FINAL

Planning and Environmental Linkages (PEL) Report

I-70 & Kipling Interchange | PEL Study

I-70 & Kipling Interchange
PEL Study

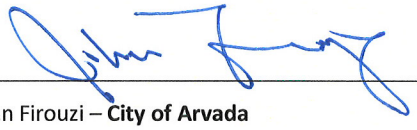
July 2013

Agency Support

The public agencies that were engaged in the preparation of this Planning and Environmental Linkages (PEL) Study for the I-70 and Kipling Interchange have expressed their support of this plan, as defined in this *Final PEL Report*, dated July 2013.

- Federal Highway Administration (FHWA) and Colorado Department of Transportation (CDOT) agree that this study fits the criteria for the FHWA PEL planning process. Through this process, the evaluation and findings of the PEL study can be more readily applied to subsequent National Environmental Policy Act (NEPA) evaluation. Resource agencies with jurisdiction in the interchange area have expressed support for the process and willingness to work cooperatively on future NEPA processes for individual interchange improvements. (See the Agency and Public Coordination section.)
- The agencies will work to complete the NEPA environmental evaluation requirements for specific improvements at the I-70 and Kipling Street interchange. Subsequent to future NEPA clearance, the agencies will work cooperatively to fund and implement the interchange area improvements.
- The agencies will develop collaborative transportation partnerships to support the interchange recommendations through the Denver Regional Council of Governments (DRCOG) planning process to help facilitate improvements to this interchange area.

Written letters of support from the agencies represented on the I-70 and Kipling Interchange PEL Study Technical Team have been requested and will be compiled by CDOT as they are received. The Technical Team supports the recommendations of this project as indicated by those letters.



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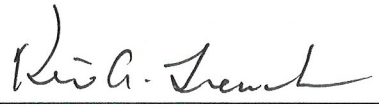

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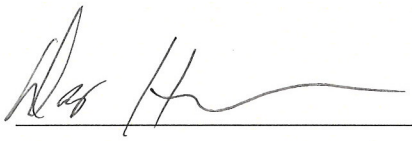

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List of Acronyms and Abbreviations

ADT – average daily traffic
AICP – American Institute of Certified Planners
AM – ante meridiem
BMPs – Best Management Practices
CDOT – Colorado Department of Transportation
CFR – Code of Federal Regulations
CPW – Colorado Parks & Wildlife
DRCOG – Denver Regional Council of Governments
EB – eastbound
FHWA – Federal Highway Administration
GIS – Geographic Information System
I-70 – Interstate 70
LOS – Level of Service
LT – left turn
MBTA – Migratory Bird Treaty Act
MPH – miles per hour
NEPA – National Environmental Policy Act
NB – northbound
NE – northeast
NW – northwest
PEL – Planning and Environmental Linkages
PE – Professional Engineer
PM - post meridiem
PTOE – Professional Transportation Operations Engineer
ROW – right-of-way
RT – right turn
RTD – Regional Transportation District
SB – southbound
Sec/veh – seconds per vehicle
SH – State Highway
SPUI – Single Point Urban Interchange
SW – southwest
TSM – Transportation System Management
U.S. – United States
USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service
Veh/hr – vehicles per hour
WB – westbound

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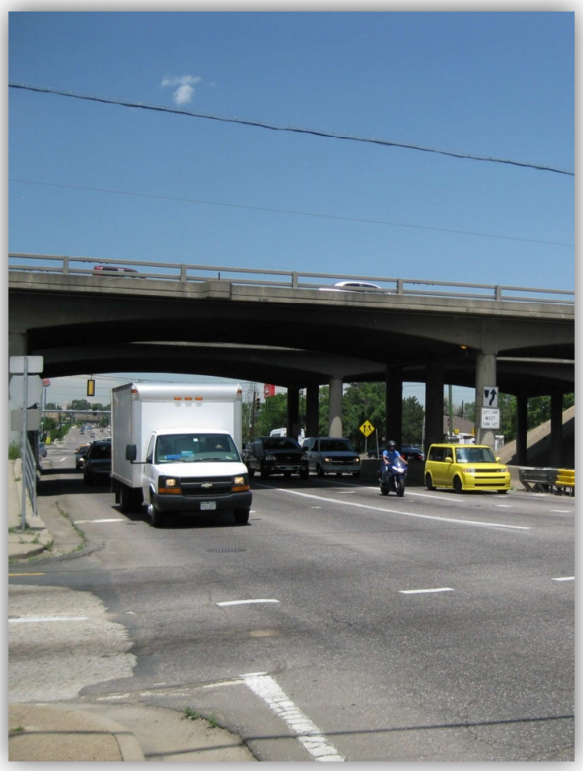


Looking north along Kipling Street towards I-70

Introduction

PEL Report

This report documents the results of a PEL study conducted to identify and evaluate transportation improvements at the Interstate 70 (I-70) and Kipling Street (State Highway [SH] 391) interchange. CDOT initiated the PEL study to develop a range of improvements to reduce congestion and improve operations and safety at the I-70 and Kipling Street interchange. A thorough and inclusive technical and public process helped to identify and screen a wide range of improvement alternatives.

This study was conducted following FHWA PEL guidance regarding the integration of transportation planning and the NEPA process, which encourages the use of planning studies to provide information for incorporation into future NEPA documents (23 Code of Federal Regulations [CFR] 450). The goal of these early integrated planning efforts is to streamline subsequent alternatives analysis during the NEPA process(es).

This PEL study is intended to provide the framework for the long-term implementation of interchange improvements as funding is available and to be used as a resource for future NEPA documentation. The technical reports prepared for this PEL study are intended for use in support of future NEPA documentation with minimal re-evaluation of alternatives.

The following NEPA process principles were followed for this PEL study:

- Preparation of a project Purpose and Need
- Screening of alternatives
- Coordination with federal, state, and local agencies, including concurrence at key decision points to align with those of the NEPA process:
    - Purpose and Need
    - Range of alternatives
    - Screening evaluation criteria
    - Identification of recommended alternatives

A project Purpose and Need was developed in accordance with Council on Environmental Quality NEPA regulations (40 CFR 1506.13). A thorough and inclusive technical and public process was applied to identify a reasonable range of alternatives, as described by the Council on Environmental Quality guidance (40 CFR 1502.14). Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.

The initial alternatives were screened to eliminate those that did not meet the project Purpose and Need and those that were deemed unreasonable based on an alternatives evaluation process that determined impacts and feasibility considering traffic operations, multimodal accommodations, community impacts, environmental impacts, engineering, and cost. Based on the alternatives evaluation, interchange alternatives were identified to carry forward into future NEPA process(es).

