately adjacent to I-64 is largely woods or forest. The City of New Albany connects to the freeway at the I-64 & Spring Street interchange and the I-265 & State Street interchange. US 150 and SR 62/SR 64 corridors connect to communities like Duncan, Georgetown, Lanesville, and Floyds Knobs that have residential developments. These "bedroom communities" to the Louisville Metropolitan Area make I-64 function as a commuter corridor.

2.2 Existing Roadways

I-64 and I-265 are classified as urban interstates and are part of the National Highway System and National Truck Network. US 150 is an urban minor arterial and is part of the National Truck Network. The existing roadways are described in **Table 2–1**.

Between SR 62/64 and one-half mile east of US 150, the eastbound and westbound lanes of I-64 have matching profile grades and are separated by a grass median varying in width between 38- and 50-feet. Cable barrier is provided along the eastbound median shoulder. The profile grade varies from 0.00% to 3.00% and the horizontal alignment is tangent except for a 1^{o} curve at US 150.

From one-half mile east of US 150 to approximately 1.7 miles east of US 150, the eastbound and westbound lanes of I-64 separate both horizontally and vertically due to rolling terrain. The median width increases to 80-feet before decreasing to 62-feet at I-265. The profile grade of the eastbound lanes is 4.00% and is as much as 30-feet higher than the +3.00% profile grade of the westbound lanes. Rock faces as high as 140-feet are present along the outside shoulders of the roadway and as high as 40-feet within the median. There is a 1^{o} horizontal curve within this segment.

Immediately west of the I-265 interchange, the eastbound and westbound lanes further separate horizontally and are on independent alignments (both with 1^{o} curves) through the interchange. I-64 curves from an easterly direction to a southeasterly direction. The maximum distance between inside edges of eastbound and westbound travel lanes is approximately 300-feet. The independent vertical alignments (-4.00% EB and +3.00% WB) continue with the westbound lanes becoming as much as 40-feet higher than the eastbound lanes. The third eastbound lane is developed within the interchange by lane addition of the ramp from westbound I-265.

Approximately 0.4 miles north of Cherry Street, the adjacent land use becomes urban. Here the vertical and horizontal alignments merge to create a 14-foot wide paved median. The median in this segment includes a 2-foot wide concrete barrier. The horizontal alignment is basically tangent with only a 0^{o} 15' curve. The profile grades are relatively flat (0.00% to 0.50%). This extends to the project terminus at Main Street.

Table 2–1 Existing Roadways

	I-64 From SR 62/64 to I-265	I-64 From I-265 to Spring St.	I-265 from I-64 to Green Valley Rd	US 150 From 500 ft. South of Old Vincennes Road to I-64
Functional Classification	Urban Interstate	Urban Interstate	Urban Interstate	Urban Minor Arterial
Number of Through Lanes	5 Lanes 3 Westbound/ 2 Eastbound	6 Lanes 3 Westbound/ 3 Eastbound	4 Lanes 2 Westbound/ 2 Eastbound	Varies from 1 in each direction at bridge over I-64 to 2 in each direction north of I-64
Median Width	Varies 38 ft. to 80 ft.	Varies from 14 ft. in New Albany City Limits to > 300 ft. with independent EB and WB alignments at I-265.	60 ft. (30 ft. each side)	50 ft. (25 ft. each side)
Lane Width	12 ft.	12 ft.	12 ft.	12 ft.
Shoulder Width	Inside: Varies 4 ft. to 7 ft. Outside: Varies 10 ft. to 12 ft.	Inside: Varies 4 ft. to 7 ft. Outside: Varies 10 ft. to 12 ft	Inside: 4 ft., Outside 10 ft.	Inside: 4 ft., Outside 10 ft.
Drainage	Curbed shoulders with inlets and/or median and side ditches.	Curbed shoulders and median barrier with inlets and/or side ditches	Median and side ditches	Median and side ditches
Posted Speed Limit (mph)	55-mph	55-mph	65-mph EB 55-mph WB	55-mph

The majority of I-265 within the project limits is on a curved (2^o) horizontal alignment with a 60-foot wide grass median. Near and within the I-64 & I-265 interchange, the eastbound and westbound lanes have independent alignments and profile grades of +3.00% and +0.75%, respectively. The horizontal alignments and the profile grades of -3.00% are the same for both roadways east of the interchange. Cable barrier is provided along the eastbound median shoulder within the 60-foot wide median segment. Significant cut heights are present along the outside shoulders.

US 150 is on a tangent alignment with the project limits. Eastbound US 150 consists of two through travel lanes that taper to a one lane ramp at the bridge over I-64. Westbound US 150 consists of two lanes created by single lane ramps from eastbound and westbound I-64. A left turn lane to Wesley Chapel Lane is located approximately 1,800 feet north of I-64. The eastbound and westbound lanes have matching +3.00% and-3.00% profile grades, respectively.

All ramps at the I-265 and US 150 interchanges provide 18-foot wide travel lanes with 4-foot inside shoulders and 10-foot outside shoulders. All of the ramps include 9^{o} curves (954.93' radius), which is the minimum radius for 55-mph design. The westbound I-265 ramp to eastbound I-64 passes over the eastbound I-64 to eastbound I-265 ramp and under westbound I-64.

2.3 Pavement

I-64 was initially constructed in the 1960's with 10-inch joint reinforced concrete pavement (JRCP). In 1991, the pavement was cracked and seated and then overlaid with 5.5 inches of hot mix asphalt (HMA) over 10 inches of JRCP by Contracts R-7258 and R-19348. The paved shoulders along I-64 are HMA-only with depths ranging from 4-inches to 6-inches.

The original I-265 pavement was built in 1970 under Contract R-8872. As-built contract R-10033 details an 11-inch concrete pavement with 4 inches of bituminous stabilized subbase on top of a special subgrade treatment. Shoulders along I-265 are composite, with an average of 5 inches of HMA on top of 10 inches of concrete.

US 150 was built in 1967 as 9-inch concrete pavement with HMA at an average depth of 5 inches. The original pavement was crack and seated in 1995 before being overlaid with 7 inches of HMA.

Preliminary core analysis of the corridor was completed by Terracon and K&S Engineers, Inc. in April 2021 to determine where pavement replacement is needed. Refer to **Appendix S** for the results of the pavement investigation and **Section 6.9** for the preliminary pavement design.

2.4 Hydraulics

2.4.1 *Roadside Drainage*

The segment of I-64 between SR 62/64 and approximately 0.5 miles east of US 150 is bordered by roadside ditches with cross culverts at various locations. Ditches are also present in the median and discharge to the roadside ditches via median inlets. Roadside ditches flow to various outfall locations where stormwater runoff leaves the INDOT right-of-way.

East of this segment, most median and outside shoulders are bordered by four-inch bituminous curbs or concrete median barrier and the roadway is drained by inlets located along the shoulder or median. I-265 and US 150 are bordered by roadside and median ditches. All interchange ramps are bordered by roadside ditches.

2.4.2 *Culverts*

Most of the culverts within the project limits were identified using the Indiana Bridge Inspection Application System (BIAS) or the INDOT Bridge and Drainage Assets viewer. Survey data for this project included several culverts that are not included in either of these sources. In all, 29 culverts were identified within the project limits, 17 with diameters of 36 inches or greater and 12 with diameters less than 36 inches. Ratings for those culverts with diameters greater than 36 inches are listed in **Table 2–2** as these culverts will be considered for replacement or rehabilitation if the remaining life is less than the anticipated life of the proposed road work. Culverts less than 36" will be replaced or rehabilitated in accordance with IDM guidance. A location map showing all culvert locations is provided in **Appendix B** along with condition ratings for all culverts.

Table 2–2 Ratings for Culverts 36" and Larger

	Rating Scale			
	3 - Poor	5 - Fair	7 – Good	N - Unknown
# of Culverts 36" or Larger	3	2	9	3

2.4.3 *Waterway Bridges*

There are two INDOT bridges over waterways within the project limits, as depicted in the Bridge Location Maps in **Appendix B**. Neither bridge is anticipated to be replaced as part of this project. The bridge over UNT Little Indian Creek Bridge, located on US 150 approximately 700 feet north of the I-64 and US 150 interchange, was not in BIAS and INDOT does not have a name or condition rating on record. The structure consists of twin corrugated metal pipe arch (CMPA) culverts, 143 inches in span and 92 inches in rise per survey data. Due to their combined pipe arch spans, this twin structure is classified as a bridge.

The Fall Run Bridge, Structure Number I64-123-04687, is located on I-64 approximately 1,250 feet northwest of Spring Street. This bridge is a 35-foot span concrete arch structure with a current INDOT Structure Evaluation Rating of 7. The INDOT Bridge Inspection Report is located in **Appendix B.**

2.4.4 *Stormwater Outfalls*

There are 23 known watershed outfalls where flow from the project area leaves INDOT right-of-way and ultimately flows into one of seven creeks. Each outfall can be seen in the Outfall Locations Map in **Appendix B**. There are no reported drainage problems with the outfalls.

2.4.5 *Drainage*

The only known drainage problem within the project limits is located along eastbound I-64 between the Spring Street interchange and the Sherman Minton bridge. INDOT District maintenance personnel have verified drainage issues at this location. Water pooling or "ponding" on the roadway surface in this area is believed to be a contributing factor in rear-end and sideswipe crashes that are common in this area. There are no other known drainage problems within the project limits.

2.5 *Structures*

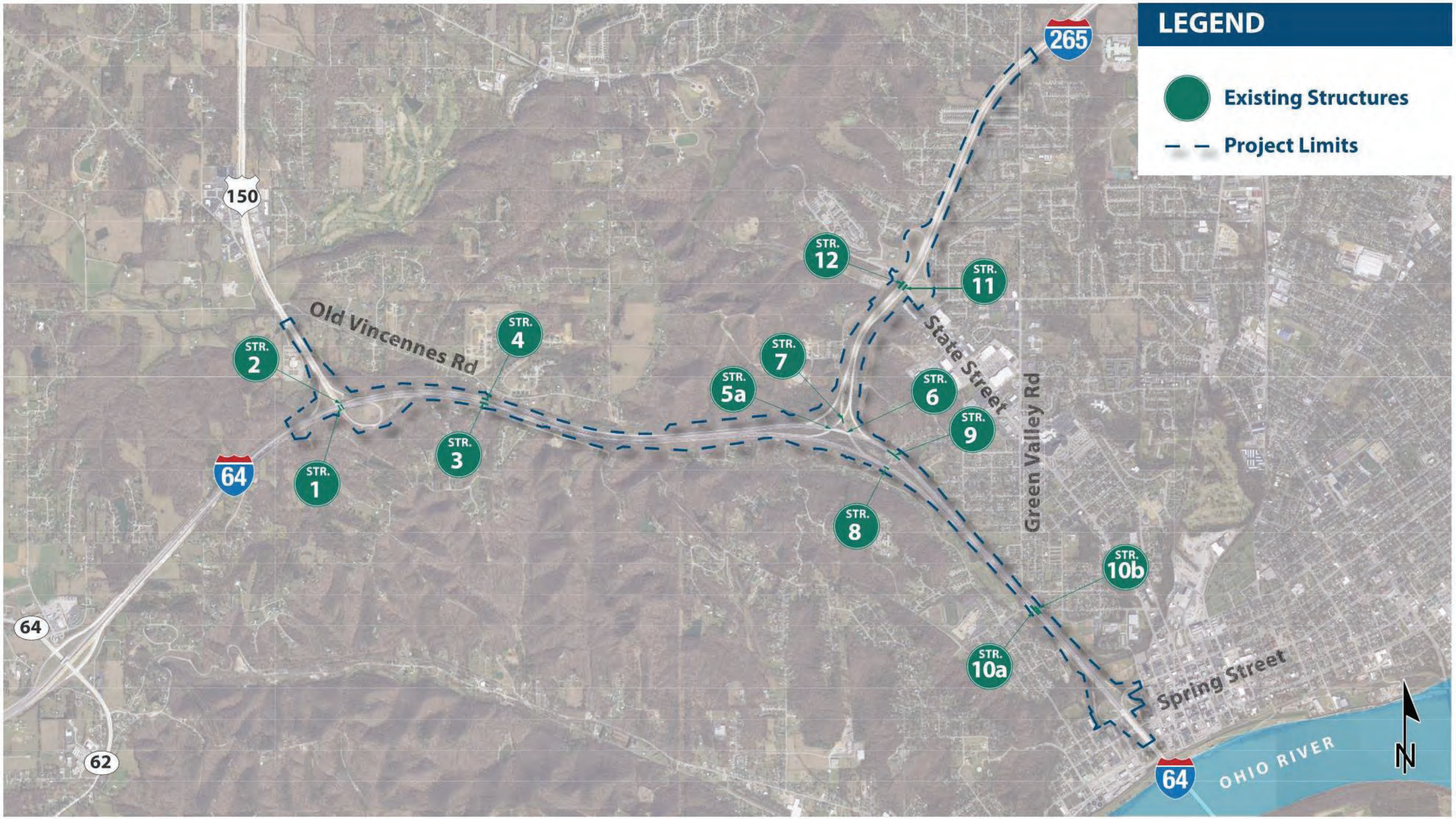
There are 12 bridge structures located within the project limits. A summary is shown in **Figure 2-1** followed by description of existing conditions.

2.5.1 *Structure No. 1 – EB US 150 over I-64 (Bridge Structure 150-22-04983 AEBL – NBI 27640):*

The existing structure is a four-span (49'-4", 69'-0", 69'-0", and 49'-4") continuous steel beam bridge constructed in 1966. The out-to-out coping width of the bridge is 27'-6" with a clear roadway width of 24'-0". The bridge carries one 12'-0" lane of eastbound traffic with 6'-0" shoulders. The current striping provides an approximate lane width of 18'-0" with 3'-0" shoulders. In 1981, the bridge was rehabilitated by repairing the concrete deck and placing an overlay. The rehabilitation also included replacement of the joint at the south abutment and repair of the joint at the north abutment. The 2021 Bridge Inspection Report lists the following:

- Deck:
  - Fair condition with efflorescence and areas of delamination.
  - Spalling was noted in Span B, and minor shrinkage cracks were observed in both copings.
  - The joint at each abutment was noted to be leaking.
- Superstructure:
  - Satisfactory condition with moderate failure of the paint with minor pitting in the failed paint areas.
  - Several diaphragms at the joints were noted with corrosion.
- Substructure
  - Good condition with minor cracking with efflorescence in both backwalls.

Figure 2-1 Existing Structure Locations



2.5.2 *Structure No. 2 – WB US 150 over I-64 (Bridge Structure 150-22-04983 AWBL – NBI 27650):*

The existing structure is a four-span (49'-4", 69'-0", 69'-0", and 49'-4") continuous steel beam bridge constructed in 1966. The out-to-out coping width of the bridge is 27'-6" with a clear roadway width of 24'-0". The bridge carries one 12'-0" lane of eastbound traffic with 6'-0" shoulders. The current striping provides an approximate lane width of 18'-0" with 3'-0" shoulders. In 1981, the bridge was rehabilitated by repairing the concrete deck and placing an overlay. Rehabilitation also included the replacement of the joint at the south abutment and repair of the joint at the north abutment. The 2021 Bridge Inspection Report lists the following:

- Deck:
  - Fair condition with transverse cracks ; efflorescence on the underside of the deck and areas of delamination and spalling in Spans B and C.
  - Minor shrinkage cracks were noted in both copings, and the joint at each abutment was showing signs of wear and leakage.
- Superstructure
  - Satisfactory condition with areas of paint failure; minor pitting in the failed paint areas.
- Substructure
  - Satisfactory condition with minor cracking with efflorescence in both backwalls and minor cracking in both slope walls.
  - Cracking and spalling with exposed reinforcement were noted in the west end of Pier 3, and one spall on the west end of Abutment 1 was also noted.

2.5.3 *Structure No. 3 – EB I-64 over Quarry Road (Bridge Structure I64-120-04984 JBEB – NBI 34390):*

The existing structure is a three-span (60'-6 1/2", 61'-1", and 60'-6 1/2") composite prestressed concrete I-beam beam bridge constructed in 1965. The out-to-out coping width of the bridge is 43'-1" with a clear roadway width of 40'-3". The bridge carries two 12'-0" lanes of traffic with a 6'-3" inside shoulder and a 10'-0" outside shoulder. In 1981, the bridge was rehabilitated by placing an overlay. In 1992, the bridge was rehabilitated with a link slab conversion, new bridge railings, partially reconstructed mudwalls, and new expansion joints at the end bents. Portions of the approach slabs were replaced in 2015. This bridge was not part of the 2018 bridge rehabilitation bundle contract B-38056 (I-64 EB over Quarry Road, I-64 EB over Captain Frank Road, and I-64 WB over Captain Frank Road) and was therefore not rehabilitated. The 2019 Bridge Inspection Report lists the following:

- Deck
  - Satisfactory condition with transverse cracks; efflorescence on the underside of the deck in Span B.
- Superstructure
  - Fair condition with several noted deficiencies.
  - Beam 6 in Span B has a spall with exposed strands at both ends near Bents 2 and 3.
  - The concrete diaphragm between Beams 3 and 4 at Bent 4 exhibit spalling with exposed reinforcing steel.
  - A 10" spall with one exposed strand was noted on Beam 3 at Bent 4.

- Substructure
    - Satisfactory condition with minor cracking; exposed reinforcing steel was noted on the underside of the cap at Bent 2 and at column 2 also at Bent 2.

2.5.4 *Structure No. 4 – WB I-64 over Quarry Rd. (Bridge Structure I64-121-04984 CWBL – NBI 34400):*

The existing structure is a three-span (49'-6 1/2", 50'-1", and 49'-6 1/2") composite prestressed concrete I-beam bridge constructed in 1965. The out-to-out coping width of the bridge is 59'-2" with a clear roadway width of 56'-2". The bridge carries three 12'-0" lanes of traffic with an outside shoulder (variable width, 11'-9" to 12'-6") and an inside shoulder (variable width, 7'-6" to 8'-3"). In 1981, the bridge was rehabilitated by placing an overlay and replacing the expansion joints. In 1992, the bridge was rehabilitated with a link slab conversion, bent cap and beam patching, new bridge railings, and new expansion joints at the end bents. The bridge was rehabilitated in 2018, and the deck was widened from an out-to-out coping of 54'-8" to 59'-2". The 2018 rehabilitation also included a second overlay, new FT bridge railings, fiber-reinforced polymer beam repairs, widened end bents, interior bent patching, new expansion joints, and new approach slabs including terminal joints and sleeper slabs. The 2019 Bridge Inspection Report lists the following:

- Deck
    - Satisfactory condition with map cracking; efflorescence on the underside of the deck in Span C.
- Superstructure
    - Satisfactory condition with no noted deficiencies.
- Substructure
    - Good condition with spalled concrete noted at the bent cap under Beam 1 at Bent 1.