This PEL Study Report summarizes the findings and recommendations for the I-70 and Kipling Street interchange improvements. The following interim reports (available on the project website and from project team members) were completed throughout the study process and provide additional information and details regarding the analyses:

- *Final Existing Transportation Conditions Report* (May 2012)
- *Final Environmental Scan Report* (May 2012)
- *Final Alternatives Development and Analysis Report* (June 2013)

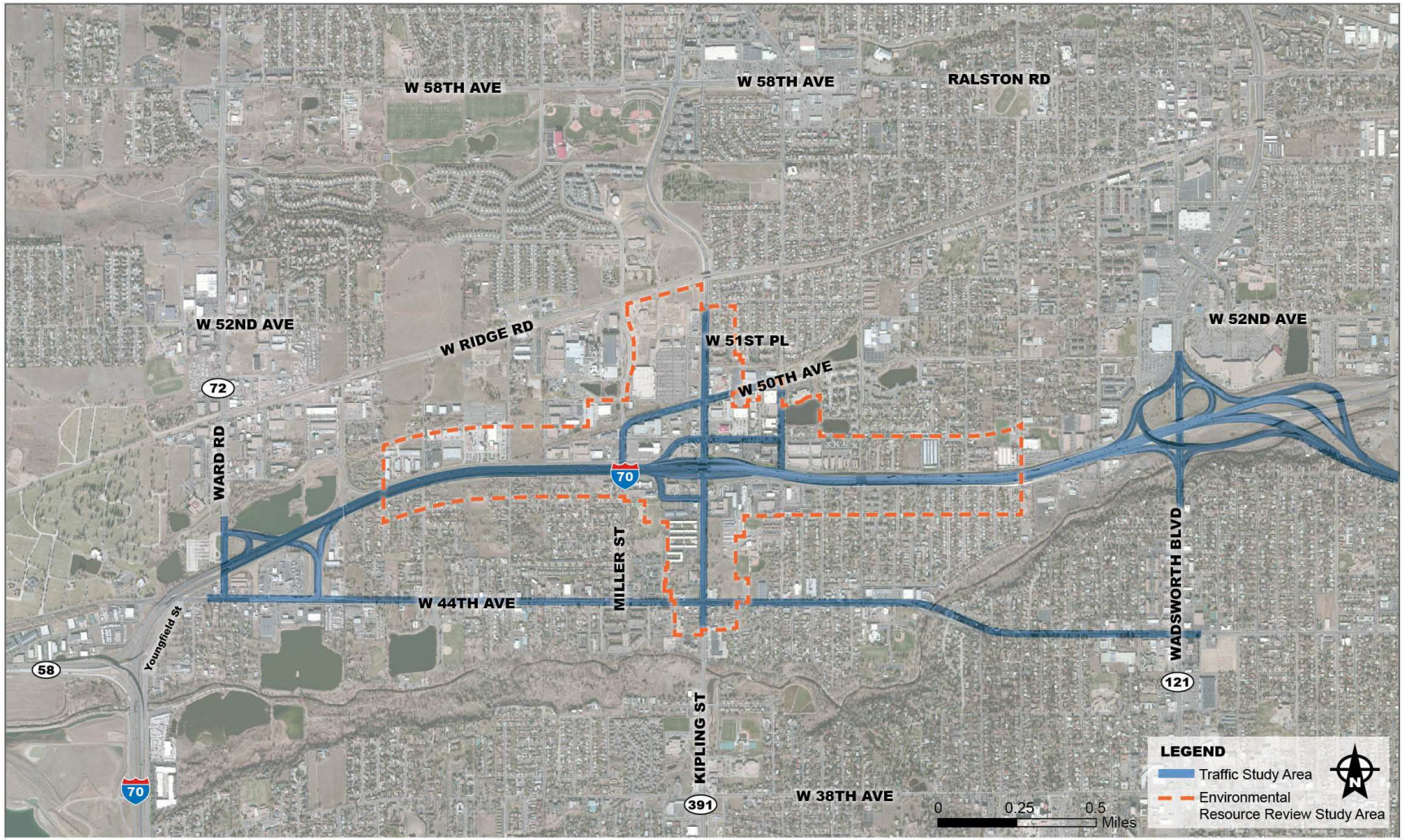
Study Area

The traffic study roadways and environmental study area are illustrated in **Figure 1.** The traffic study roadways include I-70 from Ward Road to Wadsworth Boulevard, which encompasses the interchanges adjacent to the I-70 and Kipling Street interchange. The traffic study roadways include Kipling Street from 44th Avenue to 51st Place, the major intersections approximately ½ mile north and south of the interchange. The traffic study area also includes 44th Avenue, which was evaluated as a parallel arterial to I-70 with the existing conditions evaluation.

The I-70 and Kipling Street interchange is located within the City of Wheat Ridge in Jefferson County. The boundary for the City of Arvada is located immediately north of the interchange between the 50th Avenue and 51st Avenue intersections. The interchange is located in a predominantly urban area and provides access to well-established commercial, residential and light industrial areas, as well as areas identified for urban renewal and new transit-oriented development in Wheat Ridge and Arvada.

The environmental study area is focused around the area of most likely physical impacts of interchange improvements along I-70 and Kipling Street. To take into account the potential for indirect or secondary effects to community or environmental resources as a result of a proposed action, the environmental study area was extended to the back property line of area parcels.

Figure 1: Study Area



DEPARTMENT OF TRANSPORTATION

I-70

The speed limit along I-70 through the study area is 65 miles per hour (MPH).

I-70 is a major east-west interstate highway that crosses the United States (U.S.) from Baltimore, Maryland to I-15 south of Salt Lake City, Utah. I-70 crosses central Colorado and travels through the middle of the Denver metropolitan area. Within the study area, I-70 has six through lanes. East of Kipling Street to Wadsworth Boulevard, I-70 has three through lanes eastbound and four through lanes westbound with the inside through lane merging at the Kipling Street bridge. There is also a westbound continuous auxiliary lane between the Wadsworth and Kipling interchanges.

Approximately ½ mile east of the Kipling interchange, I-70 was reconstructed in the early 1990s as part of the final connection of I-76. The Wadsworth interchange is a complex interchange including directional ramps from Wadsworth Boulevard and an eastbound exit ramp and westbound entrance ramp to/from I-76. Auxiliary and acceleration/deceleration lanes are provided through the Wadsworth and I-76 interchanges. East of I-76, I-70 provides six through lanes through the I-25 interchange and beyond.

Westbound I-70 approaching Kipling Street interchange

Kipling Street (SH 391)

Kipling Street is typical of many suburban arterials developed in the 1960s-1970s with numerous private driveway accesses, close intersection spacing, and limited storage for left turning traffic in the median.

Kipling Street is a principal north-south arterial within the Denver metropolitan area, providing almost 30 miles of continuity through the western Denver suburbs from C-470 in southern Jefferson County to Ralston Road in Arvada. It is designated SH 391 between US Highway 285 in Lakewood and 49th Avenue in Wheat Ridge. Within the study area, CDOT defines the functional classification of Kipling Street as Other – Principal Arterial, which is defined as a corridor that serves major centers of activity with relatively high traffic volumes and long trips, but with partial or no control of access.

Kipling Street has four through lanes and two continuous turn lanes from 44th Avenue to 51st Place with a posted speed limit of 40 MPH. The section north of I-70 contains six lanes with the additional lanes providing continuous auxiliary lanes between the westbound I-70 ramps and 50th Avenue.

Southbound Kipling Street approaching I-70 interchange

There are seven traffic signals along Kipling Street within the study area and only the southbound approach at the eastbound I-70 ramps and northbound approach at the 50th Avenue intersection have double left turn lanes. DRCOG provided traffic signal timing and coordination improvements along Kipling Street within the study area in 2009. That project resulted in travel time and speed improvements for travelers during peak hours in both directions of travel from 51st Place to Alameda Avenue in the City of Lakewood.

Logical Termini

Logical termini - rational end points for a transportation improvement and for environmental review.

Independent utility – usable and a reasonable expenditure, even if no additional transportation improvements are made in the area.

The study area boundaries meet the criteria for logical termini and independent utility as required by FHWA. The full logical termini analysis for the I-70 and Kipling Street interchange project is provided in a technical memo in **Appendix A**.

The FHWA guidance on NEPA and transportation decision-making includes policy regarding development of logical project termini, which are defined as rational end points for a transportation improvement and for environmental review. This guidance states that transportation projects must consider a "whole" or integrated project, satisfy an identified need, and be considered in the context of the local area. Otherwise, proposed improvements may only partially satisfy the need or may cause unexpected adverse impacts. An issue of "segmentation" may also occur when a transportation need extends throughout an entire corridor but environmental issues are evaluated for only a smaller segment of the corridor.

In order to ensure meaningful evaluation of alternatives and to avoid commitments to transportation improvements before they are fully evaluated, the evaluated action must:

- Connect logical termini and be of sufficient length to address environmental matters on a broad scope;
- Have independent utility; i.e., be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made; and
- Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements.

There is a drop in traffic volumes and accident rates outside the proposed study area boundaries. The traffic volume and crash data findings demonstrate that the area incorporates logical termini. The proposed study area is of sufficient length to address environmental matters on a broad scope. Future transportation expenditures to justify the current investment would not be required given the locations of the logical termini along I-70 from Ward Road to Wadsworth Boulevard and on Kipling Street between 44th Avenue and 51st Avenue. Therefore, this project demonstrates independent utility.

In addition, no other reasonably foreseeable transportation projects would be restricted by the recommended improvements of this study.

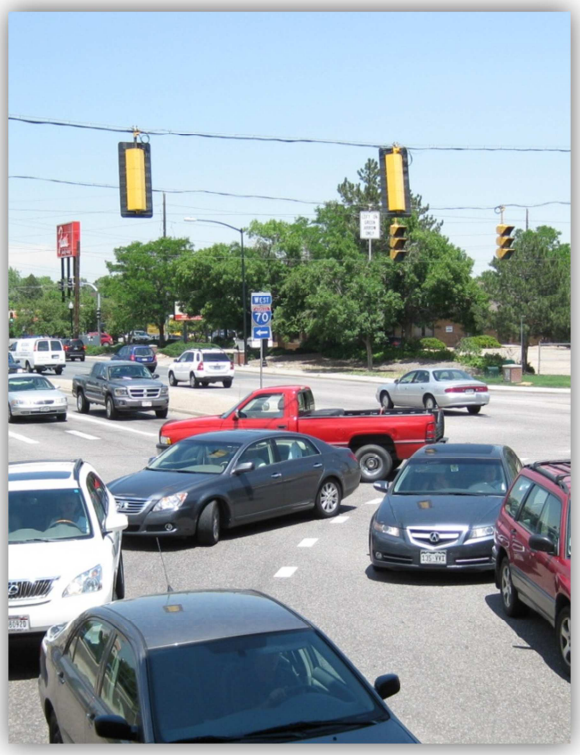
Planning Context

A number of plans have been developed that relate to the study area, including plans for the adjacent land use, local transportation plans, and statewide plans. Previous local and regional plans that were considered during the alternatives development process include:

- *Envision Wheat Ridge* (2009)
- *City of Wheat Ridge Bicycle and Pedestrian Master Plan* (2010)
- *City of Arvada Comprehensive Plan* (2006)
- *City of Arvada Pedestrian and Bicycle Access Plan* (2009)
- *Jefferson County Countywide Transportation Plan* (2002)
- *Jefferson County Bicycle and Pedestrian Plan* (2012)
- *2035 Metro Vision Regional Transportation Plan* (2011)
- *2035 Statewide Transportation Plan* (2011)

The reconstruction of the I-70 and Kipling Street interchange is consistent with local and regional transportation plans. The project is included in DRCOG's Fiscally Constrained 2035 Regional Transportation Plan (RTP). The RTP includes the interchange reconstruction in its list of 2015 to 2024 regionally significant and funded roadway capacity improvement projects.

The I-70 and Kipling Street interchange reconstruction project is also consistent with local planning documents. Although not included as locally-funded, the project is included in the Wheat Ridge Comprehensive Plan and Jefferson County Countywide Transportation Plan.



Kipling Street and westbound I-70 ramps intersection

Purpose and Need

CDOT in cooperation with local communities and other agencies is preparing this PEL study to identify and assess potential transportation improvements at the I-70 and Kipling Street interchange. Thorough documentation of the process and recommendations is a critical element of the PEL process so the decisions can be used in future NEPA process(es). This Purpose and Need was developed in coordination with agency stakeholders with review by the general public.

The specific needs, summarized below and shown in **Figure 2** on page 11, are based on the analysis and findings documented in this report and in separate documents prepared as part of this project, including the *Existing Transportation Conditions Report* (May 2012) and *Purpose and Need Statement* (May 2012).

Purpose of the Project

The purpose of the I-70 and Kipling Street interchange project is to reduce congestion, optimize operations, improve safety, and accommodate multimodal connections at the I-70 and Kipling Street interchange.

Need for Interchange Improvements

The existing design and configuration of the interchange no longer accommodates travel demands. Kipling Street is an important transportation corridor supporting mobility and economic activity in Jefferson County, including the cities of Wheat Ridge and Arvada. Improvements are needed to:

- Meet current and future traffic demands
- Improve operational efficiency of the interchange
- Improve traveler safety through the interchange
- Accommodate multimodal connections

Capacity and Operations

High traffic volumes and frequent congestion issues occur within the study area on Kipling Street north of the interchange and on I-70 east of the interchange. I-70 carries approximately 147,000 vehicles daily east of the Kipling Street interchange as measured by traffic counts taken in 2010. Existing daily traffic on Kipling Street collected for this project south of I-70 is approximately 42,000 vehicles, while north of I-70 the existing daily traffic is about 48,000 vehicles. By 2035, the average daily traffic (ADT) on I-70 is expected to increase about 25% to approximately 184,000 vehicles east of the Kipling Street interchange and the ADT on Kipling Street is expected to increase about 15% to about 55,000 vehicles north of I-70.

The interchange at I-70 and Kipling Street was constructed in 1967. Although it served the communities and traffic conditions when it was constructed, the tight diamond configuration with closely-spaced frontage road intersections can no longer effectively handle current or future traffic demands.

Problems at the interchange have the potential to redirect traffic and create operational and capacity issues on other local roadways.

Existing traffic volumes at the interchange create operating conditions characterized by restricted movements and recurring back ups. Specific movements that currently exhibit operational problems include the peak turning movements from the Westbound I-70 Off Ramp and the ante meridiem (AM) peak traffic backs up along Kipling Street on the southbound approaches to the interchange.

Many drivers making the right turn from the Westbound I-70 Off Ramp desire to turn left at the Kipling Street and 49th Avenue/North Frontage Road intersection, located 375 feet north of the ramp. There are currently signs that indicate the right turn lane as a continuous acceleration lane, but there are right turning drivers that stop in the continuous flow lane in order to wait for a gap in traffic to get to the northbound left turn lane at 49th Avenue. This reduces the capacity of the ramp signal and causes traffic to queue up the off ramp and onto the I-70 mainline.

Close spacing between frontage road intersections and interchange ramps does not provide adequate distance between traffic signals for traffic to progress through the interchange. Because of the relatively high overall intersection volumes, turn phases and a long signal cycle length are needed during the peak hours. These required signal operations combined with the over-capacity traffic volume conditions create vehicle queues that spill back from the I-70 ramp signals through the adjacent intersections at the frontage roads. Traveling through the four ramp and frontage road traffic signals with queues backing up through intersections requires drivers to slow their speeds through the interchange area, which further limits the capacity of the entire interchange area and adversely affects through traffic on Kipling Street.