2.5.5 *Structure No. 5A – I-64 WB over I-64 EB to I-265 EB Ramp (Structure I64-121-04985 RCB – NBI 34410):*

The existing structure is a three-span (57'-4", 69'-0" and 57'-4") continuous steel beam bridge constructed in 1965. The out-to-out coping width of the bridge is 54'-10" with a clear roadway width of 51'-10". The bridge carries three 12'-0" lanes of traffic with a 5'-8" median shoulder and 10'-2" exterior shoulder. The bridge was rehabilitated in 1992 with new truck height bridge railing on the outside coping and FC railing on the inside coping. The ends of the deck, bridge deck joints and tops of the mudwall were also replaced in 1992. A new concrete overlay was also installed at this time. Plans were not available for the rehabilitation that occurred between 1965 and 1992, but based on 1992 plans, a concrete overlay was placed. The 2019 Bridge Inspection Report lists the following:

- Deck
    - Satisfactory condition with some transverse cracks, especially at the north drip edge area.
    - There is some spalling in the top of the deck especially near the joints.
- Superstructure
    - Satisfactory Condition with rust on the bearings and plates.
- Substructure

- o Satisfactory Condition with minor cracking; efflorescence and spalling in the backwalls and cracking in the end bent caps.

2.5.6 *Structure No. 6 – I-64 WB over I-265 WB to I-64 EB Ramp (Structure I64-121-04985 RBB – NBI 34420):*

The existing structure is a three-span (47'-6", 57'-0" and 47'-6") continuous steel beam bridge constructed in 1965. The out-to-out coping width of the bridge is 54'-10" with a clear roadway width of 51'-10". The bridge carries three 12'-0" lanes of traffic with a 5'-8" median shoulder and 10'-2" exterior shoulder. The bridge was rehabilitated in 1992 with new truck height bridge railing on the outside coping and FC railing on the inside coping. The ends of the deck, bridge deck joints and tops of the mudwall were replaced in the 1992 rehabilitation. A new concrete overlay was also installed at this time. Plans were not available for the rehabilitation that occurred between 1965 and 1992, but based on 1992 plans, a concrete overlay was placed. The 2019 Bridge Inspection Report lists the following:

- Deck
  - o Satisfactory condition with some transverse cracks, especially at the north drip edge area.
  - o There are vertical cracks in the bridge railing and both joints are leaking.
- Superstructure
  - o Satisfactory Condition with rust on the bearings and plates.
- Substructure
  - o Satisfactory Condition with minor cracking; efflorescence in the backwalls.

2.5.7 *Structure No. 7 –I-265 WB to I-64 EB Ramp over I-64 EB to I-265 EB Ramp ((I64) I265-00-05228B – NBI 49510):*

The existing structure is a three-span (62'-0", 103'-0" and 31'-0") continuous steel beam bridge constructed in 1972. The bridge was widened in 1999. To widen the bridge, the deck was replaced, and the end bent widened. New wingwalls were constructed and the bridge was converted to semi-integral. Lastly, the existing hinges in the steel beams were retrofitted with top flange, bottom flange, and web splice plates. After the 1999 rehabilitation, the clear roadway width was increased from 25'-0" to 29'-2 ½", while the out-to-out coping width increased from 28'-0" to 32'-2". A polymeric bridge deck overlay was placed over the bridge in 2018. The bridge accommodates a 4'-7 ½" shoulder, 16' lane and 8'-7 ½" shoulder. New FC railing was installed as part of the 1999 rehabilitation. The 2019 Bridge Inspection Report lists the following:

- Deck
  - o Satisfactory condition with some areas of corrosion in the bottom of the stay-in-place deck forms.
- Superstructure
  - o Good Condition.
- Substructure
  - o Good Condition with a small spall and delamination in one column.

2.5.8 *Structure No. 8 – EB I-64 over Captain Frank Road (Bridge Structure I64-123-04986 JCEB – NBI 34430):*

The existing structure is a three-span (35'-0 1/2", 52'-1", and 35'-0 1/2") composite prestressed concrete I-beam bridge constructed in 1965. The out-to-out coping width of the bridge is 57'-2" with a clear roadway width of 54'-3". The bridge carries two 12'-0" lanes and one auxiliary lane (variable width, 12'-9" to 15'-0") of traffic with a 10'-0" outside shoulder and an inside shoulder (variable width, 5'-3" to 7'-6"). In 1981, the bridge was rehabilitated by repairing the concrete deck and placing an overlay. This also included replacing the approach slabs, and the interior bent and end bent joints. The bridge was rehabilitated in 1992 with a link slab conversion, bent cap and beam patching, new bridge railings, and new expansion joints at the end bents. In 2018, the bridge was rehabilitated and widened (Previous: variable width out-to-out coping 54'-11" to 57'-2". New: constant out-to-out coping of 57'-2"). The 2018 rehabilitation also included a second overlay, new FT bridge railing on the north coping, fiber-reinforced polymer beam repairs, interior bent patching, new expansion joints, and new approach slabs including terminal joints and sleeper slabs. The 2019 Bridge Inspection Report lists the following:

- Deck
  - Satisfactory condition with transverse cracks; efflorescence on the underside of the deck.
- Superstructure
  - Fair condition with small concrete spalls noted at the end of each beam at Bent 4; exposed prestressing strand on Beam 8 at Bent 1.
- Substructure
  - Good condition with minor cracking with efflorescence in both end bents.

2.5.9 *Structure No. 9 – WB I-64 over Captain Frank Road (Bridge Structure I64-123-04986 CWBL – NBI 34440):*

The existing structure is a three-span (72'-0 1/2", 72'-7", and 72'-0 1/2") composite prestressed concrete I-beam bridge constructed in 1965. The out-to-out coping width of the bridge varies, (65'-1" to 71'-4") with a variable clear roadway width, (62'-2" to 68'-5"). The bridge carries three 12'-0" lanes and one variable width auxiliary lane, 10'-5 3/4" to 16'-8 3/4") of traffic with a 10'-0" outside shoulder and a 5'-8 1/4" inside shoulder. The bridge was rehabilitated in 1981 by placing an overlay and replacing the expansion joints. In 1992, the bridge was rehabilitated and included widening (Previous: variable width out-to-out coping 60'-1" to 68'-10". New: 65'-1" to 71'-4"), widening substructure units, a link slab conversion, bent cap and beam patching, new bridge railings, replaced approach slabs, mudwall reconstruction and new expansion joints at the end bents. In 2018, the bridge was rehabilitated by placing a second overlay, fiber-reinforced polymer beam repairs, interior bent patching, new expansion joints, and replacing the approach slabs and terminal joints. The 2019 Bridge Inspection Report lists the following:

- Deck
  - Satisfactory condition with transverse cracks; efflorescence on the underside of the deck and a 3'x3' delamination in the bottom of the deck in Span C.
- Superstructure

- o Satisfactory condition with multiple beams exhibiting cracking and spalling at the beam ends at Bent 1 and Bent 4.
- Substructure
  - o Good condition with no noted deficiencies.

2.5.10 *Structure No. 10A (EB) & 10B (WB) – I-64 over Cherry Street I64-122-04988 C – NBI 34450):*

The existing structures are three-span (52'-11", 86'-11½" and 52'-11") prestressed concrete I-Beam bridge constructed in 1965. The eastbound and westbound bridges are separate structures except the footing at the interior bents, which are continuous between the structures. The out-to-out coping width of the eastbound and westbound bridges are 54'-8½" and 57'-5½" with a clear roadway widths of 52'-1½" and 54'-10½", respectively. The westbound bridge carries three 12'-0" lanes of traffic with a 5'-10½" median shoulder and 10'-3" exterior shoulder. The eastbound bridge carries three 12'-0" lanes of traffic with a 5'-10½" median shoulder and 13'-0" exterior shoulder. Both bridges were rehabilitated in 1981 with a new bridge deck overlay. Both bridges were again rehabilitated in 1992 with curb removal, new joints were constructed, and new rails were installed. The eastbound bridge was rehabilitated in 2010 when the ends of the deck, bridge deck joints and tops of the mudwall were replaced, and concrete overlay was applied. The bridge deck was also widened by 14'-9". The 2019 Bridge Inspection Report lists the following:

- Deck
  - o Satisfactory condition with some transverse and diagonal cracks in the eastbound bridge.
  - o The westbound bridge has approximately 100 square feet of concrete patches, 1 square foot of bituminous patches and one spall in the right lane, span B.
- Superstructure
  - o Good Condition with several of the beam ends, on the bottom flange area at the abutments, having minor cracks with delamination and some minor spalling.
- Substructure
  - o Good Condition with the south bent cap at Beam No. 11 having cracking and one spall.
  - o All bent caps have cracking with delamination.

2.5.11 *Structure No. 11 – I-265 EB and Ramp over State Street (Bridge Structures I265-00-05513 JBEB & I265-00-05513 DRCA – NBI 49520 & 49535):*

The existing structure is a three-span (44'-0", 71'-6" & 44'-0") continuous steel beam bridge constructed in 1972. In 1981, the bridge was widened to construct the ramp portion of the bridge and the original portion was overlayed. The entire bridge was overlayed in 1998 and the bridge railing was replaced. The bridge was painted in 2016. Although two structure numbers are listed for this bridge, the two decks are connected, and the steel beams are connected through diaphragms. The end bents are also connected, but the piers are separate units. Due to the tapering ramp, the clear roadway width and out-to-out coping vary, but the bridge provides two 12'-0" eastbound lanes and a 16'-0" ramp lane. The median shoulder width, adjacent to the eastbound lanes, varies but provides a 6'-7" minimum shoulder. The exterior shoulder width, adjacent to the ramp lane, is 6'-6". There is a variable width gore between the ramp lanes and the eastbound lanes. The 2020 Bridge Inspection Report lists the following:

- Deck
  - Satisfactory condition to the eastbound portion and Satisfactory condition for the ramp portion with cracking with leaching and staining in the underside of the bridge deck.
  - There is also an isolated area of map cracking on the underside of Span B of the ramp portion of the bridge.
- Superstructure
  - Satisfactory condition for the eastbound portion and Good condition for the ramp portion with minor corrosion of the beams, diaphragms and bearing plates of the original beams.
  - The original beams also have welded coverplates.
- Substructure
  - Good condition with cracking of the end bents due to leaking joints above.
  - There was cracking noted in the slopewall during the site visit.

2.5.12 *Structure No. 12 – I-265 WB over State Street (Bridge Structures I265-00-05513 CWBL – NBI 49530):*

The existing structure is a three-span (31'-6", 69'-3" & 31'-6") continuous steel beam bridge constructed in 1972. The out-to-out coping width of the bridge is approximately 55'-3" with a clear roadway width of approximately 52'-3". The bridge carries two 12'-0" lanes of traffic with a 5'-9" minimum inside shoulder. In addition to the two through lanes, the bridge carries one 12'-0" ramp lane with a 10'-3" minimum exterior shoulder. The bridge was widened by one beam line to the west and the remainder of the deck was overlayed in 1981. The bridge was widened with another beam line in 1998, the deck was replaced, and the bridge was converted to semi-integral. New approach slabs were also constructed. In December 2014, the west exterior beam was impacted by a vehicle and heat straightened in 2015. The bridge was most recently painted in 2016. The 2020 Bridge Inspection Report lists the following:

- Deck
  - Good condition with random transverse cracks and leaching in the overhangs.
  - In the area of the 2014 vehicular impact, the coping is damaged with a deep spall.
- Superstructure
  - Satisfactory condition with minor damage to a steel diaphragm in Span C.
- Substructure
  - Good condition a minor spall in Pier 3 Column 4.
  - There was cracking noted in the slopewall during the site visit.

2.6 Utilities

Existing utilities within the project limits are identified by provider and type in **Appendix C**. The most critical utility within the project area is the overhead transmission lines owned by LG&E that cross over the I-64 & I-265 interchange. The low point of these lines lies over the I-64 corridor and influences how the ramps of the I-64 & I-265 interchange can be configured. This is discussed in detail in a later section of the report.

2.7 Geotechnical Conditions

2.7.1 Geologic Setting

The project site is located within the Cincinnati Arch. This is a stable area surrounded by basins that subsided due to the weight of accumulated sedimentary rocks. According to published information and historic subsurface data, the predominant rock at the site consists of gray argillaceous siltstone and silty shale of the Borden Group. These rocks contain frequent interbeds and discontinuous lenses of fine-grained sandstone, limestones, and clay shales. The Borden Group is comprised in ascending order of the New Providence Shale, Spickert Knob, and Edwardsville (containing the Floyds Knob Limestone Member) Formations.

Core data indicated the siltstone to be soft to hard, medium to fine grained, blue gray to brown to gray, low bedding planes angles and moderate to high angle joint fractures, with occasional layers of limestone and trace fossils. The shale was described as very weak to hard, gray to brown, calcareous, and at times silty.

Some geology descriptions in published literature noted that the shale shrank upon drying, which could indicate a low slake durability index. Published reports indicate that the shale is generally rippable with conventional excavation equipment while the siltstone is not.

The bedrock is relatively impermeable, and groundwater tends to flow through the soil on the top of rock. Properly designed excavations and shallow foundations can be constructed into shale and siltstone bedrock if seepage is managed. One reference noted that the limestone layers below the shale yielded salt water.

Published documents indicated that the bedrock is covered by a thin veneer of stony soil along with loess silt and clay. Due to the steepness of the slopes, the soil layer continuously creeps downhill, and landslides are common. Tree clearing, excavation, loading the slopes with new fill or heavy structures, and stormwater erosion can significantly increase the rate of creep and trigger landslides as the soil layer is mainly stabilized by tree roots. Due to the high silt content, site soils also have a high potential for frost heave.

2.7.2 Field Investigations

Borings were drilled by K & S Engineers and laboratory testing and final boring logs were completed by Terracon Consultants. An exploratory program was coordinated with the INDOT Geotechnical Division and then borings were taken to characterize the rock in the I-64 median, the composition of the deep embankments, and determine subsurface conditions at planned bridge locations. Pavement cores were also taken to investigate type, thickness, and condition.

Terracon engineers and geologists performed a site visit in April 2021 to perform limited rock structure mapping and collect observations on slope conditions. Observations and measurements were collected only at ground-level without the use of high-angle rope access. On the southeastern end of the east-bound travel lanes, an active landslide was observed on the slope.

Scree piles line the shoulders of the road at the base of the slopes. The scree consists of rock fragments splintered from the face due to exfoliation weathering. The natural angle of repose of the scree piles is approximately 40° to 44°.

Fallen boulders were observed in the ditches along the shoulders of the westbound travel lanes with widths between 10- and 20-inches and lengths of 4.5 to 10 feet. Along the shoulders of the eastbound travel lanes, fallen boulders varied in widths between 7- and 33-inches with lengths ranging from of 3.5 to 6.5 feet.

Evidence of past and current seepage was observed at isolated locations at the rock face along bedding joints.

2.8 Environmental Resources

A Draft Red Flag Investigation (RFI) was completed for the project and submitted to INDOT Site Assessment & Management (SAM) for review on June 11, 2021. Refer to **Appendix D** for a copy of the Draft RFI.

2.8.1 *Wetlands/Streams*

The US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapping identified one wetland adjacent to the project area.

The Draft RFI identified 12 river and stream segments within the project area including: Little Indian Creek, Hill Brook, Valley View Creek, Falling Run, Trinity Run, Holy Run, Knob Brook, and several unnamed tributaries.

A Waters of the US Report will be prepared, and any wetlands and streams identified during field reviews will be documented. The Waters of the US Report will be submitted to the INDOT Ecology and Waterway Permitting Office (EWPO) for review and approval. If any wetlands are located within the project area, additional coordination with the US Army Corps of Engineers, Louisville District (USACE) and the Indiana Department of Environmental Management (IDEM) will be required to determine permitting requirements. USACE Section 404 and IDEM Section 401 permits will likely be required for the project. Any identified wetlands and jurisdictional waterways will also be labeled on the final design plans.

2.8.2 *Floodplains*

The Draft RFI identified 14 floodplain polygons within the project area. The floodplains are associated with Little Indian Creek, Valley View Creek, and Falling Run. Construction in a Floodway Permits from the Indiana Department of Natural Resources (IDNR) will likely be required for work within the floodways of streams with a drainage area of more than one square mile, unless they qualify for an exemption. Coordination with INDOT EWPO will be completed.

2.8.3 *Geological Resources*

The Draft RFI determined the project is within a mapped sinking-stream basin. Coordination occurred with the INDOT EWPO and a karst survey was completed for the project. Refer to **Appendix E** for the Draft Karst Survey Report that was submitted to INDOT EWPO for review on June 21, 2021. No karst features were identified within the project area during the survey. Eight non-karst springs were identified within or near the project area. If impacted by the project, flow from these springs will be perpetuated with a spring-box or other appropriate engineered structure.

2.8.4 *Historic Resources*

Section 106 consultation was initiated for the project on May 27, 2021 with an early coordination letter sent to potential consulting parties and the State Historic Preservation Officer (SHPO).

A Draft Historic Property Report (HPR) was completed for the project. No properties listed in the National Register of Historic Places (NRHP) are within the project Area of Potential Effects (APE). The Draft HPR recommended two properties as being eligible for inclusion in the NRHP: the Reyse (Roy[s]ce)-Friend House (Indiana Historic Sites and Structures Inventory [IHSSI] No. 043-046-34204) located at 229 W. Spring Street, New Albany 47150, and the James Carr House (IHSSI No. 043-046-34202) located at 217 W. Spring Street, New Albany 47150. Both properties are located south of Spring Street in New Albany. The Draft HPR has been reviewed but not yet approved by the INDOT Cultural Resources Office (CRO), consulting parties, or the SHPO. Additional historic properties may be identified and effects to them will be determined through the Section 106 consultation process.

An assessment of the project area by a Professional Archaeologist will be completed to determine if an archaeological survey will be required. Further coordination with INDOT CRO will occur regarding archaeology.

2.8.5 *Section 4(f) and Section 6(f)*

Section 4(f) of the of the US Department of Transportation Act of 1966 prohibits the use of public parks, recreational facilities, wildlife refuges, or historic sites for federally funded transportation facilities unless there is no feasible and prudent alternative to such use.

The Draft RFI identified two publicly owned recreation areas near the project area, Anderson Park, and the Cherry Valley Golf Course. Billy Herman Park is also located adjacent to the project area, although not identified in the Draft RFI. Anderson Park and Billy Herman Park are located northeast of I-64 near the Spring Street interchange. The Cherry Valley Golf Course is located southwest of I-64 and north of Spring Street near Valley View Creek. These publicly owned recreational resources are protected under Section 4(f).

The Draft HPR recommended two properties as being eligible for inclusion in the NRHP: the Reyse (Roy[s]ce)-Friend House (IHSSI No. 043-046-34204) located at 229 W. Spring Street, New Albany 47150, and the James Carr House (IHSSI No. 043-046-34202) located at 217 W. Spring Street, New Albany 47150. If determined eligible for the NRHP, these historic resources are protected under Section 4(f).

No other publicly owned parks, recreational areas, wildlife refuges, or historic sites afforded protection under Section 4(f) have been identified within the project limits. Impacts to Section 4(f) resources are not anticipated.

The National Park Service (NPS) Land and Water Conservation Fund (LWCF) was created through the Land and Water Conservation Fund Act of 1965. Section 6(f) of the Act prohibits the conversion of LWCF lands unless the NPS approves the conversion of property with reasonable equivalent usefulness and location and of at least equal fair market value. A review of the *Land and Water Conservation Fund (LWCF) County Property List for Indiana (Last Updated July 2020)* on July 16, 2021 did not identify any potential Section 6(f) sites within the project area. Impacts to Section 6(f) resources are not anticipated.

2.8.6 *Noise*

As proposed, the construction of additional travel lanes on I-64 would be considered a Type I project. In accordance with 23 CFR 772 and the (2017) INDOT Traffic Noise Analysis Procedure, this action will require a formal noise analysis as part of the NEPA process. The noise analysis will follow guidelines by the 2017 INDOT Traffic Noise Analysis Procedure and FHWA regulations.

2.8.7 *Hazardous Materials*

A Draft RFI was completed for the project and submitted to INDOT Site Assessment & Management (SAM) for review on June 11, 2021. Several potential hazardous materials sites are located within a 0.5-mile radius of the project area; however, the Draft RFI did not recommend any soil or groundwater sampling. The Draft RFI recommends coordination with three National Pollution Discharge Elimination System (NPDES) facility permit holders, which will be completed as part of the project. There were no other recommendations regarding hazardous materials. INDOT SAM may make additional recommendations during their review of the Draft RFI.

2.8.8 *Air Quality*

This project does not qualify as being exempt from conformity. Therefore, the project must be accurately reflected in the Kentuckiana Regional Planning and Development Agency's (KIPDA) Metropolitan Transportation Plan (MTP) and Transportation Improvement Program (TIP). Floyd County is classified as being in Non-Attainment for the National Ambient Air Quality Standards (NAAQS) of 8-hour Ozone. Further investigation and coordination with INDOT Environmental Services Division (ESD) will be completed to determine if a Mobile Air Source Toxics (MSAT) Analysis will be required.

2.8.9 *Endangered, Threatened and Rare Species*

The Floyd County listing of the Indiana Natural Heritage Data Center information on endangered, threatened, or rare (ETR) species and high-quality natural communities was reviewed. The county listing has numerous plant and animal species categorized as rare, endangered, and/or threatened.

A review of the U.S. Fish and Wildlife Service (USFWS) database did not indicate the presence of endangered bat species in or within 0.5 miles of the project area. Since the project area falls within the range of the Indiana bat and the Northern Long Eared bat, the Range-wide Programmatic Informal Consultation (RPIC) for these species will be completed using the "USFWS's Information for Planning and Consultation (IPaC) System."

Coordination with USFWS and Indiana Department of Natural Resources (IDNR) will occur during project development.

2.9 Historical Safety Analysis

Crash records for years 2017, 2018, and 2019 were analyzed within the project area of influence. Crashes are summarized by location, manner of crash, crash severity, and light conditions in **Appendix F**. Of the 656 crashes that occurred on the freeway mainline during the 3-year period, 301 (46%) were rear end crashes that are typically related to congested conditions.

The INDOT RoadHAT 4D software was used to calculate the index of crash cost (I_{cc}) and the index of crash frequency (I_{cf}) for each location based on the number and severity of crashes occurring during the 3-year period, traffic volumes, and facility characteristics. An I_{cf} or I_{cc} value greater than zero indicates that the crash rate at a specific location is higher than expected given the type of facility and traffic volumes. A positive I_{cf} or I_{cc} value corresponds to the standard deviation. For example, an I_{cf} or I_{cc} value of 1 indicates that crashes are 1 standard deviation higher than expected. Results of the RoadHAT analysis are summarized below and in **Table 2–3** and **Table 2–4**. Values exceeding the thresholds stated above are highlighted in these tables. Software output is included in **Appendix F**.

The eastbound I-64 freeway segment between SR 62 and US 150 has an I_{cf} value of 2.26 and an I_{cc} value of 1.29, and the adjacent segment between US 150 and I-265 has an I_{cf} value of 1.37. There is a clear pattern of rear-end crashes occurring in congested conditions during peak hours. During the AM peak, congestion and queueing are frequently observed on eastbound I-64 upstream of the I-265 interchange. Congestion and queuing extend west of US 150 towards SR 62. Review of crash narratives for the segment of eastbound I-64 between SR 62 and I-265 indicated that over half of the crashes (85 of 151) specifically identified queueing or congested conditions as contributing factors to the crash.

The I_{cf} value is greater than 1.0 on westbound I-64 between I-265 and US 150, indicating a possible high crash frequency. The I_{cc} is 1.82 at the I-64/Spring Street interchange approaching the Sherman Minton bridge. There are multiple crashes associated with standing water or wet roadway conditions at this location. INDOT District maintenance personnel have verified drainage issues at this location, and this project will apply a high friction surface treatment to address the issue.

The ramp terminal intersections at I-265/ State Street have I_{cf} values greater than 3.0 and I_{cc} values greater than 1.0, which indicate high crash frequencies and possible high crash severity. At the eastbound I-265 ramp terminal intersection with State Street, 16 of 28 crashes were rear end crashes. Most crashes, regardless of crash type, were caused by southbound vehicles on State Street. No time of day, lighting, weather, or seasonal patterns were observed, and crash narratives did not indicate any contributing design factors. Replacement of the southbound 5-section left turn indication with a flashing yellow indication is recommended to improve conspicuity of the left turn signals. Installation of backplates on all signal indications is recommended.

Table 2–3 Freeway Mainline Crash Frequency and Severity by Location

Location	Total	Crash Frequency Index (Icf)	Crash Cost Index (Icc)
I-64 FREEWAY MAINLINE			
I-64 EB at SR 62	30	-0.62	-1.05
I-64 WB at SR 62	15	-0.98	-1.14
I-64 EB SR 62 to US 150	42	**2.26**	**1.29**
I-64 WB US 150 to SR 62	16	-0.01	-0.17
I-64 EB at US 150	27	0.16	0.20
I-64 WB at US 150	15	-1.04	-1.90
I-64 EB US 150 to I-265	82	**1.37**	**1.14**
I-64 WB I-265 to US 150	45	**1.35**	0.20
I-64 EB at I-265	37	-0.68	-0.23
I-64 WB at I-265	23	-0.95	-1.38
I-64 EB I-265 to Spring St	8	-0.91	-0.53
I-64 WB Spring St to I-265	10	-0.79	-1.50
I-64 EB at Spring St	74	0.39	**1.82**
I-64 WB at Spring St	35	-0.50	0.08
I-64 EB Spring St to State Line	11	-0.37	0.91
I-64 WB State Line to Spring St	1	-1.39	0.12
I-265 FREEWAY MAINLINE			
I-265 EB at I-64	0	-1.42	-1.76
I-265 WB at I-64	11	-1.03	-1.77
I-265 EB at State St	24	-0.80	0.00
I-265 WB at State St	51	0.00	**1.00**
I-265 EB State St to Grant Line Rd	23	-0.08	0.01
I-265 WB Grant Line Rd to State St	27	0.32	-1.50
I-265 EB at Grant Line Rd	20	-0.96	-0.06
I-265 WB at Grant Line Rd	29	-0.73	-1.71

Note: The highlighted values indicate that crash frequency or severity exceed expected values by at least 1 (orange) or 2 (red) standard deviations. These locations were further investigated.

Table 2–4 Interchange Crash Frequency and Severity by Location

Location	Total	Crash Frequency Index (Icf)	Crash Cost Index (Icc)
I-64 AT SR 62/64 INTERCHANGE			
I-64 at SR 62 Ramp A	0	-0.35	-0.10
I-64 at SR 62 Ramp B	6	0.24	-0.17
I-64 at SR 62 Ramp C	4	0.01	-0.30
I-64 at SR 62 Ramp D	1	0.24	-0.02
I-64 EB Ramp Intersection at SR 62	15	**2.47**	0.81
I-64 WB Ramp Intersection at SR 64	14	0.55	0.04
I-64 AT US 150 INTERCHANGE			
I-64 at US 150 Ramp B	8	0.28	0.72
I-64 at US 150 Ramp C	0	-0.40	-0.50
I-64 at US 150 Ramp D	0	-0.38	-0.24
I-64 at US 150 Ramp F	0	-0.39	-0.29
US 150 and Old Vincennes Rd Intersection	8	0.29	0.92
US 150 and Lawrence Banet Rd Intersection	63	0.62	0.59
I-64 AT I-265 INTERCHANGE			
I-64 I-265 Ramp C	2	-0.26	-0.47
I-64 I-265 Ramp D	1	-0.34	0.63
I-64 I-265 Ramp E	1	-0.34	-0.52
I-64 I-265 Ramp H	1	-0.34	-0.52
I-64 AT SPRING STREET INTERCHANGE			
I-64 Spring St Ramp A	0	-0.40	-0.33
I-64 Spring St Ramp C	3	-0.02	-0.30
I-64 Spring St Ramp D	0	-0.40	-0.39
I-64 Spring St Ramp E	7	0.32	**1.23**
I-64 EB Ramp Intersection at Spring St	5	**1.22**	0.08
I-64 WB Ramp Intersection at Elm St	15	**1.48**	**1.22**

Note: The highlighted values exceed established thresholds and indicate possible high crash frequency or costs.

Table 2–4 Interchange Crash Frequency and Severity by Location (cont.)

Location	Total	Crash Frequency Index (Icf)	Crash Cost Index (Icc)
I-265 AT STATE STREET INTERCHANGE			
I-265 at State St Ramp A	0	-0.41	-0.49
I-265 at State St Ramp B	1	-0.28	-0.41
I-265 at State St Ramp C	1	-0.28	-0.41
I-265 State St Ramp D	1	-0.30	-0.45
I-265 EB Ramp Intersection at State St	28	**3.30**	**1.66**
I-265 WB Ramp Intersection at State St	33	**3.80**	**1.92**
I-265 AT GRANT LINE ROAD INTERCHANGE			
I-265 Grant Line Rd Ramp A	3	-0.05	-0.32
I-265 Grant Line Rd Ramp D	0	-0.41	-0.49

Note: The highlighted values exceed established thresholds and indicate possible high crash frequency or costs.

At the westbound I-265 ramp terminal intersection with State Street, 21 of 33 crashes were rear end. Of the 29 crashes where vehicle approach directions could be identified, 13 were caused by southbound vehicles, 10 by westbound vehicles, and 6 by northbound vehicles. No time of day, lighting, weather, or seasonal patterns were observed. Crash narratives indicate that some westbound vehicles may have difficulty seeing opposing vehicles approaching on Kenzig Road, possibly due to the intersection offset.

The eastbound I-64 ramp terminal intersection at SR 62/64 has an I_{cf} of 2.47 and I_{cc}. value of 0.81. Most of the crashes that occurred during the 2017-2019 analysis period were related to vehicles turning left from eastbound SR 64 to enter eastbound I-64. Many of these were either rear end crashes due to congested conditions or inattention or they were sideswipe crashes between vehicles in the two left turn lanes.

Overall, the safety performance was as expected. The portions of freeway mainline that experience the most delay, I-64 eastbound from SR 62/SR 64 to I-265, also have the highest crash indexes. Addressing the recurring delay will improve safety along the I-64 corridor.

2.10 Traffic Operations

Existing traffic operating conditions were analyzed using the Highway Capacity Software (HCS7) Facilities module as well as the VISSIM Version 2021 traffic simulation model. VISSIM models were developed for 3-hour AM and PM peak periods and validated to field conditions using the methods of the 2004 FHWA Traffic Analysis Toolbox, Volume 3. Balanced 2019 traffic volumes, along with 2019 INRIX traffic speed data from INDOT, were used to calibrate the VISSIM model. Further detail on VISSIM model calibration and validation details are provided in **Appendix K**.

Due to limitations in the underlying Transportation Research Board Highway Capacity Manual (HCM) methods, the HCS7 results could not accurately recreate observed queueing and congested operating conditions. Limitations in HCM weaving methodologies, for instance, meant that vehicle lane changing was not considered in evaluating the operation of eastbound I-64 approaching the left-side exit to eastbound I-265 or in either direction of I-265 between I-64 and State Street. While the HCS7 results are included for reference in **Appendix J**, they were not used for analysis of existing or forecast conditions.

Existing traffic operating conditions along I-64 and I-265 are provided in **Table 2–5** and **Table 2–6**. The existing freeway densities and speeds are reported from VISSIM models. The VISSIM level of service (LOS) are calculated based on the densities reported from VISSIM and the LOS thresholds from the Highway Capacity Manual. Several segments of I-64 and I-265 currently perform at LOS E or F during peak periods based on this simulation model. This indicates that traffic flow is unstable at best during the peak hours, which aligns with performance observed in the field.

During the AM peak there is a bottleneck on eastbound I-64 at the US 150 interchange due to heavy entrance ramp demand, limited mainline capacity (two lanes), a short entrance ramp merge distance, and horizontal and vertical curves. This bottleneck causes upstream LOS F conditions per the simulation models and observed speeds of less than 20-mph. Eastbound I-64 between US 150 and I-265 experiences LOS E conditions in the AM peak per the simulation models, a condition that worsen if the bottleneck at the US 150 entrance ramp were removed. Traffic on the single lane ramp from westbound I-265 to eastbound I-64 also experiences LOS E conditions in the AM peak per the simulation models.

During the PM peak there is significant congestion and LOS F conditions on westbound I-265 approaching the I-64 interchange. This is due to heavy entrance ramp demand from State Street and limited mainline capacity combined with the downstream weave to the system ramps. Westbound I-64 is congested with LOS E conditions from the Sherman Minton Bridge to Spring Street, and the westbound I-64 to eastbound I-265 ramp also operates at LOS E conditions.

Table 2–5 Existing Traffic Operations for Eastbound I-64 and Eastbound I-265

Facility	Segment	Lanes	VISSIM - 2019 Existing (AM/PM)		
			LOS*	Density (pc/mi/ln)	Speed (mph)
I-64 EB	Lanesville Rd to SR 62/64	2	B / A	14 / 9	59 / 59
	Inside SR 62/64	2	B / A	12 / 9	58 / 58
	SR 62/64 to US 150	2	F / B	62 / 13	28 / 57
	Inside US 150	2	F / B	69 / 14	17 / 54
	US 150 to I-265	2	E / C	39 / 20	49 / 54
	Inside I-265	2	C / A	21 / 10	57 / 58
	I-265 WB to I-64 EB (Ramp)	1	E / C	39 / 23	41 / 46
	I-265 to Spring St	3	C / B	24 / 13	56 / 59
	Inside Spring St	3	C / A	21 / 10	57 / 59
	Sherman Minton Bridge	3	D / B	30 / 16	52 / 55
I-265 EB	I-64 EB to I-265 EB (Ramp)	1	B / C	17 / 25	58 / 56
	I-64 to State St (weave)	2	B / C	17 / 24	58 / 57
	Inside State St	2	B / C	14 / 19	59 / 58
	State St to Grant Line Rd	2	C / D	20 / 27	56 / 55

Note: The highlighted values indicate unacceptable operating conditions.
* Simulated LOS.

Table 2–6 Existing Traffic Operations for Westbound I-64 and Westbound I-265

Facility	Segment	Lanes	VISSIM - 2019 Existing (AM/PM)		
			LOS*	Density (pc/mi/ln)	Speed (mph)
I-265 WB	Grant Line Rd to State St	2	C / D	20 / 32	57 / 51
I-265 WB	Inside State St	2	B / **F**	17 / **49**	54 / **30**
I-265 WB	State St to I-64 (weave)	2	D / **F**	33 / **46**	41 / **34**
I-265 WB	I-265 WB to I-64 WB (Ramp)	1	D / D	32 / 34	40 / 44
I-64 WB	Sherman Minton Bridge	3	B / **E**	15 / **39**	54 / **47**
I-64 WB	Inside Spring St	2	A / C	9 / 24	56 / 51
I-64 WB	Spring St to I-265	3	B / D	12 / 33	56 / 46
I-64 WB	I-64 WB to I-265 EB (Ramp)	1	C / **E**	21 / **41**	45 / **43**
I-64 WB	Inside I-265	3	A / B	6 / 16	58 / 58
I-64 WB	I-265 to US 150	3	A / D	10 / 30	58 / 52
I-64 WB	Inside US 150	3	A / C	7 / 19	59 / 58
I-64 WB	US 150 to SR 62/64	3	A / C	7 / 20	59 / 56
I-64 WB	Inside SR 62/64	3/2	A / B	7 / 17	59 / 56
I-64 WB	SR 62/64 to Lanesville Rd	2	A / C	8 / 21	59 / 56

Note: The highlighted values indicate unacceptable operating conditions.
* Simulated LOS.