The recurring congestion contributes to the difficulties for unfamiliar drivers to maneuver through the interchange area.

Because of the interchange location (on the edge of the I-70 mountain corridor) and the services provided (fuel, food, and lodging), many of the drivers using the interchange to and from the freeway are unfamiliar with the area. There is also a relatively high percentage of single unit trucks within the interchange area, providing area business service deliveries. The overall traffic operations are largely dependent on how easy it is for trucks and unfamiliar drivers to navigate the interchange and access the adjacent businesses.

South of I-70, the numerous driveways and unrestricted median encourages uncontrolled turns across Kipling Street that both increase potential for conflicts (and crashes) and disrupt traffic flow. Side-by-side opposing left turn lanes introduce multiple conflict points and create confusion because of the uncertainty of when and where drivers will enter the median lanes. In addition, drivers stopped in the turn lanes block the view of traffic in the through lanes, resulting in drivers making unsafe turns across through traffic. All of these conditions contribute to turbulence in the Kipling Street traffic flow and reduce its capacity.

Safety

The proposed action is needed to improve traveler safety through the interchange, including vehicles, pedestrians, and bicyclists.

Traffic Safety

The segment of I-70 at the Kipling Street interchange is above the average expected crash rate for the given average annual daily traffic. The occurrence of rear end crashes on I-70 in the vicinity of the interchange is closely tied to the heavy peak hour traffic volumes on the freeway. Over a three year period from 2008 through 2010, the majority of crashes on the four interchange ramps occurred on the Eastbound On Ramp and the Westbound Off Ramp and the majority of the crashes were rear end crashes during the post meridiem (PM) peak hour. On the Westbound Off Ramp, the majority of the crashes occurred at or near the free flow right turn lane from the off ramp to northbound Kipling Street when the lead vehicle did not utilize the free flow acceleration lane but instead stopped to yield to traffic on Kipling Street. The following vehicle then struck the lead vehicle.

Many of the crashes along Kipling Street in the study area occur because of congestion.

On Kipling Street, rear end crashes are the predominant crash type followed by approach turn crashes and broadside crashes. The following list describes the crash types that occur more frequently than expected in the study area and the potential cause:

- Rear-end crashes – related to congestion and frequent traffic signals through the corridor
- Approach turn and broadside – related to congested intersections, signal phasing, and signal head visibility
- Sideswipes when both vehicles are moving in the same direction – related to short weaving and lane-changing maneuvers

Pedestrian and Bicycle Safety

High traffic volumes and deficient pedestrian and bicycle facilities create safety concerns for pedestrians and bicyclists traveling through the study area. The interchange presents a particular challenge. The sidewalk on both sides of Kipling Street under the I-70 bridge is uncomfortable to use because of the proximity to the bridge piers and congested traffic lanes. The sidewalk on the west side of Kipling Street under the bridge also has steep sidewalk grades.

Over a three year period from 2008 through 2010, along Kipling Street in the study area, there were three crashes involving pedestrians and three crashes involving

bicycles. One of the pedestrian and one of the bicycle crashes occurred at the Kipling Street and 44th Avenue intersection. Two of the crashes involving bicycles occurred at the Kipling Street and South Frontage Road intersection. One of the pedestrian crashes occurred at the westbound I-70 ramps intersection.

The lack of access control along Kipling Street contributes to pedestrian and bicycle safety concerns. Along Kipling Street, pedestrians and bicyclists must cross many driveways where turning drivers are focused on entering or exiting Kipling Street and are not attentive to potential pedestrian conflicts.

Multimodal Connections

Automobiles, trucks, pedestrians, bicyclists, and buses travel through the I-70 interchange and Kipling Street lacks adequate facilities to accommodate effective connections. Effective multimodal connections provide direct links between facilities, such as existing sidewalks and multiuse paths, as well as accommodate efficient connections between modes, such as sidewalks at bus stops or multiuse paths leading to/from a rail station.

Transit Operations

Existing transit service on I-70 and Kipling Street in the study area includes local and express bus routes operated by RTD. RTD also plans to implement commuter rail transit along Ridge Road as part of the Gold Line commuter rail project, planned for opening to the public in 2016. A commuter rail station with associated transit-oriented development is planned at Ridge Road west of Kipling Street. With the opening of the commuter rail as currently planned, the proposed local bus service will remain the same as today. However, ridership for the bus route on Kipling Street serving the new rail station is expected to increase.

Buses, like other vehicles, will experience increased delays traveling through the I-70 and Kipling Street interchange area as traffic volumes increase. Buses also contribute to congestion by regularly stopping in the outside through-traffic lane, causing a temporary reduction in roadway capacity.