Figure 2-2 Existing (2019) AM Peak Simulated LOS

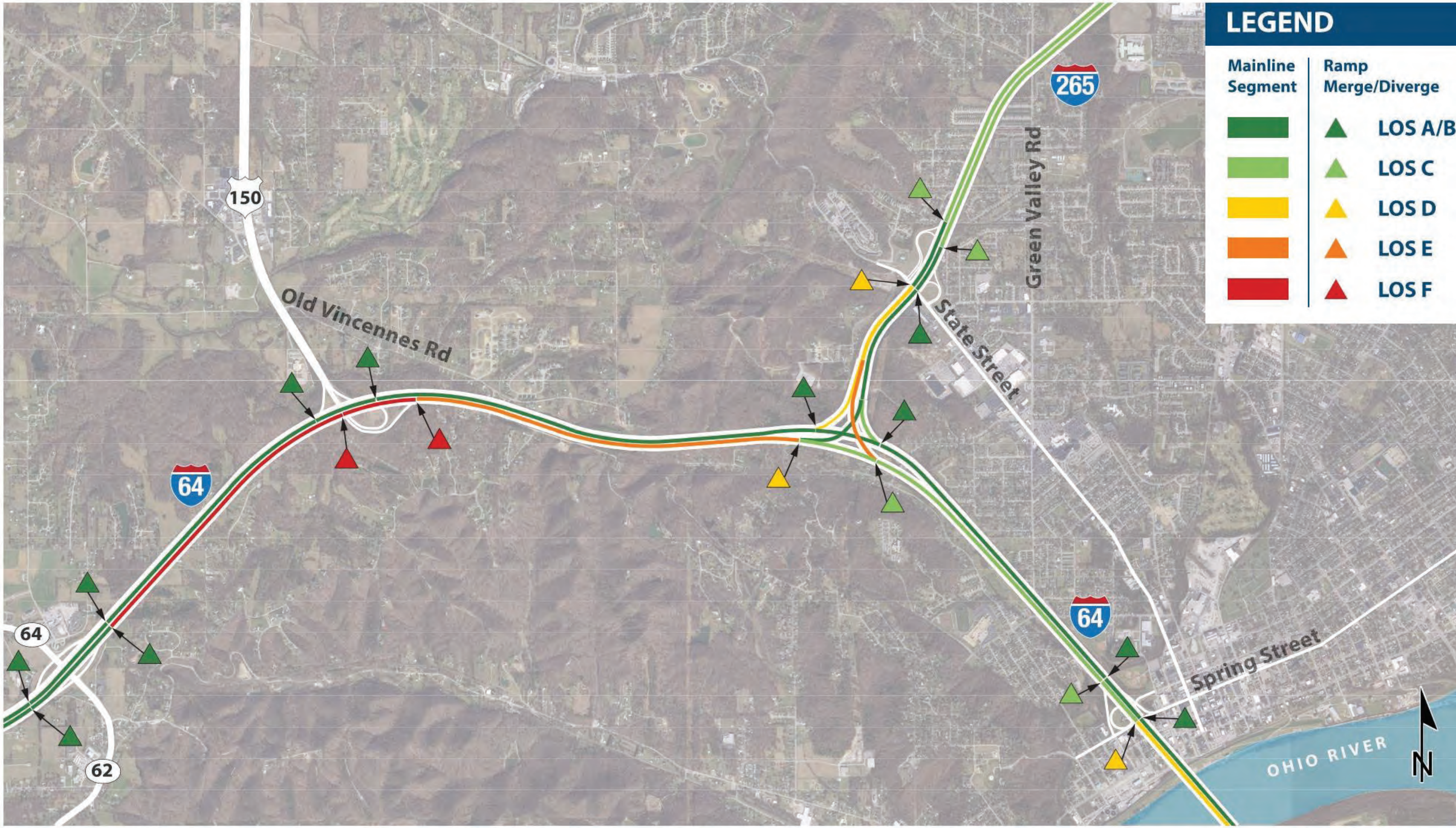


Figure 2-3 Existing (2019) PM Peak Simulated LOS

3 RELATED PROJECTS

The projects described below are currently programmed to be under construction within the same time frame as this project. For this reason, analysis and recommendations developed for this Engineer's Report assumed these projects to be in place. Design and construction of the *Improve 64* project should be coordinated with these projects to assure that the designs are compatible and to disruptions to travel and access are minimized.

The projects listed below are included as part of the *Improve 64* project. The descriptions of these projects reflect current work types and may not align with the currently programmed work types as project scope has been refined.

- Des 1700207/1500559 – Bridge replacement on eastbound and westbound I-64 bridges over Quarry Road.
- Des 1702617 – Bridge replacement on westbound I-64 bridge over eastbound I-64 ramp to eastbound I-265 and eastbound I-64 bridge over eastbound I-64 ramp to eastbound I-265.
- Des 1800721 – Bridge replacement on westbound I-64 bridge over westbound I-265 ramp to eastbound I-64 and westbound I-265 to eastbound I-64 ramp over eastbound I-64 to eastbound I-265 ramp
- Des 1500554/1500557 – Bridge replacement on eastbound and westbound I-64 bridges over Captain Frank Road
- Des 1702614 – Bridge rehabilitation on eastbound and westbound I-64 bridges over Cherry Street
- Des 2000323/2000324/200326 – Bridge widening and rehabilitation on eastbound, westbound and Ramp C bridges of I-265 over State Street
- Des 1600310 – Bridge replacement on eastbound I-64 bridge over Falling Run Creek

The projects listed below are expected to be bundled with the *Improve 64* project. These projects are depicted in **Figure 3-1**.

- Des 2100019 – I-64 Lighting from US 150 to I-64/I-265. This project will provide continuous freeway lighting along I-64 from the US 150 interchange to the I-265 interchange.
- Des 1800706/1800405 – Painting of eastbound and westbound US 150 bridges over I-64.
- Des 1700205/1700206 – Bridge deck overlay on eastbound and westbound I-64 bridges over SR 62/SR 64.
- Des 2000144/2000145 – Bridge deck overlay on eastbound and westbound I-64 bridges over Yenowine Lane.

- Des 2002072/2002073 – Replace superstructures on eastbound and westbound US 150 over Little Indian Creek, 0.65 miles west of I-64.
- Des 1900366 - Intersection improvement with added turn lanes at the intersection of US 150 and Old Vincennes Road, 0.5 miles west of I-64.

The projects listed below are regional projects that are expected to occur in the same time frame as the *Improve 64* project. These projects are also depicted in **Figure 3-1**.

- Des 2000166 - Bridge rehabilitation of Green Valley Road over I-265. This project is expected to be open to traffic in 2024.
- Des 2000288 – Interchange modification at the I-64 ramp junctions with Spring Street, including Spring Street from 5th Street to State Street and Spring Street from 5th Street to Washington Place. This project will convert Spring Street from a one-way street to a two-way street through the I-64 interchange area. It is expected to be open to traffic in 2025.
- Des 2100047 – Intersection improvement at US 150 and Lawrence Banet Road/Old Vincennes Road West. This project is expected to be open to traffic in 2026.
- Des 1800807 – Bridge deck overlay of Payne-Koehler Rd over I-265. This project is expected to be completed in 2024.
- Des 2100954 - Sign replacement on I-265 from I-64 east to the IN/KY state line. This project is expected to be completed in 2023.
- Des 20000317/2000318 - Bridge rehabilitation of eastbound and westbound I-265 bridges over CSX railroad. This project is expected to be completed in 2025.
- Des 20000319/2000321 - Bridge rehabilitation of eastbound and westbound I-265 bridges over Mount Tabor Road. This project is expected to be completed in 2025.
- Des 20000334/2000335 - Bridge rehabilitation of eastbound and westbound I-265 bridges over Jacobs Creek. This project is expected to be completed in 2025.

Figure 3-1 Related Projects

4 TRAFFIC FORECAST

Traffic forecasts were developed for 2026, the expected year in which the project opens to traffic, and 2046, the project design year. The forecasts include freeway segments, freeway weaves, surface street segments, and intersections. Build forecasts for Alternative 1/Alternative 2 and No Build forecasts were developed for the following time periods:

- Annual average daily traffic volume (AADT)
- Typical weekday AM peak hour (7-8 am)
- Typical weekday PM peak hour (4-5 pm)
- Typical weekday AM peak period (7-10 am)
- Typical weekday PM peak period (4-7 pm)

Traffic volumes representing 2019 existing conditions were assembled as the basis for all traffic forecasting. No traffic counts conducted after February 2020 were used in this study due to the impacts of the COVID-19 pandemic on travel patterns and traffic volumes. Valid recent counts were available from INDOT for nearly every location in the project study area. Volume estimates representing average 2019 weekday traffic were obtained from Streetlight Data, Inc. for use at two intersections and one local road segment where no other data was available.

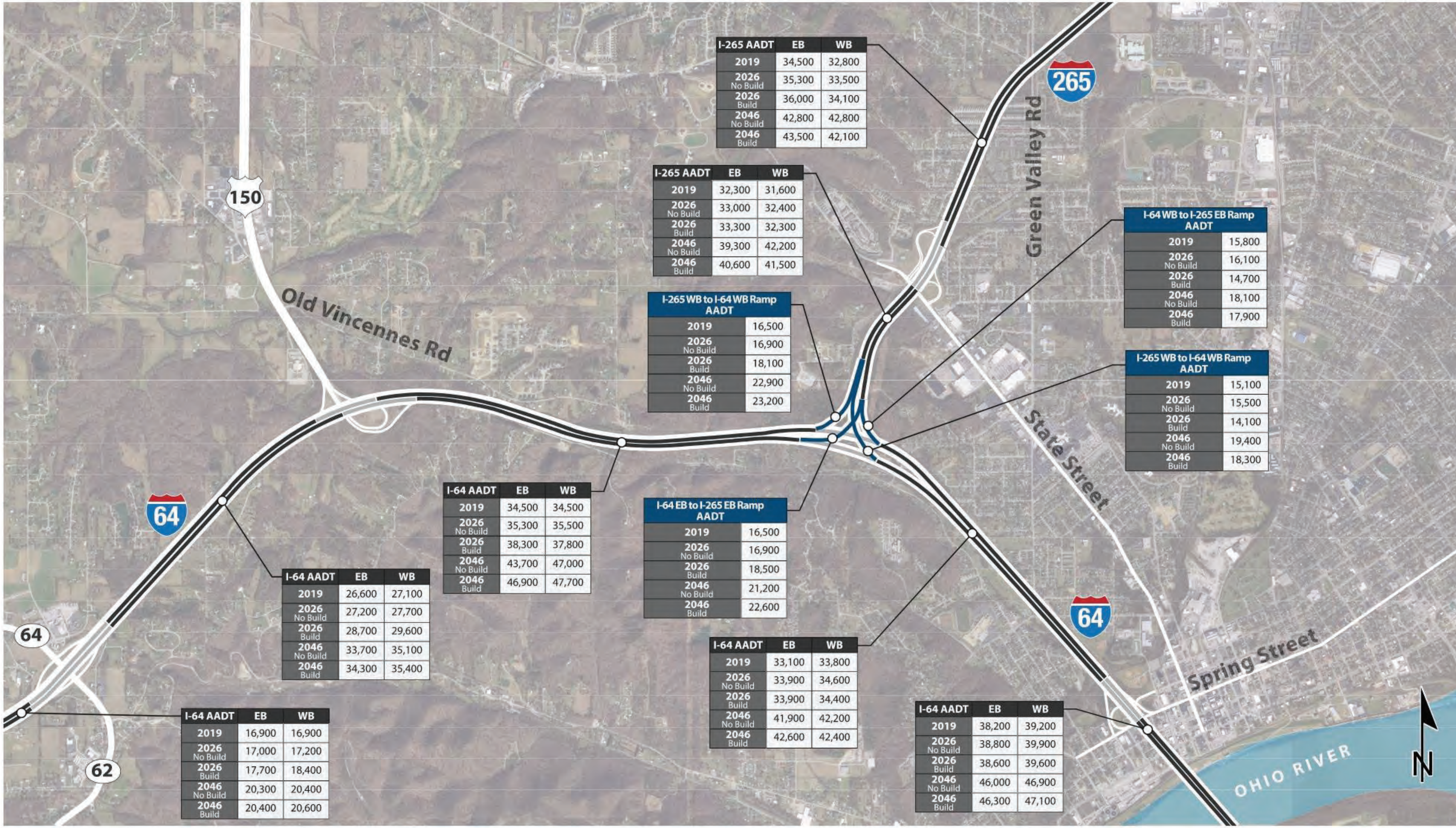
Forecasts of future traffic volumes were developed by multiplying 2019 balanced traffic volumes by traffic growth rates based on INDOT's Indiana Statewide Travel Demand Model (ISTDM). Separate truck forecasts were developed using separate truck volume growth rates from the ISTDM.

During the forecast process, growth rates were also developed using output from the Louisville regional travel demand model provided by the Kentuckiana Regional Planning and Development Agency (KIPDA). The growth rates from the two different travel demand models are similar for much of the project area. However, growth rates from INDOT's ISTDM were used for forecasting wherever possible due to minor modeling differences and the fact that the ISTDM includes separate truck forecasts, but the KIPDA model does not. Forecasts for a few local road segments that are not included in the ISTDM were developed based on growth rates in the KIPDA model.

The no build forecast growth rate accounts for traffic growth over time, while the forecasts for Alternative 1 and Alternative 2 include traffic growth over time as well as additional traffic due to added travel lanes. This accounts for the build and no build forecasts having different growth rates.

The traffic forecasts are provided in **Figure 4-1** through **Figure 4-6.** Additional detail regarding forecasting methodology and results can be found in **Appendix I**.

Figure 4-1 Annual Average Daily Traffic Volumes



I-265 AADT	EB	WB
2019	34,500	32,800
2026 No Build	35,300	33,500
2026 Build	36,000	34,100
2046 No Build	42,800	42,800
2046 Build	43,500	42,100

I-265 AADT	EB	WB
2019	32,300	31,600
2026 No Build	33,000	32,400
2026 Build	33,300	32,300
2046 No Build	39,300	42,200
2046 Build	40,600	41,500

I-265 WB to I-64 WB Ramp AADT	
2019	16,500
2026 No Build	16,900
2026 Build	18,100
2046 No Build	22,900
2046 Build	23,200

I-64 WB to I-265 EB Ramp AADT	
2019	15,800
2026 No Build	16,100
2026 Build	14,700
2046 No Build	18,100
2046 Build	17,900

I-265 WB to I-64 WB Ramp AADT	
2019	15,100
2026 No Build	15,500
2026 Build	14,100
2046 No Build	19,400
2046 Build	18,300

I-64 AADT	EB	WB
2019	34,500	34,500
2026 No Build	35,300	35,500
2026 Build	38,300	37,800
2046 No Build	43,700	47,000
2046 Build	46,900	47,700

I-64 EB to I-265 EB Ramp AADT	
2019	16,500
2026 No Build	16,900
2026 Build	18,500
2046 No Build	21,200
2046 Build	22,600

I-64 AADT	EB	WB
2019	26,600	27,100
2026 No Build	27,200	27,700
2026 Build	28,700	29,600
2046 No Build	33,700	35,100
2046 Build	34,300	35,400

I-64 AADT	EB	WB
2019	33,100	33,800
2026 No Build	33,900	34,600
2026 Build	33,900	34,400
2046 No Build	41,900	42,200
2046 Build	42,600	42,400

I-64 AADT	EB	WB
2019	16,900	16,900
2026 No Build	17,000	17,200
2026 Build	17,700	18,400
2046 No Build	20,300	20,400
2046 Build	20,400	20,600

I-64 AADT	EB	WB
2019	38,200	39,200
2026 No Build	38,800	39,900
2026 Build	38,600	39,600
2046 No Build	46,000	46,900
2046 Build	46,300	47,100