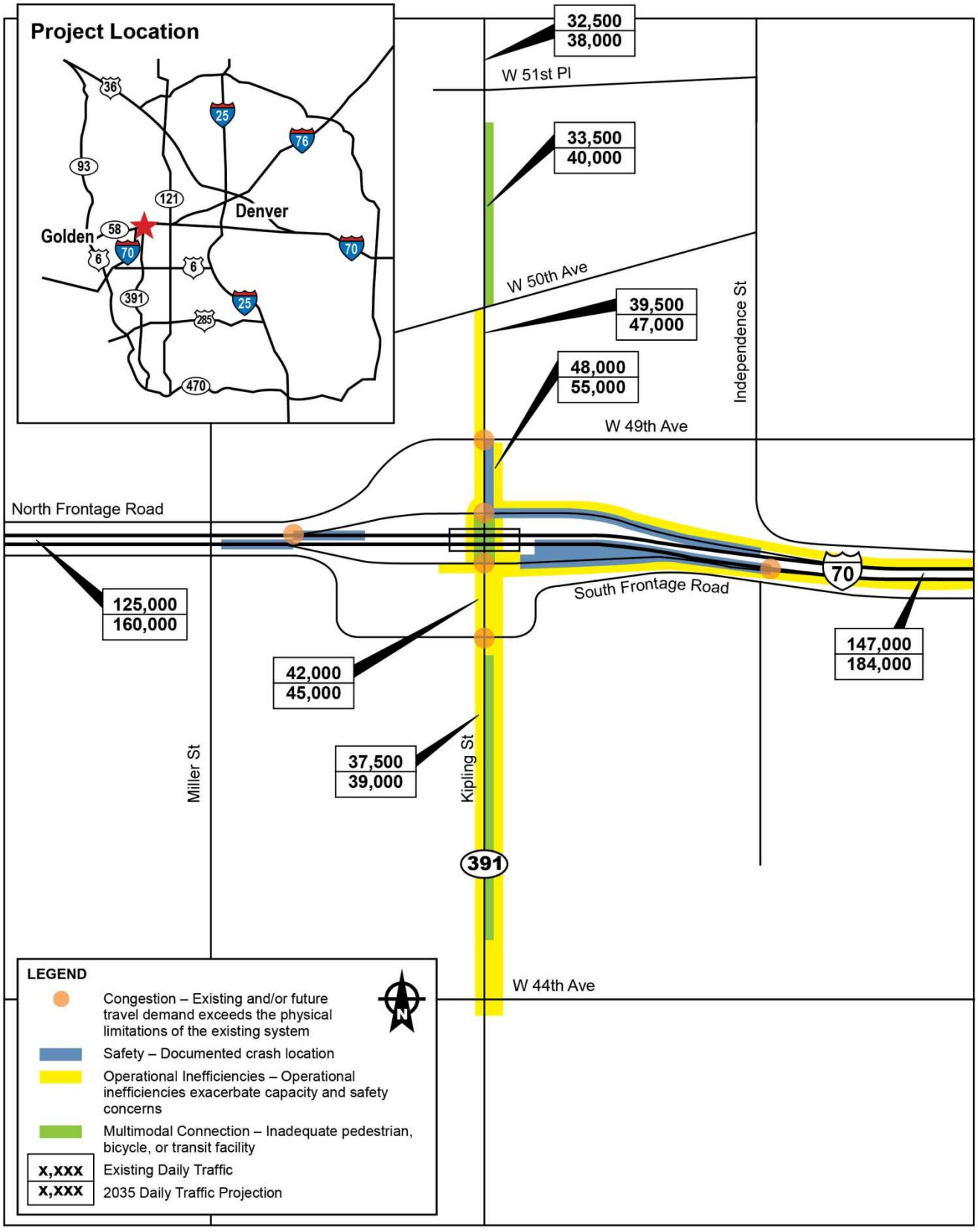
Pedestrian and Bicycle Facilities

Pedestrian and bicycle connections will become more critical with the opening of the Gold Line communter rail station north of the study area.

Local and regional plans identify the need for pedestrian and bicycle improvements to the Kipling Street corridor and its crossing of I-70. These needs will become more critical as the volume of pedestrian and bicycle travel is anticipated to increase after the opening of the Gold Line commuter rail station at Ridge Road.

Most of the existing sidewalks within the study area are attached to the roadway curb, not buffered from travel lanes, and are often too narrow to accommodate both pedestrian and bicycle use. The sidewalk on both sides of Kipling Street under the I-70 bridge is perceived to be unsafe by pedestrians because of the proximity to the bridge piers and congested traffic lanes. A segment of sidewalk between 44th Avenue and the South Frontage Road on the east side is attached, with narrow asphalt pavement in poor condition. There is no sidewalk on the east side of Kipling Street between 50th Avenue and 51st Place.

Figure 2. Display of Interchange Needs



Looking south along Kipling Street towards I-70

Alternatives Evaluation Summary

An objective of the PEL study was to work with stakeholders to analyze and develop a range of short- and long-term improvements to reduce congestion and improve operational performance and safety at the interchange. The alternatives evaluation process included developing screening criteria based on the project Purpose and Need, developing a full range of alternatives, and documenting the elimination of alternatives to limit the need for consideration during future NEPA process(es). The alternatives screening process included public involvement and outreach efforts were conducted with the local agencies and area stakeholders.

The agency coordination and public involvement activities conducted for this project are summarized later in this report.

General alternative concepts were developed and subjected to a Level 1 "fatal flaw" screening to eliminate alternatives that do not meet the project Purpose and Need. Alternatives from the Level 1 screening that were recommended for further evaluation were refined to complete additional and more detailed analysis to determine whether or not each alternative meets the Purpose and Need, compare how well each alternative would perform, and identify what impacts each alternative would have. The alternatives remaining after the Level 2 evaluation were further refined through conceptual design in Level 3 for final recommendation.

The development and evaluation of the interchange alternatives, summarized in this section, is documented in the *Final Alternatives Development and Analysis Report* (June 2013).

Transportation System Management (TSM) Improvements

TSM improvements identify options that would maximize the efficiency of the existing transportation system without major investments in new infrastructure. Several TSM strategies have been implemented within the study area and were considered as improvements on the corridor. The Kipling Street corridor was

retimed by DRCOG in 2009, and CDOT optimizes the interchange signal timing as needed at the I-70 and Kipling Street ramps. Ramp metering is in place on the Eastbound I-70 On Ramp and is utilized during the morning peak period.

When the Gold Line commuter rail line opens, there may be a reduction of trips on I-70 in the study area due to an increase in transit ridership. The Gold Line station located north of the study area may also result in a higher volume of traffic on Kipling Street. Variable message signs will be used for the Gold Line on the freeway and Kipling Street to alert passengers of parking availability, which may reduce trips through the interchange when the station parking lot is over capacity. The Gold Line commuter rail line is projected to open in 2016.

These improvement strategies alone will not be sufficient improvements for the corridor to operate acceptably in the long-term design year. In addition, safety and roadway geometric improvements are needed to improve interchange operations.

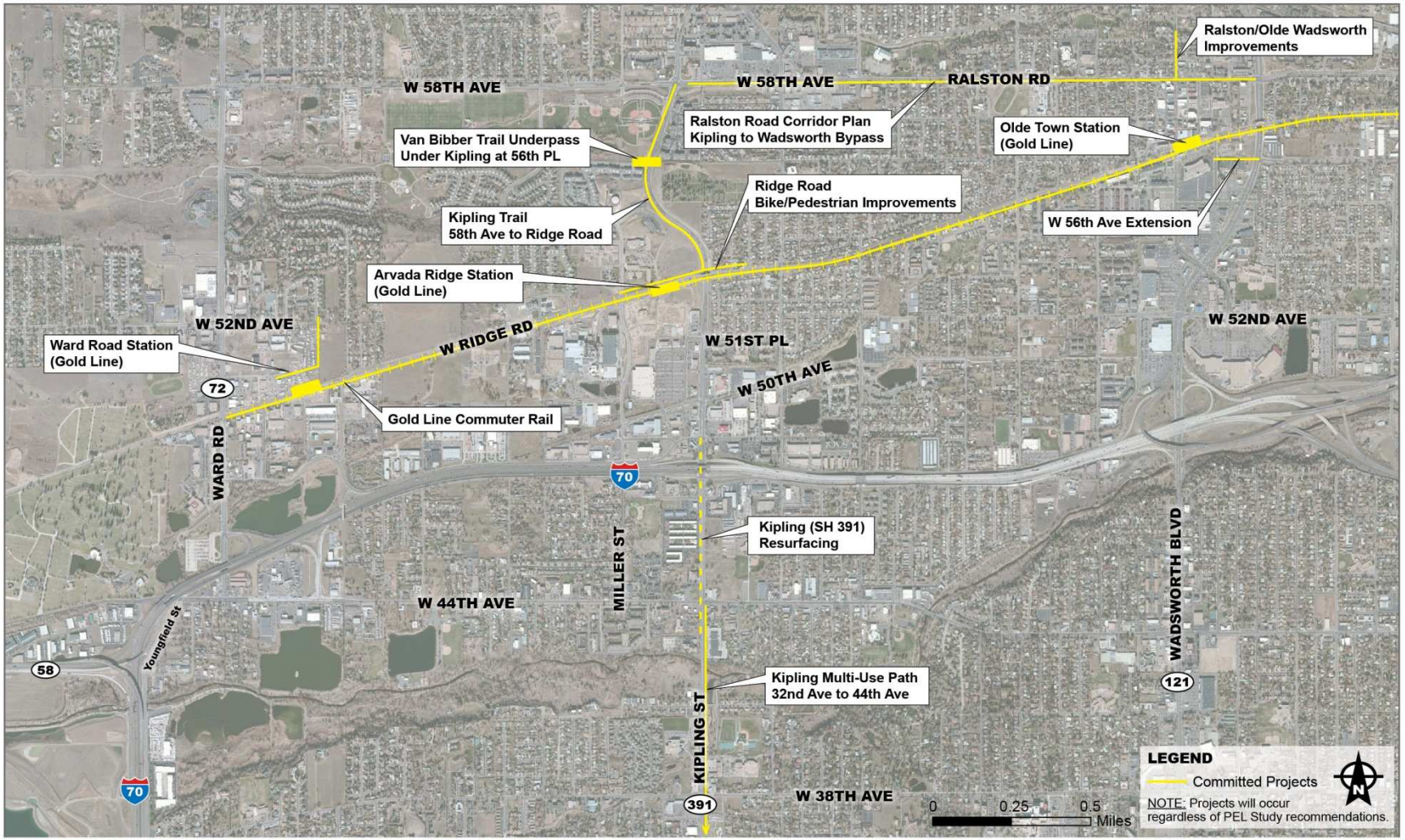
No Action Alternative

Improvements to the pedestrian and bicycle connections through the interchange will become more critical with the opening of the Gold Line commuter rail line and construction of new multi-use trails north and south of the interchange.