Figure 4-2 Existing Year (2019) Traffic Volumes

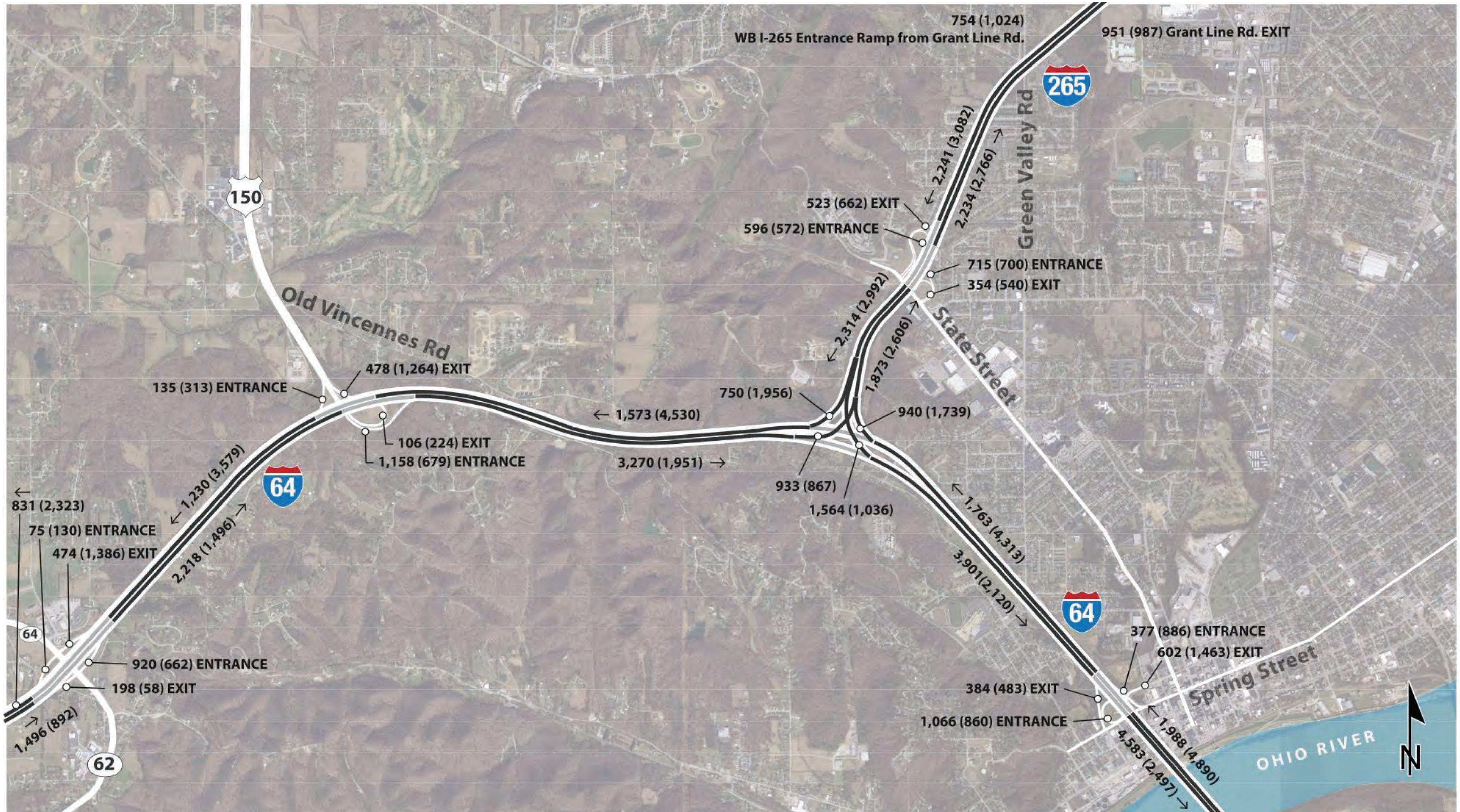


Figure 4-3 Opening Year (2026) No Build Traffic Forecasts

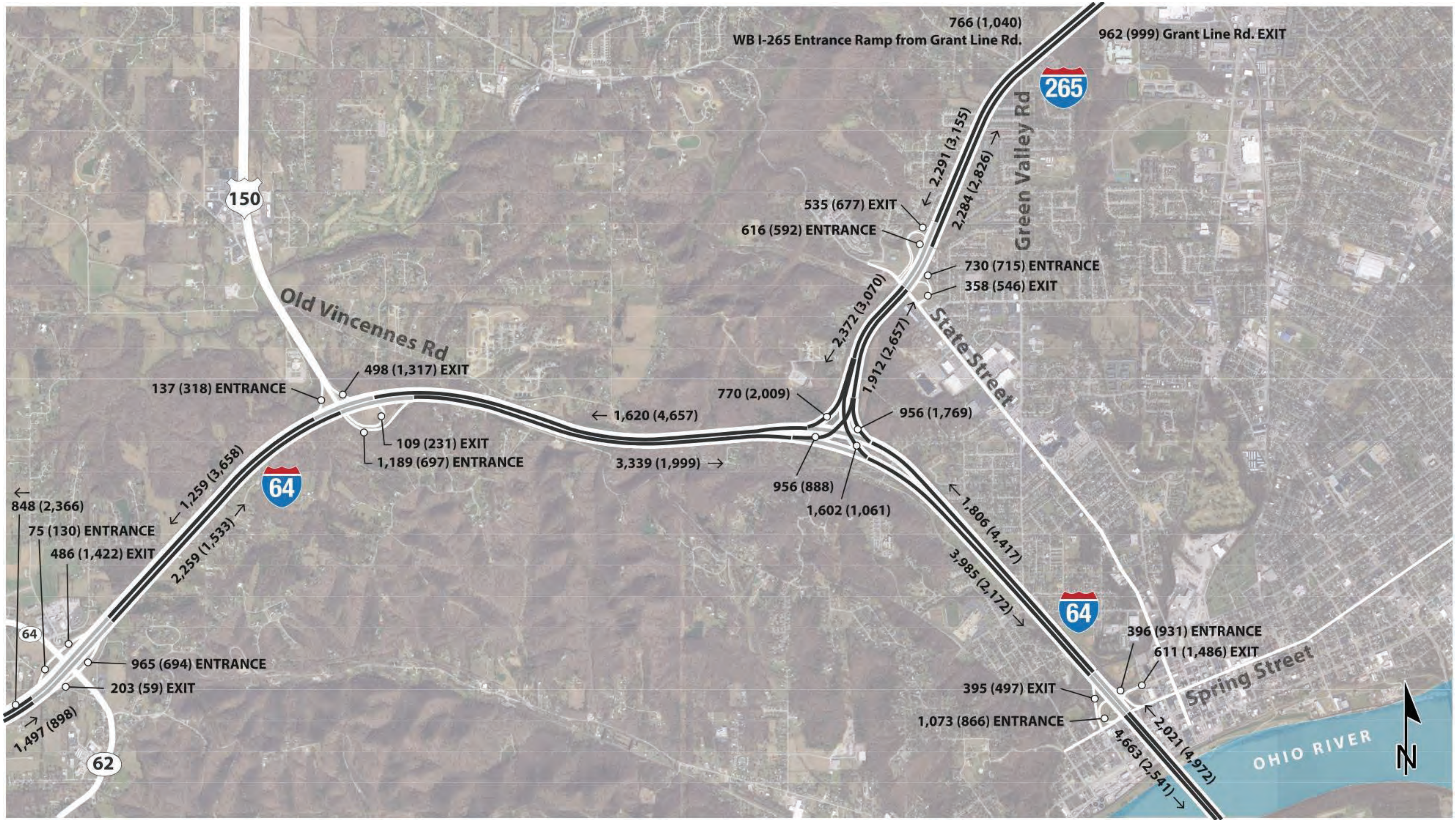


Figure 4-4 Opening Year (2026) Alternative 1/Alternative 2 Traffic Forecasts

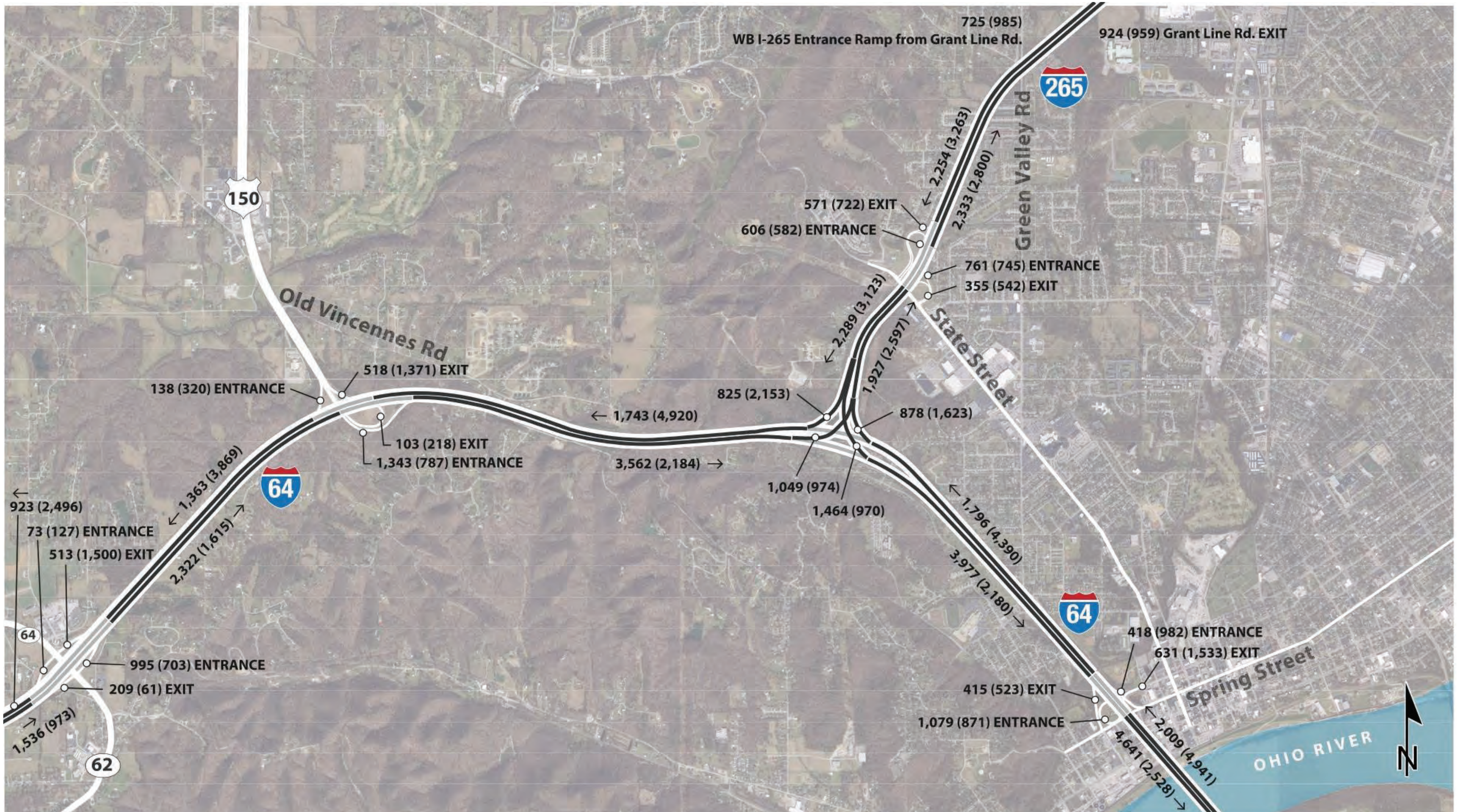
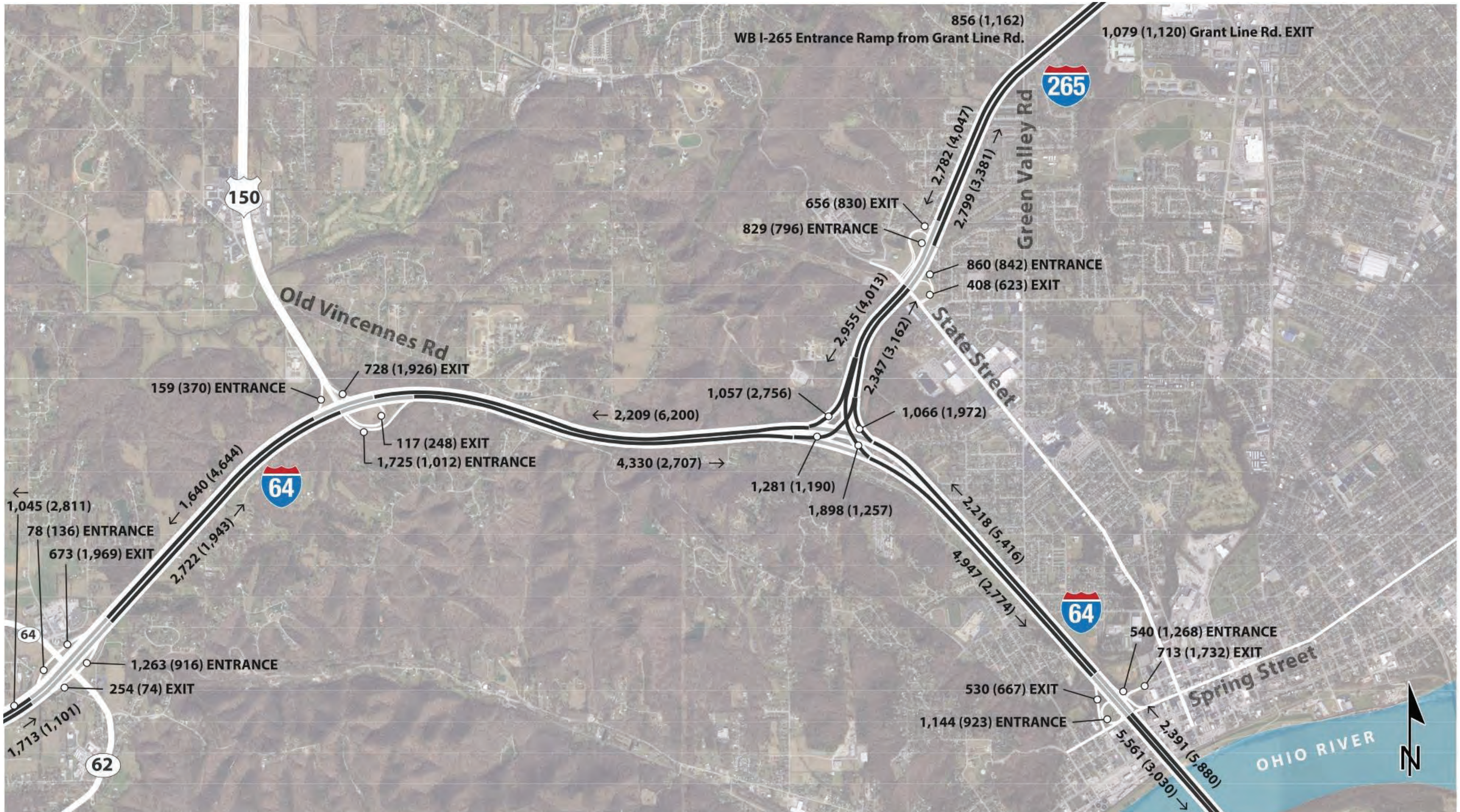


Figure 4-5 Design Year (2046) No Build Traffic Forecasts

Figure 4-6 Design Year (2046) Alternative 1/Alternative 2 Traffic Forecasts



5 DESCRIPTION AND EVALUATION OF ALTERNATIVES

5.1 Description of Alternatives

5.1.1 No Build or Do Nothing

The No Build or "do nothing" alternative will be analyzed and compared to the Build Alternatives. The No Build analysis will consist of the existing lane configuration with future year traffic. Though no capacity would be added, pavement maintenance and repair would still be required in the future. These costs have not been calculated for purposes of this report. Projects within the region described in **Section 3** of this report were already selected and programmed based on their own merit. They are only packaged with this project based on proximity to the project area and economies of scale.

5.1.2 Alternative 1

Alternative 1 was the alternative recommended in the *Final Preliminary Engineering Scoping Report*, which is described in **Section 1.3**. Alternative 1 is shown in **Figure 5-1** and includes the following improvements:

- One travel lane added to eastbound I-64 from US 150 to Spring Street
- One travel lane added to westbound I-64 from I-265 to US 150
- One travel lane added to the westbound I-64 exit ramp to westbound US 150 and to the on-ramp from eastbound US 150 to eastbound I-64
- One travel lane added to all four directional ramps at the I- 64/I-265 interchange
- One travel lane added to westbound I-265 from State Street to I-64
- One travel lane added to the outside of eastbound I-265 from I-64 to the State Street exit
- One travel lane added to the inside (median) of eastbound I-265 from I-64 to a point at least 2,000 feet downstream of the entrance-ramp from State Street

Alternative 1 generally widens the existing roadways as described above to address the need statement in **Section 1.4.** The existing roadway alignments and profiles are retained in this alternative, which minimizes the need for reconstruction.

5.1.3 Alternative 2

Alternative 2 represents a refined version of Alternative 1. Generally, these refinements were made to reduce construction cost and/or construction schedule without compromising operations or safety. The refinements resulted from corridor modeling exercises, traffic analysis, discoveries related to utilities, geotechnical evaluations, maintenance of traffic constructability and mobility requirements, and refinements to the general design criteria. All refinements are depicted in **Figure 5-2** and are described as follows:

- Lengthen the existing single-lane entrance ramp from US 150 to eastbound I-64 instead of constructing the second lane on the ramp, as proposed in Alternative 1.

- Realign the eastbound I-64 mainline through the I-265 system interchange to reduce maintenance of traffic costs during construction and allow a right-side exit that better meets driver expectation.
- Maintain two eastbound I-64 mainline lanes through the I-64 & I-265 interchange rather than the three lanes proposed in Alternative 1.
- Reduce the eastbound I-64 mainline from four lanes to three lanes upstream of Cherry Street rather than dropping a lane in the Spring Street interchange as proposed in Alternative 1.

Refer to **Appendix P** for more detailed information on work type limits for Alternative 2.

In its current configuration, the ramps between eastbound I-64 and I-265 are both left-side ramps. Left-side entrance / exit ramps are contrary to driver expectations . They can create turbulence in the traffic flow and cause safety issues due to the ramp merging/diverging to/from the travel lane with the fastest speeds. For these reasons, moving these ramps to the right-side of I-64 is preferable.

Moving these ramps to the right-side of eastbound I-64 would require right of way acquisition if the existing alignment was maintained. Conceptually, shifting the alignment of eastbound I-64 towards the existing median allows the right-side ramps to be constructed within the right of way; however, this caused the new alignment to conflict with the existing overhead transmission lines. Relocating the transmission lines was not considered to be a viable option due to a substantial cost of relocation. For this reason, other options for achieving right side ramps were explored. Each option was developed to the extent that construction costs, maintenance of traffic constraints, and geometric complexity could be evaluated and compared. The recommended option is to provide a right-side exit from eastbound I-64 to eastbound I-265, which reduces the weaving volume and turbulence that impacts upstream traffic operations. The westbound I-265 to eastbound I-64 branch connection will maintain a left-side entrance ramp from westbound I-265 to eastbound I-64. Providing a right-side exit on I-64 eastbound eliminates a two-sided weave from US 150 and performs at an acceptable LOS through the interchange. The merge distance east of the entrance ramp gore can be extended. This results in a better level of service for eastbound I-64 traffic, and the ability to develop a maintenance of traffic strategy that can take advantage of eastbound I-64 realignment. Each option explored in this exercise is depicted in **Appendix G**.

5.1.4 *Other Alternatives*

Numerous other alternatives have been developed and evaluated over the life of this project. These alternatives were evaluated at a conceptual level and were found to satisfy the purpose of the project. None of these alternatives were financially feasible and all were discarded for this reason. For details on these alternatives, refer to **Appendix A**.

Figure 5-1 Alternative 1

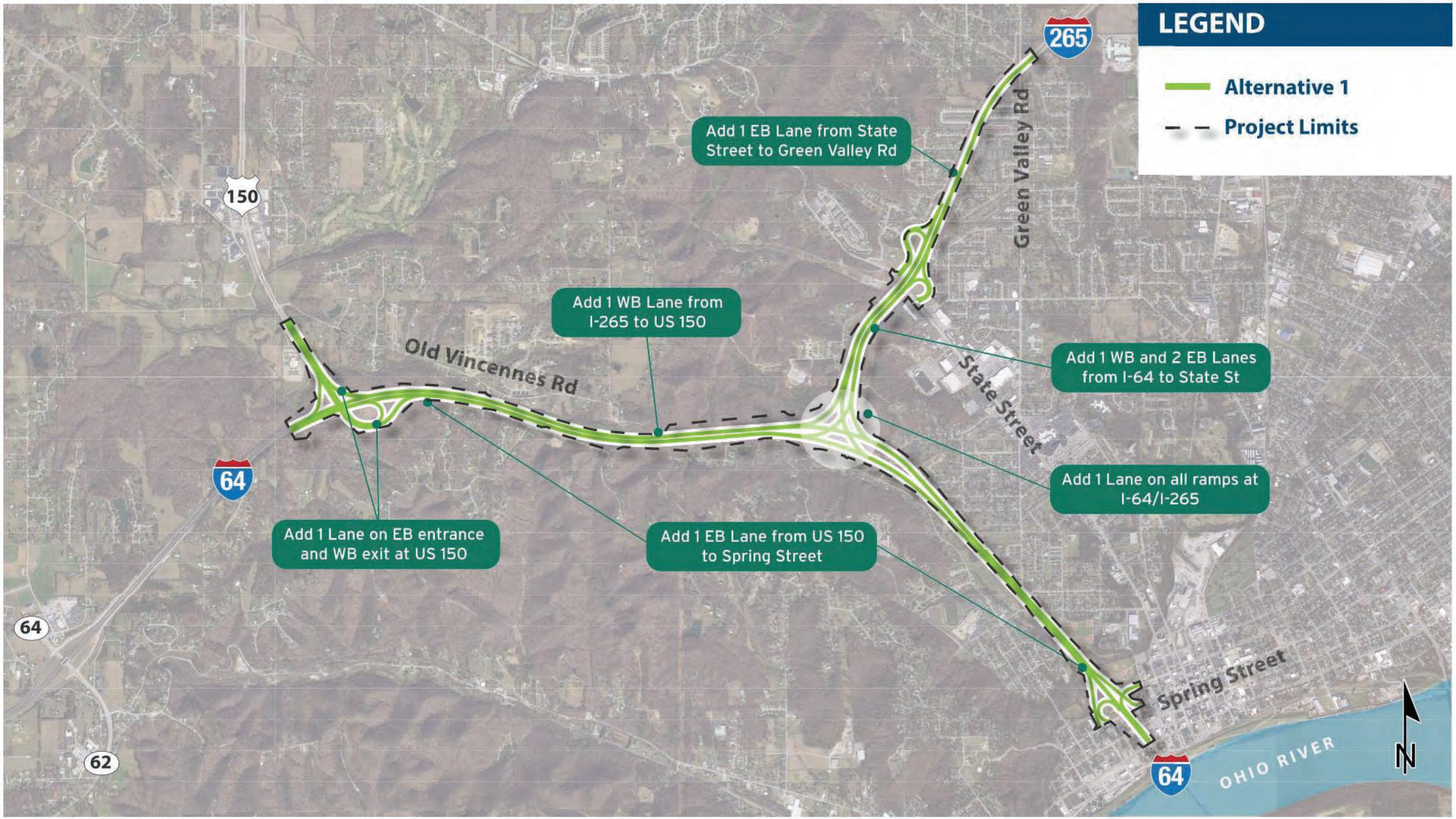
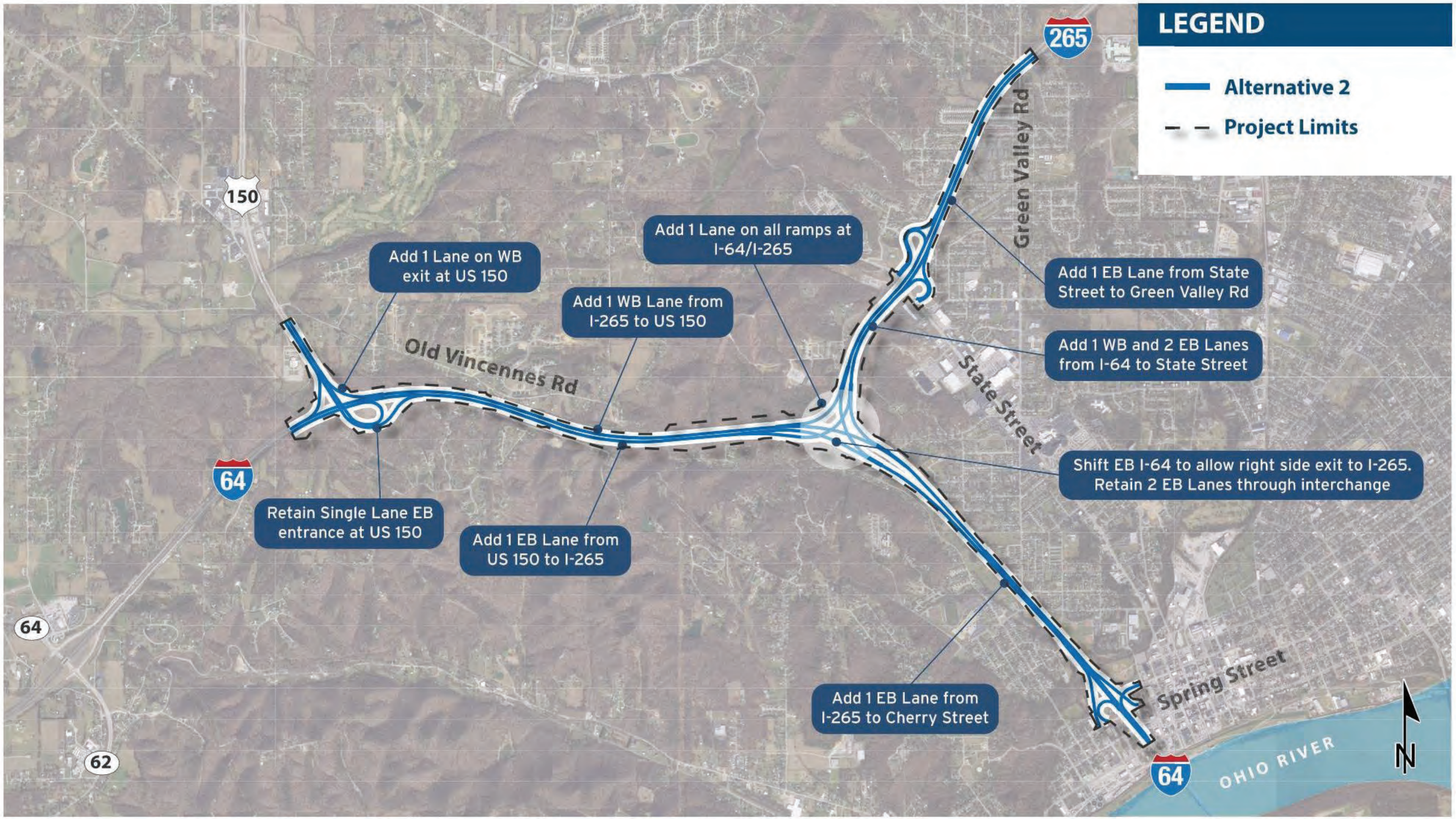


Figure 5-2 Alternative 2



5.2 Project Goals

Through a series of initial design and Traffic Management Plan (TMP) meetings, INDOT and the design team identified goals for the project. The project goals listed below expand upon the project Purpose and Need defined in **Section 1.4**. The alternatives described in this chapter have been evaluated and compared against these goals based on geometrics, drainage, structures, environmental impacts, traffic operations, constructability, and estimated construction cost. The project goals are as follows:

- Increase the current design speed of I-64 from 55-mph to 70-mph
- Minimize the number of design exceptions required
- Reduce traffic congestion along I-64 and I-265 to achieve LOS D conditions or better in peak hours
- Improve safety by reducing the frequency of crashes related to congestion
- Maintain the existing number of travel lanes throughout construction
- Avoid ramp closures during construction to maintain mobility
- Minimize queues and lane closure durations if lane and ramp closures are unavoidable
- Complete all work within two construction seasons
- Minimize or eliminate the need for additional permanent or temporary right of way.
- Provide a safe work zone for workers and motorists
- Reduce construction cost

The following sections compare the two Build Alternatives and discuss how each achieves the project goals.

5.3 Geometric Design

Alternative 2 utilizes a 70-mph design speed for I-64, while Alternative 1 utilizes a 55-mph design speed that matches the current posted speed limit. This increase in design speed is achieved by correcting the superelevation rates with no improvements to the horizontal alignments. The design speeds for I-265 are 65-mph for eastbound and 55-mph for westbound in Alternative 2 and 55-mph for both directions in Alternative 1. See **Table 5–1** for a summary of the design speeds in tabular format.

The IDM allows design speeds ranging from 50 to 70-mph for freeways. While a 55-mph design speed for I-64 is acceptable, it is on the lower end of the acceptable range and is therefore not recommended when higher design speeds are obtainable.

Table 5–1 Design Speeds

	I-64	I-265	US 150	Ramps
Alternative 1	55-mph	55-mph	55-mph	55-mph
Alternative 2	70-mph	65-mph EB/ 55-mph WB	50-mph	55-mph

The posted speed limit within the project limits will not be increased as the Indiana Code (IC 9-21-5-22 and IC 9-21-5-6) establishes a maximum speed limit of 55 mph for an interstate routes in urbanized areas. Despite this, there is a safety benefit associated with increasing the design speeds above the posted speed. This benefit can be realized through implementation of Alternative 2.

Both alternatives will require multiple Level 1 and Level 2 design exceptions (DEs) as listed in **Table 5–2**. Both alternatives will require design exceptions for horizontal curve radii, horizontal stopping sight distance, shoulder widths and maintenance of traffic shoulder widths. Alternative 2 reduces the number of design exceptions for horizontal sight distance from 3 to 1 within the I-64 & I-265 system interchange. Alternative 1 and 2 require design exceptions for horizontal curve radii at both the US 150 and I-265 interchange as well as shoulder widths along I-64 for both the final condition and during construction. Alternative 2 adds additional design exceptions not provided with Alternative 1 for superelevation rate along I-64. The superelevation rates selected for the Alternative 2 design are set at 60-mph in select locations to better align the proposed cross slopes with the existing condition. This will effectively minimize the amount of variable pavement depth. Design exceptions in addition to those listed in **Table 6–3** may be required as design development progresses.

Table 5–2 Anticipated Design Exceptions

	Alternative 1	Alternative 2
Level 1	12	9
Level 2	3	1

While the magnitude of the deficiency should be considered for each design exception, the fact that Alternative 2 requires fewer design exceptions than Alternative 1 provides a higher design speed, which suggests that Alternative 2 is the superior alternative based on geometrics. By minimizing the number of design exceptions and improving the design speed, Alternative 2 achieves both geometric goals and is therefore recommended. Design criteria and design exceptions are provided in **Appendix A** for Alternative 1 and **Section 6.5** and **Appendix N** for Alternative 2.

5.4 Structures

A summary of proposed bridge work by alternative is provided in **Table 5–3**. Alternative 1 requires fewer complete bridge replacements. Alternative 2 requires more complete bridge replacements and requires one new bridge asset. These new bridges will have a longer life span than those rehabilitated in Alternative 1; and should result in both fewer repairs and lower user costs from work zone disruptions over the design life of the project. For these reasons, Alternative 2 is preferred from a structural standpoint. Discussions of the structures are provided in **Appendix A** for Alternative 1 and **Section 6.6** for Alternative 2.

Table 5–3 Bridge Work Summary

	Preventative Maintenance	Deck Replacement and Widening	Superstructure Replacement	Complete Replacement	Widen Only	Added Bridge
Alternative 1	1	2	4	3	0	0
Alternative 2	5	1	0	7	0	1

5.5 Drainage & Hydraulics

There are no clear advantages of one alternative over the other from a drainage perspective. Both alternatives will perpetuate existing drainage patterns and will use existing outfalls. Both alternatives remove existing 4-inch bituminous curbs and inlets. Culverts deemed to be in poor condition will be replaced by both alternatives. Detailed discussions of drainage and hydraulics are provided in **Appendix A** for Alternative 1 and Sections 6.7 and 6.8 for Alternative 2.

5.6 Right of Way

Both Build Alternatives will likely require right of way acquisition in the vicinity of the I-64 & I-265 interchange. This right of way acquisition is needed for a stormwater detention pond.

5.7 Utility Relocations

Both alternatives are expected to require only minor utility relocations. For this reason, utility relocation cannot be used as a differentiator.

5.8 Environmental Impacts

As of the date of this report, much of the environmental analysis is yet to be completed. Both Build Alternatives will be largely constructed within the existing right of way. Both Build Alternatives will likely require additional right of way due to detention concerns at an existing drainage outfall located west of the I-64/I-265 interchange. For these reasons, there appear to be no major differentiating environmental factors between the Build Alternatives.

5.9 Traffic Operations

Traffic operations of the freeway facility, freeway merge and diverge areas, and intersections were evaluated. The freeway traffic operations analysis was used to "right size" the facility by identifying the requisite capacity and incorporating it into the development of alternatives. Intersection analysis was performed to determine if intersections within the area of influence are acceptable or if improvements are needed.

5.9.1 *Freeway Operations*

The Highway Capacity Software (HCS7) Facilities module was used to analyze capacity and level of service for all freeway merge, diverge, weave, and mainline locations. As outlined in **Section 2.10**, the complexity of the I-64 and I-265 interchange resulted in a need to rely on microsimulation analysis results rather than HCS results. The HCS results are included for reference in **Appendix J**.

The VISSIM simulation models were calibrated to meet validation criteria outlined in the 2004 *FHWA Traffic Analysis Toolbox Volume III*. Validation criteria for freeway mainline, ramp, and turning movement volume for each hour were met. The AM peak and PM peak VISSIM models meet travel time validation criteria. In general, the existing models accurately represent peak period field conditions during the representative day to the greatest extent possible and will accurately analyze future year conditions. Refer to **Appendix K** for detailed information on the model development and calibration and **Appendix H** for VISSIM results.

5.9.1.1 Freeway Mainline Operations

Traffic simulation results for freeway mainline, provided in **Table 5–4**, were reviewed to determine if segments along the facility operate poorly or meet project goals. The simulated LOS is depicted in **Figure 5-3** thru **Figure 5-8**. The following conclusions were made by reviewing the 2046 design year analysis.

- Eastbound I-64 inside the I-265 interchange meets LOS criteria with 2 lanes and does not need to be widened to 3 lanes.
- Reconfiguring the I-64/I-265 interchange such that the exit ramp from eastbound I-64 to eastbound I-265 is on the right-side improves traffic operations by eliminating the weave between the US 150 entrance ramp and the I-265 exit ramp.
- 2046 Alternative 1 and Alternative 2 have a few segments of freeway with LOS E along the study area boundary due to constraints at the eastbound/westbound I-64 bridge over the Ohio River and westbound I-265 at Grant Line Road.

5.9.1.2 Freeway Merge & Diverge Areas

In addition to freeway mainline, traffic simulation results for merge and diverge areas were analyzed and reviewed. The results from VISSIM are summarized in **Table 5–5** and include LOS, density, and speed. The following conclusions were made by reviewing the 2046 design year analysis:

- 2046 Alternative 1 and Alternative 2 have a few merge and diverge areas with LOS E along the study area boundary due to constraints at the eastbound/westbound I-64 bridge over the Ohio River and westbound I-265 at Grant Line Road.
- The US 150 entrance to eastbound I-64 meets LOS criteria with a single lane ramp and does not need to be widened to 2 lanes. Extending the merge area beyond the bridge over Quarry Road is critical to ensuring the single lane entrance ramp operates acceptably through the design year.
- Results indicate that both Build Alternatives reduce congestion along the I-64 and I-265 corridors and achieve LOS D or better conditions in the peak hours. For this reason, both alternatives do achieve the project goals for traffic operations.