The No Action alternative does not meet the Purpose and Need. The No Action alternative is included as a baseline for comparison to the action alternatives. Under the No Action alternative, only improvements that are already planned and funded by CDOT, the County, or cities would be completed. There are no current transportation improvement projects within the area immediately adjacent to the I-70 and Kipling interchange. However, there are a number of engineering and planning efforts taking place in the near term within the larger area surrounding the interchange. Each of these programmed improvements with committed funding sources is shown in **Figure 3**. Although some of these projects are outside the defined study area, they will impact regional travel through the interchange and are considered part of the No Action alternative.

- **Kipling Multi-Use Path, 32nd Avenue to 44th Avenue** - Project includes the construction of a detached, multi-use trail on east side of Kipling Street.
- **Kipling Trail, 58th Avenue to Ridge Road** - The project includes construction of a new detached, multi-use trail connection on the west side of Kipling Street as part of the Transit Oriented Development Access Plan for the Gold Line Arvada Ridge rail station.
- **Ridge Road Bike/Pedestrian Improvements** - The project includes widening Ridge Road to provide an improved bicycle and pedestrian connection to the Gold Line Arvada Ridge rail station.
- **RTD Gold Line** - The commuter rail project includes future parking and transportation connection improvements at three stations surrounding the I-70 and Kipling interchange: the Arvada Ridge Station (at Kipling Street and Ridge Road), Ward Road Station, and Olde Town Station.
- **Van Bibber Trail Underpass** - This includes an underpass of Kipling Street at 56th Place connecting the residential areas east of Kipling to the recreational areas and Van Bibber Trail west of Kipling.
- **Ralston Road Corridor Plan** - This planning project includes preliminary design for multimodal transportation improvements along Ralston Road between Kipling Street and Wadsworth Bypass.

Figure 3: Committed Area Transportation Projects



Level 1 (Purpose and Need) Alternatives Screening

Level 1 screening identified a range of interchange improvements that could meet the project Purpose and Need, while eliminating concepts from detailed consideration that had "fatal flaws" (that did not meet Purpose and Need).

Level 1 screening was supported by the baseline data collected at the initiation of the study.

Level 1 screening criteria were developed to screen concepts in the following areas: traffic operations, safety, and multimodal connections. Alternative concepts were evaluated with a "Yes" or "No" answer to the following questions to demonstrate each alternative's ability to meet the project Purpose and Need.

- Traffic Operations:
  - Can the alternative meet current and future traffic demands?
  - Does the alternative improve operations by addressing the interaction of the Kipling interchange with the frontage road intersections?
- Safety:
  - Does the alternative improve existing conditions that contribute to higher than expected crash rates?
- Multimodal Connections:
  - Can the alternative accommodate bicycle, pedestrian, and transit connections through the interchange?

An alternative with a "No" answer to any of the above questions was considered to not meet the project Purpose and Need and was eliminated as a stand-alone solution.

Thirty-two alternatives were considered during the Level 1 screening. Six alternatives were eliminated from further consideration because they did not meet the project Purpose and Need. The alternatives eliminated at Level 1 screening were:

- Alternative 2 – Diamond with Roundabout at Ramps
- Alternative 5 – Diamond with Rounabouts at Frontage Roads
- Alternative 14 – Three-Level Diamond
- Alternative 15 – Half Diamond to East at Garrison
- Alterative 16 – New Westbound Off Ramp West of Kipling
- Alternative 20 –Local Road I-70 Grade Separation at Miller & Independence

Fifteen alternatives were eliminated from consideration as stand-alone alternatives, but these small-scale alternatives were considered as elements of larger-scale alternatives in Level 2 screening. These were:

- Alternative 8 – Partial Cloverlead with Loop SW Quadrant
- Alternative 10 – Improved Tight Diamond Added Lanes on Kipling & Ramps
- Alternative 13 – Double Crossover Diamond
- Alternative 18 – Southbound to Eastbound Flyover Ramp
- Alternative 19 – Bike Path I-70 Grade Separation at Interchange

- Alternative 22 – Added Turn Lanes at Ramps
- Alternative 23 – Ramp Meter Modifications
- Alternative 24 – Eastbound Ramp Merge Lane Modifications
- Alternative 25 – Close West Side of 49th Avenue
- Alternative 26 – Rremove 49th Avenue Signal (closure or right in right out)
- Alternative 27 – Realign South Frontage Road Further South
- Alternative 28 – Close South Frontage Road at Kipling
- Alternative 29 – Widen/Improve Paths Under I-70 Bridge
- Alternative 30 – Bus Pullouts
- Alternative 32 – Close Driveways Between Ramps and Frontage Roads

In total, 12 alternatives were carried forward for consideration in Level 2 screening (including the No Action alternative). Those alternatives were:

- No Action
- Alternative 1 – Single Point Urban Interchange (SPUI)
- Alternative 3 – Diamond with Roundabouts at Ramps & Frontage Roads
- Alternative 4 –Diamond with Six-Leg Roundabouts at Ramps & Frontage Rd
- Alternative 6 – Fully Directional
- Alternative 7 – Partial Cloverleaf with Loops SW & NE Quadrants
- Alternative 9 – Partial Cloverleaf with Loops SW & NW
- Alternative 11 – Texas Frontage Road Diamond
- Alternative 12 – Traditional Diamond
- Alternative 17 – Button Hook Ramps
- Alternative 21 – Michigan Lefts at Ramps
- Alternative 31 – Single Roundabout Interchange

Level 2 Alternatives Screening

Alternatives from the Level 1 screening that were recommended for further evaluation were refined to add more definition of the proposed improvements, to better understand the operations and costs of the alternatives, and to provide information for further assessment in the Level 2 evaluation. The purpose of the Level 2 evaluation was to complete additional and more detailed analysis to determine whether or not each alternative meets the Purpose and Need, compare how well each alternative would perform, and identify what impacts each alternative would have.

In addition to the 12 interchange configuration alternatives carried forward from Level 1 screening, the following four new stand-alone alternatives were added for consideration in the Level 2 screening based on public and Technical Team input for combining elements of other alternatives:

- Alternative 33 – Loop SW Quadrant & Improved WB Ramps (combination of Level 1 Alternatives 8 and 11)

- Alternative 34 – Improved Tight Diamond with SB to EB Flyover (combination of Level 1 Alternatives 10, 18, and 11)
- Alternative 35 – Double Crossover Diamond Interchange (combination of Level 1 Alternatives 13, 26, and 28)
- Alternative 36 – Button Hook Ramps South & Improved WB Ramps (combination of Level 1 Alternatives 11 and 17)

With these additional alternatives, 16 alternatives (including the No Action alternative) were considered in the Level 2 screening.