Figure 5-3 2046 No Build AM Peak Simulated LOS

Figure 5-4 2046 No Build PM Peak Simulated LOS

Figure 5-5 2046 Alternative 1 AM Peak Simulated LOS

Figure 5-6 2046 Alternative 1 PM Peak Simulated LOS

Figure 5-7 2046 Alternative 2 AM Peak Simulated LOS

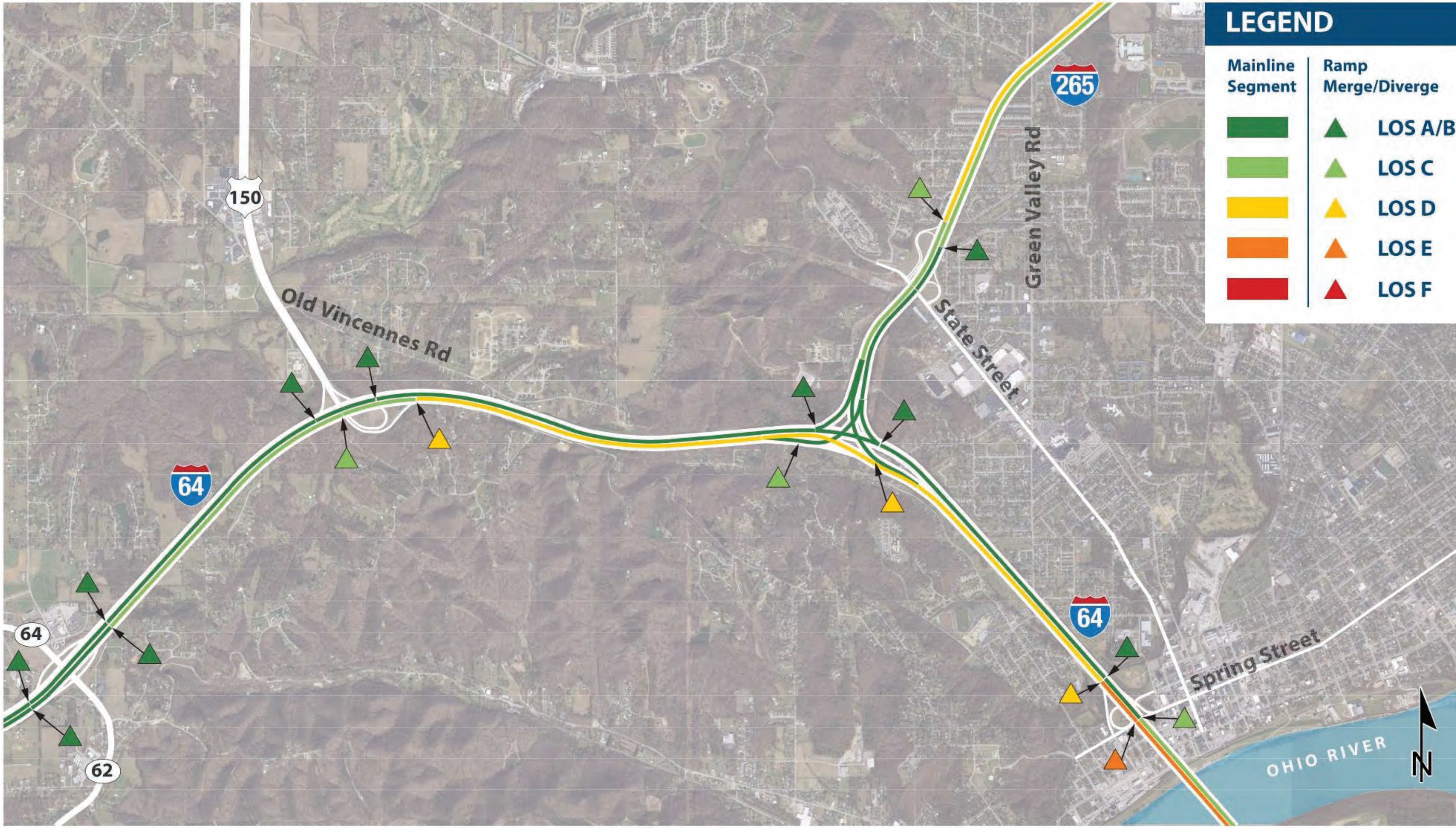


Figure 5-8 2046 Alternative 2 PM Peak Simulated LOS

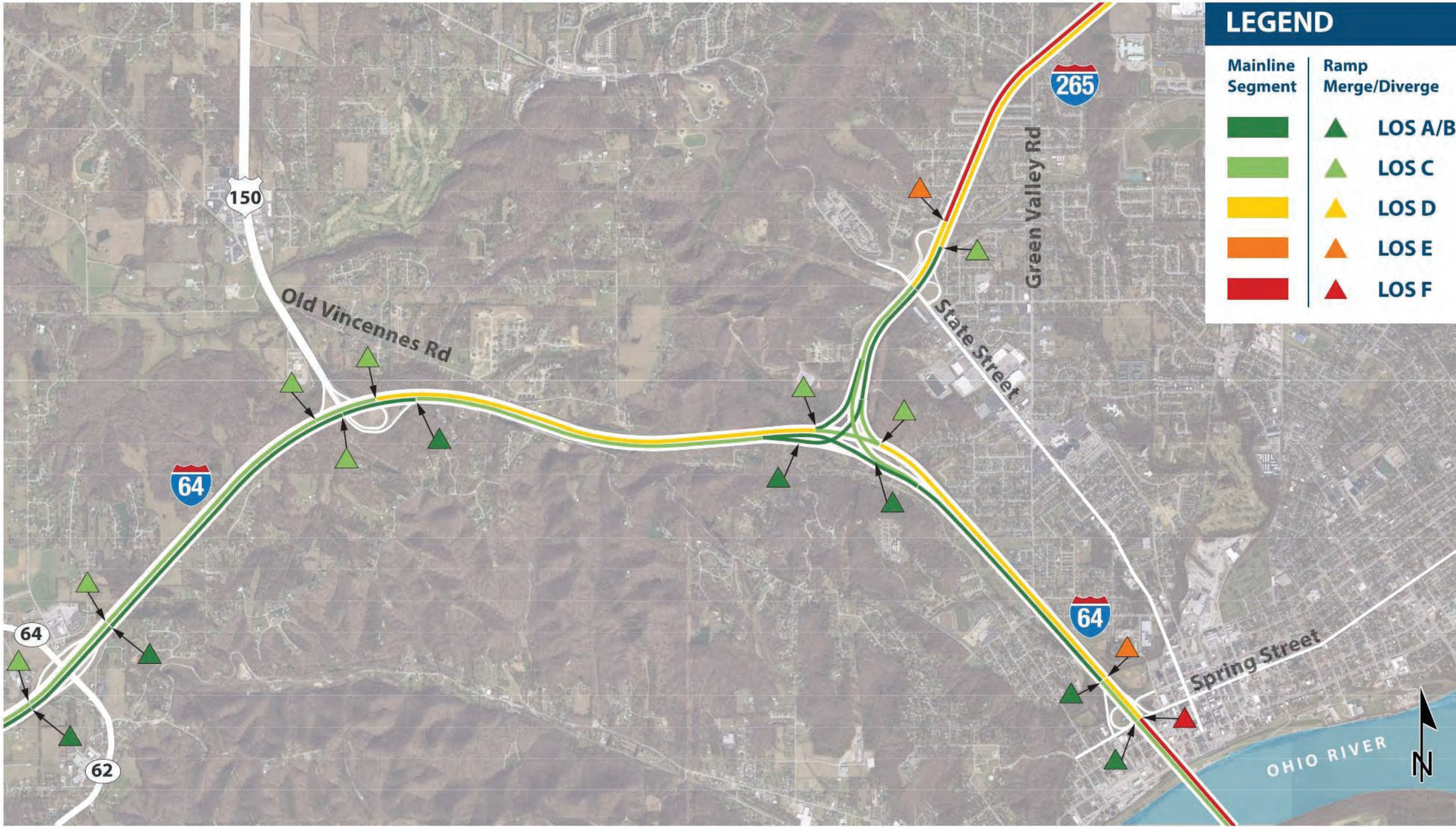


Table 5–4 Freeway Operations Comparison

Segment	VISSIM - 2019 Existing (AM/PM)				VISSIM - 2046 No Build (AM/PM)				VISSIM - 2046 Alternative 1 (AM/PM)				VISSIM - 2046 Alternative 2 (AM/PM)			
	Lanes	LOS*	Density (pc/mi/ln)	Speed (mph)	Lanes	LOS*	Density (pc/mi/ln)	Speed (mph)	Lanes	LOS*	Density (pc/mi/ln)	Speed (mph)	Lanes	LOS*	Density (pc/mi/ln)	Speed (mph)
EASTBOUND I-64																
Lanesville Rd to SR 62/64	2	B / A	14 / 9	59 / 59	2	F / B	65 / 11	33 / 58	2	B / B	15 / 11	59 / 59	2	B / B	15 / 12	59 / 58
Inside SR 62/64	2	B / A	12 / 9	58 / 58	2	F / B	151 / 11	4 / 58	2	B / B	13 / 11	58 / 58	2	B / B	13 / 11	58 / 57
SR 62/64 to US 150	2	F / B	62 / 13	28 / 57	2	F / B	134 / 17	7 / 56	2	C / B	22 / 17	53 / 55	2	C / B	22 / 17	54 / 56
Inside US 150	2	F / B	69 / 14	17 / 54	2	F / C	121 / 19	8 / 51	2/3	C / B	22 / 14	51 / 55	2/3	C / B	21 / 14	51 / 55
US 150 to I-265	2	E / C	39 / 20	49 / 54	2	E / D	43 / 27	48 / 53	3	C / B	24 / 16	55 / 56	3	D / C	28 / 18	54 / 56
System Ramp to I-265	1	B / C	17 / 25	58 / 56	1	C / D	19 / 27	57 / 56	2	B / B	14 / 15	49 / 48	2	B / B	14 / 14	50 / 49
Inside I-265	2	C / A	21 / 10	57 / 58	2	D / B	26 / 13	57 / 58	3	C / A	18 / 9	58 / 59	2	D / B	29 / 15	55 / 57
System Ramp from I-265	1	E / C	39 / 23	41 / 46	1	E / C	44 / 25	38 / 44	2	C / B	23 / 13	43 / 49	2	A / C	10 / 18	52 / 50
I-265 to Spring St	3	C / B	24 / 13	56 / 59	3	D / B	27 / 15	56 / 58	4	C / B	23 / 13	55 / 59	3	D / B	32 / 17	54 / 57
Inside Spring St	3	C / A	21 / 10	57 / 59	3	D / B	27 / 12	57 / 59	4/3	C / B	25 / 12	55 / 59	3	E / C	37 / 19	52 / 56
Sherman Minton Bridge	3	D / B	30 / 16	52 / 55	3	D / C	32 / 18	52 / 55	3	E / C	38 / 20	50 / 54	3	E / C	38 / 20	50 / 54
EASTBOUND I-265																
System Ramp from I-64	1	B / C	17 / 25	58 / 56	1	C / D	19 / 27	57 / 56	2	B / B	14 / 15	49 / 48	2	B / B	14 / 14	50 / 49
I-64 to State St (weave)	2	B / C	17 / 24	58 / 57	2	C / D	19 / 28	57 / 56	4	B / B	11 / 14	60 / 59	4	B / B	11 / 14	60 / 59
Inside State St	2	B / C	14 / 19	59 / 58	2	B / C	15 / 22	58 / 57	3	B / B	12 / 15	60 / 59	3	B / B	12 / 15	60 / 59
State St to Grant Line Rd	2	C / D	20 / 27	56 / 55	2	C / D	24 / 31	56 / 53	3/2	C / D	21 / 27	56 / 54	3/2	C / D	21 / 27	56 / 53
WESTBOUND I-265																
Grant Line Rd to State St	2	C / D	20 / 32	57 / 51	2	F / F	62 / 95	36 / 16	2	D / F	26 / 49	56 / 46	2	D / F	26 / 49	56 / 46
Inside State St	2	B / F	17 / 49	54 / 30	2	F / F	73 / 75	20 / 16	2	C / D	19 / 30	57 / 52	2	C / D	19 / 29	57 / 53
State St to I-64 (weave)	2	D / F	33 / 46	41 / 34	2	F / F	81 / 58	17 / 27	3	C / C	19 / 24	56 / 54	3	C / C	18 / 24	56 / 54
System Ramp to I-64 WB	1	D / D	32 / 34	40 / 44	1	F / E	48 / 41	28 / 37	2	A / A	1 / 1	55 / 55	2	A / A	1 / 1	54 / 57
WESTBOUND I-64																
Sherman Minton Bridge	3	B / E	15 / 39	54 / 47	3	C / F	18 / 77	53 / 26	3	C / F	18 / 75	53 / 28	3	C / F	18 / 72	53 / 29
Inside Spring St	2	A / C	9 / 24	56 / 51	2	B / E	11 / 37	55 / 38	2	B / D	11 / 27	56 / 47	2	B / D	11 / 26	55 / 48
Spring St to I-265	3	B / D	12 / 33	56 / 46	3	B / F	15 / 53	55 / 32	3	B / D	14 / 32	57 / 50	3	B / D	13 / 29	57 / 51
System Ramp to I-265	1	C / E	21 / 41	45 / 43	1	C / E	25 / 43	45 / 41	2	B / C	11 / 18	53 / 51	2	B / C	11 / 18	52 / 50
Inside I-265	3	A / B	6 / 16	58 / 58	3	A / C	8 / 18	58 / 57	3	A / C	8 / 19	58 / 56	3	A / C	8 / 19	58 / 56
System Ramp from I-265	1	D / D	32 / 34	40 / 44	1	F / E	48 / 41	28 / 37	2	A / A	1 / 1	55 / 55	2	A / A	1 / 1	54 / 57
I-265 to US 150	3	A / D	10 / 30	58 / 52	3	B / E	13 / 37	56 / 46	4	B / D	11 / 28	58 / 53	4	B / D	11 / 28	58 / 53
Inside US 150	3	A / C	7 / 19	59 / 58	3	A / C	9 / 20	59 / 57	3	A / C	9 / 24	59 / 56	3	A / C	9 / 24	59 / 56
US 150 to SR 62/64	3	A / C	7 / 20	59 / 56	3	A / C	9 / 21	58 / 56	3	A / C	10 / 25	59 / 54	3	A / C	10 / 25	59 / 54
Inside SR 62/64	3/2	A / B	7 / 17	59 / 56	3/2	A / B	8 / 17	58 / 56	3/2	A / C	8 / 20	59 / 56	3/2	A / C	8 / 20	59 / 56
SR 62/64 to Lanesville Rd	2	A / C	8 / 21	59 / 56	2	A / C	10 / 21	58 / 56	2	A / C	10 / 24	59 / 55	2	A / C	10 / 25	58 / 55

Note: The highlighted values indicate unacceptable operating conditions
* Simulated LOS.

Table 5–5 Freeway Merge/Diverge Comparison

Ramp	VISSIM - 2019 Existing (AM/PM)				VISSIM - 2046 No Build (AM/PM)				VISSIM - 2046 Alternative 1 (AM/PM)				VISSIM - 2046 Alternative 2 (AM/PM)			
	# of Lanes (Ramp/ Mainline)	LOS*	Density (pc/mi/ln)	Speed (mph)	# of Lanes (Ramp/ Mainline)	LOS*	Density (pc/mi/ln)	Speed (mph)	# of Lanes (Ramp/ Mainline)	LOS*	Density (pc/mi/ln)	Speed (mph)	# of Lanes (Ramp/ Mainline)	LOS*	Density (pc/mi/ln)	Speed (mph)
EASTBOUND I-64																
SR 62/64 Exit Ramp	1/2	B / A	14 / 9	58 / 59	1/2	F / B	91 / 12	28 / 58	1/2	B / B	15 / 12	58 / 58	1/2	B / B	15 / 12	58 / 58
SR 62/64 Entrance Ramp	2/2	B / A	11 / 8	56 / 57	2/2	F / A	167 / 10	3 / 56	2/2	B / B	13 / 10	55 / 56	2/2	B / B	13 / 10	55 / 56
US 150 Exit Ramp	1/2	F / B	108 / 15	11 / 56	1/2	F / C	125 / 20	8 / 55	1/2	D / C	30 / 21	48 / 54	1/2	C / C	27 / 21	53 / 55
US 150 Entrance Ramp	1/2	F / C	66 / 21	27 / 52	1/2	F / D	87 / 29	24 / 49	1/3	C / B	22 / 14	53 / 55	2/3	D / B	29 / 19	52 / 54
I-265 Exit Ramp	1/2	D / C	32 / 20	54 / 54	1/2	D / C	33 / 26	54 / 53	2/2**	C / B	27 / 18	58 / 59	2/3	C / B	28 / 18	54 / 57
I-265 Entrance Ramp	1/2*	C / B	23 / 13	57 / 59	1/2*	C / B	27 / 15	57 / 59	2/2	C / B	23 / 13	56 / 59	2/3	D / B	32 / 17	53 / 58
Spring St Exit Ramp	1/3	C / B	24 / 13	56 / 58	1/3	C / B	25 / 15	56 / 58	1/3	C / B	24 / 13	53 / 58	1/4	D / B	32 / 18	54 / 57
Spring St Entrance Ramp	1/3	D / B	29 / 16	54 / 57	1/3	D / B	30 / 18	55 / 57	1/3	E / B	37 / 19	51 / 57	1/3	E / B	37 / 19	52 / 56
EASTBOUND I-265																
State St Exit Ramp	1/2	B / C	17 / 24	58 / 57	1/2	B / C	19 / 28	57 / 56	-	-	-	-	-	-	-	-
State St Entrance Ramp	1/2	C / C	20 / 26	58 / 56	1/2	C / D	23 / 31	57 / 55	1/3	B / C	17 / 20	58 / 56	1/3	B / C	17 / 21	58 / 54
Grant Line Rd Exit Ramp	1/2	C / C	21 / 27	56 / 54	1/2	C / D	24 / 32	55 / 52	1/2	C / D	26 / 33	55 / 52	1/2	C / D	26 / 34	56 / 51
WESTBOUND I-265																
Grant Line Rd Entrance Ramp	1/2	C / D	20 / 29	58 / 55	1/2	F / F	64 / 150	43 / 10	1/2	C / F	25 / 106	57 / 19	1/2	C / F	26 / 107	57 / 18
State St Exit Ramp	1/2	C / E	21 / 43	56 / 41	1/2	F / F	70 / 84	30 / 18	1/2	C / E	26 / 37	56 / 53	1/2	C / E	26 / 37	56 / 52
State St Entrance Ramp	1/2	D / E	32 / 41	41 / 38	1/2	F / F	69 / 50	21 / 32	-	-	-	-	-	-	-	-
WESTBOUND I-64																
Elm St Exit Ramp	2/2	B / E	18 / 45	53 / 48	2/2	C / F	21 / 58	52 / 41	2/2	C / F	21 / 50	52 / 45	2/2	C / F	21 / 48	52 / 47
Spring St Entrance Ramp	1/2*	B / D	11 / 29	58 / 52	1/2*	B / F	14 / 55	57 / 31	1/2*	B / E	15 / 35	57 / 48	1/2*	B / E	15 / 35	57 / 49
I-265 Exit Ramp	1/3	B / E	12 / 35	55 / 43	1/3	B / F	15 / 48	54 / 37	2/3	B / C	12 / 25	57 / 54	2/3	B / C	11 / 24	57 / 54
I-265 Entrance Ramp	1/3	B / D	10 / 29	58 / 54	1/3	B / D	13 / 33	58 / 52	2/3	B / C	11 / 28	58 / 52	2/3	B / C	11 / 27	58 / 55
US 150 Exit Ramp	1/3	B / D	10 / 30	56 / 51	1/3	B / D	14 / 34	55 / 49	2/3**	B / C	11 / 28	58 / 53	2/3**	B / C	10 / 27	58 / 53
US 150 Entrance Ramp	1/3	A / C	8 / 22	59 / 56	1/3	A / C	10 / 23	59 / 56	1/3	B / C	11 / 27	59 / 55	1/3	B / C	11 / 27	59 / 54
SR 62/64 Exit Ramp	2/3	A / B	6 / 16	59 / 56	2/3	A / B	8 / 18	58 / 55	2/3	A / C	8 / 21	58 / 54	2/3	A / C	8 / 21	58 / 54
SR 62/64 Entrance Ramp	1/2	A / C	8 / 21	59 / 56	1/2	A / C	10 / 21	58 / 56	1/2	B / C	10 / 24	59 / 55	1/2	B / C	10 / 25	59 / 55

Note: The highlighted values indicate unacceptable operating conditions.
* Simulated LOS.

5.9.2 *Intersections*

AM and PM peak hour operation of all signalized intersections and select unsignalized intersections within the area of influence were evaluated using Synchro 10 software. Outputs from analyses of 2019 existing conditions, as well as 2026 and 2046 forecasted No Build and Build conditions are provided in **Appendix L**. Outputs include forecast volumes, lane configurations, queue lengths, delays, and LOS for each alternative, analysis year and peak hour. There is no difference in intersection traffic forecasts or operations between Alternatives 1 and 2, as such they and are thus simply identified as Build in the results.

The 2046 peak hour approach and overall intersection levels of service for each intersection are summarized in **Table 5–6**. Per the IDM, intersection approaches should provide 2046 peak hour operations of LOS E or better, with the overall intersections operating at LOS D or better. The following conclusions were drawn from the intersection operations evaluation:

- The ramp terminal intersection at westbound I-64 and SR 62/SR 64 is the only location that shows any difference in LOS between Build and No Build LOS. The westbound exit ramp is near capacity in the 2046 PM peak under the No Build condition but operates at LOS C. The Build condition adds 21 more vehicles at the intersection during the PM peak hour, which is enough to degrade exit ramp operation to LOS E and the overall intersection operation to LOS D. These LOS values still meet the IDM criteria.
- The intersection at US 150 and Old Vincennes Road/Lawrence Banet Road operates poorly in both the Build and No Build conditions. Analysis shows that queues on eastbound Old Vincennes Road currently extend beyond the designated turn bay and that there will be more queueing in the future. INDOT has a programmed project to modify this intersection (Des 2100047) but the proposed configuration is unknown as of the date of this report.
- The ramp terminal intersection at eastbound I-265 and State Street is expected to meet LOS criteria until approximately 2037. To meet LOS requirements, the exit ramp approach will ultimately need to be widened to allow a second left turn lane. There is no difference in operation or improvement requirements between the Build and No Build conditions.
- The intersection of State Street and Daisy Lane is also expected to meet LOS criteria until approximately 2037. To meet LOS criteria after that, the intersection will need to be modified to provide two left turn lanes on eastbound State Street and two right turn lanes on southbound Daisy Lane. There is no difference in operation or improvement requirements between the Build and No Build conditions.
- No intersection queueing was found to affect freeway operation.

Table 5–6 2046 Intersection LOS

Location	Control	Scenario	Level of Service (AM / PM)				
			EB	WB	NB	SB	Intersection*
I-64 EB Ramps & SR 62 (SR 62 is N/S)	Signal	No Build	D/C	-/-	C/B	B/A	B/B
		Build	D/C	-/-	C/B	B/A	B/B
I-64 WB Ramps & SR 62/SR 64 (SR 62 is N/S)	Signal	No Build	-/-	C/C	A/B	A/C	B/C
		Build	-/-	C/**E**	A/B	-/C	B/D
US 150 & Old Vincennes Rd / Lawrence Banet Rd (US 150 is N/S)	Signal	No Build	**F/F**	**E/F**	**F**/D	D/**E**	**F/F**
		Build	**F/F**	**E/F**	**F**/D	D/**E**	**F/F**
US 150 & Old Vincennes Rd (East) (US 150 is N/S)	Signal	No Build	A/A	C/D	A/C	B/B	B/B
		Build	A/A	C/D	A/C	C/B	B/C
I-265 WB Ramps & State St/ Paoli Pike (State/Paoli is E/W)	Signal	No Build	C/B	C/C	B/B	D/C	C/C
		Build	C/B	C/C	B/B	D/C	C/C
I-265 EB Ramps & State St (State St is E/W)	Signal	No Build	B/B	D/B	-/-	D/**F**	C/**E**
		Build	B/B	D/A	-/-	D/**F**	C/**E**
State St & Daisy Ln (State St is E/W)	Signal	No Build	A/A	C/**F**	C/C	C/**E**	B/**E**
		Build	A/A	C/**F**	C/C	C/**E**	B/**E**
I-64 EB Ramps & Spring St/5th St (Spring St is E/W)	Signal	No Build	A/B	A/B	B/B	C/B	B/B
		Build	A/B	A/B	C/B	C/B	A/B
Spring St & 4th St (Spring St is E/W)	Stop on 4th	No Build	-/-	-/-	B/A	-/-	-/-
		Build	-/-	-/-	B/A	-/-	-/-
Spring St & I-64 WB Entrance (Spring St is E/W)	Stop on Wash.	No Build	-/-	-/-	C/C	-/-	-/-
		Build	-/-	-/-	C/C	-/-	-/-
Spring St & Scribner Dr (Spring St is E/W)	Signal	No Build	B/A	B/C	B/B	C/C	B/C
		Build	A/A	B/C	B/B	C/C	B/C
I-64 WB Exit/Elm St & Scribner Dr (Scribner Dr is N/S)	Signal	No Build	A/C	-/-	A/B	A/B	A/C
		Build	A/C	-/-	A/B	A/B	A/C

*Overall intersection LOS is undefined for two-way stop intersections.
Note: The highlighted values indicate unacceptable operating conditions.