At the end of the Level 2 screening, the following 11 alternatives were not carried forward for further consideration:

- Alternative 3 – Diamond with Roundabouts at Ramps & Frontage Roads
- Alternative 4 –Diamond with Six-Leg Roundabouts at Ramps & Frontage Rd
- Alternative 6 – Fully Directional Interchange
- Alternative 9 – Partial Cloverleaf with Loops SW & NW Quadrants
- Alternative 11 – Texas Frontage Road Diamond
- Alternative 21 – Michigan Lefts for Ramps
- Alternative 31 – Single Roundabout Interchange
- Alternative 33 – Loop SW Quadrant & Improved WB Ramps
- Alternative 34 – Improved Tight Diamond with SB to EB Flyover
- Alternative 35 – Double Crossover Diamond Interchange
- Alternative 36 – Button Hook Ramps South & Improved WB Ramps

Five alternatives (including the No Action alternative) were carried forward for further consideration. The four action alternatives meet the project Purpose and Need and goals while minimizing impacts to natural and community resources.

The alternatives carried forward from Level 2 screening were:

- No Action
- Alternative 1 – SPUI
- Alternative 7 – Partial Cloverleaf with Loops SW & NE Quadrants
- Alternative 12 – Traditional Diamond
- Alternative 17 – Button Hook Ramps

The draft design concepts for the four alternatives are shown in **Appendix B**.

Level 3 Alternatives Refinement

Based on coordination with the Technical Team, local agencies, area stakeholders, and the general public, an additional evaluation process was conducted at the beginning of the Level 3 evaluation to evaluate if the alternatives should be further narrowed prior to refining the conceptual design and traffic operations analysis for the recommended alternative(s), which are the alternative(s) that will be endorsed to be carried into the NEPA process as the Preferred Alternative(s).

Priority Criteria Evaluation

The evaluation criteria for Level 3 were prioritized to include criteria of most concern from comments received during small group meetings with the Technical Team and area stakeholders, presentations to local agency elected officials, and the open house held with the general public. For this level of screening, the criteria of highest priority for the evaluation of interchange alternatives were developed based on stakeholder input. The criteria were:

- Interchange Capacity
- Driver Expectancy
- Pedestrian and Bicycle Crossings
- Property Impacts
- Business Access
- Phased Construction Opportunities
- Project Costs

The four remaining alternatives were compared against these seven priority evaluation criteria using the Level 2 analysis results. The Partial Cloverleaf alternative (Alternative 7) and Button Hook Ramps alternative (Alternative 17) under perform compared to the SPUI (Alternative 1) and the Traditional Diamond (Alternative 12) on many of these priority criteria, including driver expectancy, pedestrian and bicycle crossings, property impacts, and business access.

Many of the drivers using this interchange are not from this area, so driver expectancy is important to optimize the operational efficiency of the interchange. The Partial Cloverleaf alternative is worse for driver expectancy because the loop ramps require out-of-direction turn movements (i.e., a driver must turn west to access eastbound I-70 via the loop ramp in the southwest quadrant). With drivers unfamiliar to the area, this can lead to sudden lane changes leading to the loop ramps. The Button Hook Ramps alternative is difficult for driver expectancy because it is an unusual interchange configuration and the unusual movements for ramp access to/from Kipling Street via the frontage roads are perceived difficult for drivers to negotiate.

There are serious concerns for the pedestrian and bicycle crossings with the Partial Cloverleaf and Button Hook Ramps alternatives because both configurations include crossings of free-flow loop ramp movements, which are substantially higher speed movements than the free-flow right-right turn movements provided in the SPUI and Traditional Diamond alternatives. The Traditional Diamond alternative has no pedestrian crossing of Kipling Street at the unsignalized 49th Avenue/North Frontage Road intersection.

The Partial Cloverleaf and Button Hook Ramps alternatives require more right-of-way (ROW) than the SPUI and Traditional Diamond alternatives for the ramp configurations. The physical ROW acreage for the Traditional Diamond alternative is similar, but most of the acreage and full property acquisitions are for the relocated South Frontage Road, which helps reduce the access impacts south of the interchange. The loop ramps of the Partial Cloverleaf alternative require closing the

direct frontage road access in the northeast and southwest quadrants, which impacts access to the surrounding businesses worse than the SPUI alternative.

The Button Hook Ramps alternative is worse for area business access than the SPUI and Traditional Diamond alternatives due to the unusual interchange configuration and perceived difficulty for drivers to negotiate through the interchange area via the frontage roads.

Comparatively, the SPUI alternative and Traditional Diamond alternative ranked high on the majority of the prioritized criteria.

The Partial Cloverleaf alternative would provide the highest interchange capacity of the four remaining alternatives with the loop ramps providing free-flow operations and simplified signal phasing; however, the SPUI and Traditional Diamond alternatives would also provide traffic operational benefits notably better than the typical CDOT operational standards. The Technical Team determined that the small operational benefits of the Partial Cloverleaf alternative over the SPUI and Traditional Diamond alternatives did not outweigh the additional property and business access impacts.

The SPUI alternative provides the least opportunities for phased construction of the ultimate interchange layout because the freeway bridge and ramps must be constructed as one construction project with a relatively large funding source. The SPUI construction cannot be phased with separate construction projects, which would need less funding at one time. However, comments from the public and stakeholders indicated that the substantially lower property impacts of the SPUI (less than 10% of any of the other remaining alternatives) are more important than the desire for major construction to occur earlier (which may be possible with a series of smaller funding sources rather than waiting for a single, large funding source). Also, the SPUI alternative does not preclude short-term improvements that will provide safety and capacity benefits.

Recommended Alternatives

The alternatives were not further narrowed and all four alternatives will be carried forward for further evaluation in future NEPA process(es). However, after a comparison of the four alternatives against the priority criteria, the SPUI and Traditional Diamond alternatives are the recommended alternatives from this PEL study evaluation.

Further definition and evaluation for the two recommended alternatives are described in the “Study Recommendations” section of this report.

Kipling Street at eastbound I-70 ramps intersection

Agency and Public Coordination

Understanding the ideas, perspectives, and needs of key stakeholders in the interchange area was critical to building broadly supported decisions and solutions. Stakeholder involvement was emphasized throughout the PEL process and feedback was solicited from the agency and public partners at key decision points to foster acceptance of recommendations.

Agency Coordination

Technical Team Meetings

CDOT provided multiple opportunities for the local jurisdictions, regional partners, resource agencies, and general public to engage and inform the study.

The study included the formation of a Technical Team that met frequently with the project team to provide technical input. The Technical Team included staff from CDOT, the cities of Arvada and Wheat Ridge, Jefferson County, DRCOG, RTD, and FHWA.

The Technical Team Charter, signed by all Technical Team members, identified roles, responsibilities, and the decision-making process for the project. The Charter established the concurrence points with meetings at key milestones within the study process and stated that concurrence for decisions presented at Technical Team meetings was provided with acceptance of the distributed meeting notes.

The Technical Team was heavily involved in shaping the alternatives evaluation criteria and performance measures, as well as the alternatives that were considered. Members of the Technical Team kept their respective elected officials updated and brought elected official feedback to the project team.

The evaluation criteria, performance measures, alternatives development, and alternatives screening were reviewed and approved by the Technical Team throughout the agency coordination process.