Programmed intersection improvement projects identified in **Section 3** of this report affected the traffic control and lane configurations assumed at several intersections for the operations analysis. The following assumptions were made:

- The intersection of US 150 and Old Vincennes Road (east) was assumed to be a reduced conflict intersection beginning in 2026 under either Build or No Build Alternatives. The intersection will be signalized, but direct left turns from Old Vincennes Road to eastbound US 150 will not be allowed. These vehicles will need to turn right onto westbound US 150 and use a provided U-turn roadway to access eastbound US 150. This configuration was determined in cooperation with INDOT as the likely recommendation at this intersection.
- The intersection at US 150 and Old Vincennes Road/Lawrence Banet Road is programmed for modification; however, the proposed configuration is unknown at this time. The existing intersection configuration and traffic control were used for all analysis.
- There is a programmed project to convert Spring Street to a 2-way street through the I-64 interchange. Preliminary signal warrant analyses were performed using 2046 forecasted volumes and the proposed 2-way configurations for the existing unsignalized Spring Street intersections with Washington Place/ Westbound I-64 entrance ramp, 4th Street, and 5th Street/Eastbound I-64 ramps. The warrant analyses were used to inform the assumptions of future traffic control at the Spring Street interchange for the operational analysis. The analysis results indicate the intersection of Spring Street with the eastbound I-64 ramp is likely to warrant a traffic signal by 2046, and this intersection was therefore assumed to be signalized for the *Improve 64* evaluation. The Spring Street intersections with 4th Street and with the westbound I-64 entrance ramp/Washington Place are not expected to warrant signals in 2046 based on forecast volumes, so these intersections were assumed to have stop control on the side street for the *Improve 64* evaluation. The same traffic control and lane configurations were assumed for both Build and No Build analysis in 2026 and 2046. Traffic control at these intersections will ultimately be determined as part of the Spring Street modification project.

5.10 Predictive Safety Analysis

Alternative 1, Alternative 2, and the No Build were evaluated from a safety perspective using the predictive method of the FHWA's Interactive Highway Safety Design Model (IHSDM). IHSDM modeling was developed for years 2026 and 2046 using Indiana IHSDM calibration factors. The models were not calibrated to historic crash data, as they were used only for a comparative crash prediction of each alternative. Model limits were:

- I-64 from the SR 62/64 Interchange to the Spring Street Interchange
- US 150 from the I-64 Interchange to Lawrence Banet Road Intersection
- I-265 from the I-64 Interchange to Grant Line Road

The models include freeway, arterial, and ramp segments within the study limits in addition to the following ramp terminals and arterial intersections:

- SR 64/62 & I-64 ramp terminals (2)
- I-265 and Paoli Pike ramp terminals (2)
- I-64 and Spring Street ramp terminals and arterial intersections (5)
- US 150 and Old Vincennes Road Intersection
- US 150 and Lawrence Banet Road Intersection

The results of the 2046 IHSDM analysis are summarized in **Table 5–7.** Both the 2026 and 2046 analyses are provided in **Appendix M**. The results indicate that both Build Alternatives are expected to decrease predicted crashes at all severity levels despite a slight increase in traffic volume compared to the No Build Alternative. Alternative 2 has marginally lower expected crashes compared to Alternative 1. For practical purposes the alternatives should be viewed as having the same level of safety. The main differences between the alternatives are listed below:

- The addition of travel lanes reduces I-64 mainline crash totals for both Build Alternatives compared to the No Build.
- The increase in travel lanes on the system ramps between US 150 and I-64 increases ramp crashes for the Build Alternatives.
- Alternative 2 has fewer crashes on the US 150 ramps than Alternative 1 because only one ramp is expanded from one to two travel lanes.
- The I-64 & I-265 interchange ramps are expanded from one to two lanes in the Build Alternatives leading to an increase in crashes.
- Alternative 2 has longer I-265 ramps than Alternative 1, which accounts for the difference between the Build Alternatives.

While the IHSDM predictive models were not calibrated to historic crashes, the number of predicted 2046 total crashes for the No Build alternative is similar to crash numbers observed in 2017 through 2019. The 2046 predicted crashes on the I-64 mainline is 160, while the 2017-2019 average annual number of crashes on the same segment of I-64 was 157. The 2046 predicted crashes on the I-265 mainline is 52, while the 2017-2019 average annual number of crashes on the same segment of I-64 was 62.

The IHSDM analysis results are thought to underestimate the expected crash reduction of the Build Alternatives. The IHSDM predictive method focuses on the safety implications of geometric design but does not appear to adequately consider the safety implications of reducing queueing and congestion within the project limits. Of the 656 freeway mainline crashes that occurred in the analysis limits during 2017-2019, approximately half (323) occurred within the peak commuting hours of 7-10 am and 4-7 pm. Many of the crashes were related to traffic congestion and queueing, which are not directly addressed by the IHSDM methodology. While the relationship between traffic congestion and crashes is complex, recent Purdue University research found that crash rates on urban interstate segments were 20.7 times higher under congested conditions (speeds less than 45 mph) than under uncongested conditions.[2] A comparison of the 2046 peak period speeds predicted from the Vissim analysis of the *Improve 64* alternatives shows that the No Build condition is expected to have 93 instances where a freeway segment has 15-minute average speeds less than 45 mph. Build Alternative 2 is expected to reduce those congested segment instances by more than 70%, from 93 to 27. Nearly all the congested segment instances forecast in the 2046 Build condition are on segments outside of the project limits. For these reasons, both Build Alternatives do achieve the project goals to improve safety by reducing congestion related crashes.

Table 5–7 2046 IHSDM Predicted Crashes

Location	No Build				Alternative 1				Alternative 2			
	Fat.	Inj.	PDO	Total	Fat.	Inj.	PDO	Total	Fat.	Inj.	PDO	Total
I-64 Mainline	1	48	111	160	1	44	101	146	1	44	102	146
I-265 Mainline	0	16	36	52	0	17	36	53	0	17	36	53
US 150 Mainline	0	1	3	5	0	2	4	5	0	2	4	5
I-64/SR 62 Ramps	0	1	2	3	0	1	2	3	0	1	2	3
US 150 Ramps	0	1	2	4	0	2	4	6	0	2	3	5
I-265 Ramps	0	5	7	12	0	5	11	16	0	5	12	17
State St Ramps	0	4	5	10	0	3	4	6	0	3	4	6
Grant Line Rd Ramps	0	1	1	2	0	1	1	2	0	1	1	2
Spring St & Elm St Ramps	0	4	6	9	0	4	5	9	0	4	5	9
SR 62/64 Intersections	0	16	19	36	0	16	20	36	0	16	20	36
US 150 Intersections	0	2	5	7	0	2	5	7	0	2	5	7
State St Intersections	0	8	16	24	0	8	16	24	0	8	16	24
Spring St & Elm St Intersections	0	8	18	26	0	6	15	21	0	6	15	21
TOTALS	**2**	**116**	**231**	**348**	**1**	**110**	**224**	**335**	**1**	**109**	**224**	**335**

[2] Mekker, M.M.; Remias, S.M.; McNamara, M.L.; and Bullock, D.M., "Characterizing Interstate Crash Rates Based on Traffic Congestion Using Probe Vehicle Data" (2020). *JTRP Affiliated Reports.* Paper 31. https://doi.org/10.5703/1288284317119

The IHSDM analysis results did not predict any crash reduction due to changing the eastbound I-64 exit to I-265 from a left-hand exit in Build Alternative 1 to a right-hand exit in Build Alternative 2. This result was unexpected, as research cited in the US Department of Transportation's CMF Clearinghouse website indicates a crash reduction of up to 49% could be expected.[3]

5.11 Constructability and Maintenance of Traffic

5.11.1 Alternative 1

The Final Preliminary Engineering Scoping Report (Alternative 1) included MOT typical sections and a concept level description of the MOT phasing plan. The proposed alignments for Alternative 1 are essentially in the same location as the existing alignments. Therefore, any areas requiring pavement or bridge replacement make it impossible to build while maintaining the same number of existing travel lanes during construction. The MOT plan required a significant number of lane closures to build the project. For example, the maintenance of traffic for construction of the new westbound I-64 bridges over the widened I-64 & I-265 system interchange ramps requires significant temporary bridges, over-build, or new alignment. Closing freeway mainline or the system interchange ramps is not a viable option. For this reason, the maintenance of traffic cost of construction for Alternative 1 is expected to greatly outweigh the cost of Alternative 2.

5.11.2 Alternative 2

The proposed alignments of I-64, I-265 and the ramps were designed to allow for maximum traffic mobility and minimal lane closures during construction. For example, the westbound I-64 alignment was purposely shifted to the south to allow room to build two lanes of the new bridge while maintaining two lanes on the existing bridge. Most of the proposed mainline and ramp alignments are offset from the existing pavements to allow room for construction while maintaining the same number of existing lanes during construction.

Alternative 2 best achieves the maintenance of traffic goals for this project and does so in a manner that requires less cost for maintenance of traffic. This suggests that Alternative 2 is recommended from the standpoint of maintenance of traffic.

5.12 Estimated Cost

The Preliminary Scoping Report (PSR) estimated the cost of Alternative 1 at $137.5M in 2020 dollars, or $142.5M when escalated to 2021 dollars. Updates to unit prices, in particular those for rock excavation and retaining wall construction, have increased this estimate by $17.6M.

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[3] Zhou, H., Chen, H., Zhao, J., and Hsu, P., "Operational and Safety Performance of Left-Side Off-Ramps at Freeway Diverge Areas." Presented at the 89th Annual Meeting of the Transportation Research Board, Washington, D.C., (2010)

Additionally, the 10% contingency used in the Preliminary Scoping Report has been updated to 25% for this Engineer's Report, increasing the cost by $23.5M. Collectively, these changes have resulted in the Alternative 1 and 2 cost estimates to be $184.0 M and $162.2M, respectively, as listed in **Table 5–8**.

Table 5–8 Construction Cost Estimates – Year 2021 Dollars

	Alternative 1	Alternative 2
Engineer's Report	$ 184,006,000	$ 162,191,000

The project is programmed to let in March 2024 and as such, the estimates were escalated to 2024 dollars at 3% and 4% inflation, as shown in **Table 5–9**.

Table 5–9 Construction Cost Estimates – Escalation to 2024 $'s

	Alternative 1	Alternative 2
2024 $'s with 3% Inflation	$ 201,069,000	$ 177,230,000
2024 $'s with 4% Inflation	$ 203,021,000	$ 178,951,000

The $24.1M (12%) difference in costs between Alternative 1 and Alternative 2 represents a substantial savings that can be achieved by selecting Alternative 2 as the Recommended Alternative. Alternative 2 does achieve the project goal of yielding a construction cost that is less than Alternative 1. Supporting documentation is provided in **Appendix W**.

No costs were estimated for the No-Build alternative. The No-Build alternative is expected to have substantial costs associated with pavement preservation and/or replacement, and bridge rehabilitation and/or replacements. These costs were not estimated as the No-Build alternative does not satisfy the purpose of this project.

5.13 Recommendation

As described in **Section 1.4**, the purpose of the *Improve 64* project is to reduce traffic congestion to provide peak hour operating conditions at LOS D or better are provided within the area of need, where possible, and to address deteriorating infrastructure. This project will also allow INDOT to synchronize its asset management plans for aging infrastructure. The improved operating conditions will result in faster and more consistent travel speeds, reduced queuing, and fewer congestion-related crashes. These improvements to the I-64 and I-265 corridors will provide better travel time reliability along these critical routes and better mobility within the Louisville Metro Area. A simplified asset management plan will reduce impact to motorists and result in economies of scale.

The No Build alternative is not recommended because it fails to address congestion or aging infrastructure and thus does not satisfy the purpose of this project.

Alternative 1 and Alternative 2 are expected reduce congestion and address the issue of aging pavement; thereby satisfying this need statement. The reduction in congestion is expected to reduce congestion-related crashes and thus improve safety within the project limits.

The geometric goals of improving design speed and reducing the number of required design exceptions are achieved by Alternative 2. Alternative 1 utilizes a lower design speed and requires more design exceptions than Alternative 2 and is therefore not preferred.

The maintenance of traffic goals were largely attained by both Build Alternatives; however, Alternative 2 achieves all of these goals and does so in a manner that requires less cost for maintenance of traffic. This suggests that Alternative 2 is preferred from the standpoint of maintenance of traffic.

Section 5.12 discusses how the cost estimate for Alternative 1 has been adjusted to provide true comparison with Alternative 2. This has resulted in the cost of Alternative 1 being $203.0M in 2024 dollars, based on 4% inflation. Alternative 2 was found to have a construction cost of $179.0M in 2024 dollars, based on 4% inflation, which represents a 12% savings over Alternative 1 and achieves the project goal for reduced construction cost. For these reasons, Alternative 2 is the recommended alternative. In summary, Alternative 2:

- Achieves acceptable traffic operations through the design year
- Is expected to improve safety by reducing congestion-related crashes
- Provides for a higher design speed and fewer design exceptions than other alternatives
- Achieves the maintenance of traffic goals with a lower cost for maintenance of traffic
- Is the least expensive alternative by $24.1M (12%)

Alternative 2 improvements include added capacity, interchange modification, and bridge work as described in **Table 5–10.** Additional detail on the recommendation, including pavement replacement and roadway alignment can be found in **Chapter 6**.

Table 5–10 Alternative 2 Summary

Segment	Alternative 2
I-64 / US 150 Interchange	• Extend merge area for entrance ramp to EB I-64 • Add 1 lane to WB I-64 exit ramp • Bridge Painting Str No. 1 – EB US 150 over I-64 • Bridge Painting Str No. 2 – WB US 150 over I-64
I-64 from US 150 to I-265	• Add 1 lane to EB and WB I-64 • Replace Str No. 3 – EB I-64 over Quarry Rd • Replace Str No. 4 – WB I-64 over Quarry Rd
I-64 / I-265 Interchange	• Reconfigure EB I-64 to EB I-265 ramp to a right-side exit • Shift the alignment of EB I-64 to allow for new right-side exit ramp • Add 1 lane to all ramps • Maintain 2 lanes on EB I-64 and 3 lanes on WB I-64 through the interchange • Replace Str No. 5A – I-64 WB over I-64 EB to I-265 EB Ramp • Replace Str No. 6 – I-64 WB over I-265 WB to I-64 EB Ramp • Replace Str No. 7 –I-265 WB to I-64 EB Ramp over I-64 EB to I-265 EB Ramp • New Str No. 5B – I-64 EB over I-64 EB to I-265 EB Ramp
I-64 from I-265 to Spring St	• Add 1 lane EB to Cherry St • No added capacity on WB I-64 • Replace Str No. 8 – EB I-64 over Captain Frank Rd • Replace Str No. 9 – WB I-64 over Captain Frank Rd • Structural Overlay Str No. 10A (EB) & 10B (WB) – I-64 over Cherry St
I-64 / Spring St Interchange	• No added capacity
I-265 from I-64 to State St	• Add 2 lane to EB I-265 • Add 1 lane to WB I-265
I-265 / State St Interchange	• No added capacity • Deck Replacement Str No. 11 – I-265 EB and Ramp over State St • Str No. 12 – I-265 WB over State St
I-265 from State St to Grant Line Rd	• Add 1 lane to EB I-265 ending south of Green Valley Rd overpass

5.14 Other Improvements

The following improvements are not currently part of the *Improve 64* project but should be considered for implementation based on safety and/or operational concerns identified in this report.

5.14.1 *Eastbound I-64 at SR 62/64*

The eastbound I-64 ramp terminal intersection at SR 62/64 has an I_{cf} of 2.47, which indicates a higher-than-expected crash rate. Most of the crashes that occurred during the 2017-2019 analysis period were related to vehicles turning left from eastbound SR 64 to enter eastbound I-64. Many of these were either rear end crashes due to congested conditions, inattention or they were sideswipe crashes between vehicles in the two left turn lanes. Using durable markings to maintain the dotted lines that separate the two left turn lanes through the intersection should help minimize the sideswipe crashes. Google Earth aerial photography from 2020 also suggests that dotted lines may be leading vehicles in the outside left turn lane into the painted median for the westbound right turning roadway, which could cause drivers to over-correct and lead to sideswipes. These markings should be reviewed.

5.14.2 *I-265 & State Street Ramp Terminals*

The I-265 ramp terminal intersections with State Street both have a I_{cf} values of in excess of 3.0 and I_{cc} values of in excess of 1.0, which suggests that both crash frequency and crash severity are higher than expected. Crash narratives indicate that some westbound vehicles may have difficulty seeing opposing vehicles approaching on Kenzig Road, possibly due to the intersection offset. Adding a brief protected left turn phase for westbound traffic and a flashing yellow arrow left turn indication could improve safety. This is unlikely to impact intersection performance due to the low volume on Kenzig Road. Replacement of the southbound 5-section left turn indications at both intersections with a flashing yellow indications is also recommended, as is installation of backplates on all signal indications.

The ramp terminal intersection at eastbound I-265 and State Street is expected to meet LOS criteria until approximately 2037. To meet LOS requirements, the exit ramp approach will ultimately need to be widened to allow a second left turn lane.

5.14.3 *State Street & Daisy Lane*

The intersection of State Street and Daisy Lane is also expected to meet LOS criteria until approximately 2037. To meet LOS criteria after that, the intersection will need to be modified to provide two left turn lanes on eastbound State Street and two right turn lanes on southbound Daisy Lane. Recent improvements by the City of New Albany have improved the intersection performance in the short-term.

5.14.4 *US 150 and Lawrence Banet Road/Old Vincennes Road West*

This intersection has existing overall LOS of F in the AM peak hour and E in the PM peak hour due to high traffic volumes and closely spaced intersections on the side streets. By 2046, the intersection is expected to operate with overall LOS F in both the AM and PM peak hours under either Build or No Build conditions. In 2020, INDOT conducted a Road Safety Audit (RSA) that confirmed these same LOS deficiencies and identified crash problems at the intersection. The RSA recommended converting the intersection to a

Median U-Turn configuration. INDOT has a programmed intersection improvement project for this intersection that is anticipated to be open to traffic in 2026.

5.14.5 *I-64 High-Friction Surface Treatment*

High-friction surface treatment (HFST) will be applied to pavement on I-64 between the Spring Street interchange and Sherman Minton Bridge. A pattern of crashes due to wet pavement conditions was noted in the crash review in **Section 2.9**. It is estimated that HFST reduces crashes in wet conditions by 83%[4].

[4] Federal Highway Administration. High Friction Surface Treatments. https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/high_friction/