Concurrence was provided at the following key milestones:

- Technical Team Charter
- Purpose and Need Statement
- Evaluation Criteria
- Initial Alternatives Developed
- Level 1 Alternatives Screening Results
- Level 2 Alternatives Screening Results
- Level 3 Alternatives Evaluation Results
- Improvement Recommendations
- Final Study Recommendations

Ten meetings of the Technical Team were held:

- February 24, 2012
- March 12, 2012
- April 16, 2012
- June 1, 2012
- July 11, 2012
- August 24, 2012
- October 3, 2012
- November 9, 2012
- January 18, 2013
- April 19, 2013

Resource Agency Coordination

The study was coordinated with local, State and Federal resource agencies, including:

- City of Wheat Ridge Parks and Recreation Department
- Colorado Department of Public Health and Environment, Air Pollution Control Division
- Colorado Parks & Wildlife (CPW)
- Colorado State Historic Preservation Office
- DRCOG
- Jefferson County Parks and Open Space
- Jefferson County Planning and Zoning
- U.S. Army Corps of Engineers (USACE)
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service (USFWS)

Information was distributed to representatives at these resource agencies at two points during the study. Early in the study a letter and study area map were mailed as an introduction to this PEL process and requested input on the existing conditions and concerns within the study area. A second letter was mailed serving as an update on the study following Level 2 alternatives screening. Graphics of the two recommended alternatives and a summary of critical considerations were enclosed for review to identify potential resource impacts and next steps required for future NEPA process(es). A summary of the resource agency coordination and input is included in **Appendix C**.

Other Agency Coordination

Small group meetings were held with individuals representing public agencies and organizations, emergency providers, and others directly affected by the project work to identify likely impacts and help shape the study recommendations.

Presentations to inform stakeholders and gather feedback were also made.

These meetings and presentations occurred as follows:

- Transportation Environmental Resource Council Briefing – February 13, 2012
- Jefferson County Transportation Action and Advocacy Group Presentation – April 11, 2012 and December 12, 2012 and May 8, 2013
- LiveWell Wheat Ridge Meeting – May 22, 2012 and May 14, 2013
- City of Arvada Council Workshop Presentation – November 12, 2012
- Colorado State Patrol and Arvada Fire District Meeting – November 29, 2012
- Wheat Ridge Police Department and Pridemark Paramedic Services Meeting – November 29, 2012
- City of Wheat Ridge Public Works and Community Development Meeting – December 7, 2012 and May 8, 2013
- City of Wheat Ridge Council Presentation – December 17, 2012
- RTD Meeting – February 12, 2013

During coordination with LiveWell Wheat Ridge, the potential for a Health Impact Assessment (HIA) for the study area was discussed. Although a formal HIA was not performed for this study, many of the goals of an HIA were incorporated into the alternatives evaluation process. An overview of the study process related to an HIA is provided in the *Health Impact Assessment Overview, Connections and Strategies* Technical Memorandum in **Appendix A**.

Public Participation

In an effort to gain as much community input as possible, public participation was emphasized throughout the study process. It was important that all participants, including potential users of the interchange and roadways in the vicinity, clearly understand each alternative. The website and graphics illustrated proposed alternatives, operational characteristics, appearance, impacts, and cost estimates.

General Public Meetings

This study held two public meetings in open house format. The first meeting, held on April 25, 2012, served to introduce the project and discuss interchange travel conditions and the need for improvement. At the second meeting, held on December 4, 2012, alternatives and Level 1 and 2 evaluation results were presented for comment. The meetings were each attended by 55 – 85 individuals.

Public meetings were well attended

Community Focus Groups

Community Focus Groups were formed to advise the project team of the concerns of various groups of stakeholders in the area. Three separate focus groups were formed, including representatives from:

- Businesses surrounding the interchange area
- Residents and homeowners' associations
- Multimodal groups

The project team, comprised of CDOT and project consultant staff, met with each focus group two times during the alternatives evaluation to review proposed improvement alternatives and evaluation criteria and to discuss likely impacts of improvements and possible mitigation or resolution techniques.

Meetings were held as follows:

- Residential Group Meeting – August 7, 2012 and November 12, 2012
- Business Group Meeting – August 8, 2012 and November 14, 2012
- Multimodal Group Meeting – August 8, 2012 and November 14, 2012

Information Distribution

A postcard was distributed via U.S. Postal Service or email to over 4,500 property owners, tenants, and other interested individuals prior to each public meeting.

The study utilized many methods of advertising and outreach. Each public meeting was preceded by a news release, which was sent to local media outlets as well as local jurisdictions' Public Information Officers for inclusion in their community bulletins. Flyers advertising the first public meeting were distributed door-to-door to apartment buildings, community gathering places and high traffic businesses in the immediate interchange area, as well as local agency offices.

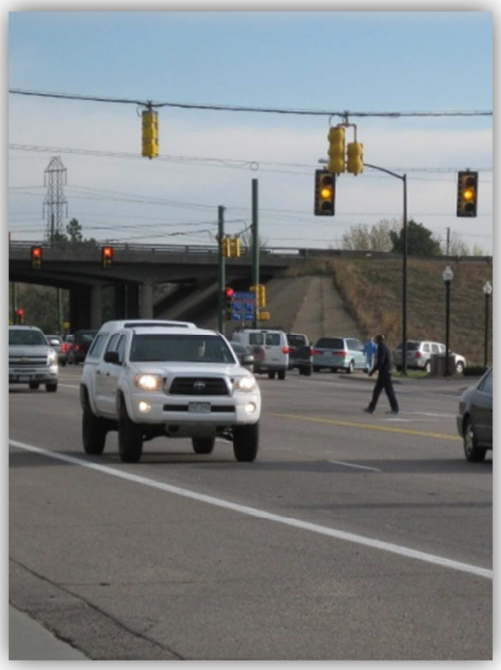
A final public notice to this mailing list is planned at the end of the study to describe the recommended improvements and inform the public regarding next steps towards improvement implementation.

Public Comments

Input was solicited at the public and focus group meetings and community members were also able to submit comments via the project website throughout the course of the study. Public meeting graphics and summaries of comments received were subsequently posted on the project webpage, http://www.coloradodot.info/projects/i70kiplingpel.

Comments received were shared with project staff and the Technical Team and considered during the alternatives development, evaluation and refinement process. Summaries of comments received are included in **Appendix D**.

Comments discussed during an open house meeting



Kipling Street and South Frontage Road intersection

Study Recommendations

Based on the results of the alternatives development and evaluation process, four interchange improvement alternatives will be carried forward into future NEPA evaluation. With the Level 3 alternatives evaluation, steps were taken to further narrow the alternative recommendations and to refine the design elements of the alternatives, considering design solutions to minimize costs and community impacts and maximize multimodal benefits. This evaluation information will be used to identify a Preferred Alternative during NEPA scoping.

Alternatives to be Carried Forward

All four action alternatives meet the project Purpose and Need and are considered reasonable alternatives. Therefore, the four action alternatives to be carried forward into future NEPA process(es) are:

- Alternative 1 – SPUI
- Alternative 7 – Partial Cloverleaf with Loops SW & NE Quadrants
- Alternative 12 – Traditional Diamond
- Alternative 17 – Button Hook Ramps

The design concepts for the four action alternatives are shown in **Appendix B**.

After a comparison of the four action alternatives against the priority criteria, the SPUI and Traditional Diamond alternatives were determined to meet the Purpose and Need to the highest degree while minimizing environmental and community impacts and they are the recommended alternatives from this PEL study.

Recommended Alternatives

Based on the Level 3 alternatives evaluation and public and agency input described in the *Alternatives Development and Analysis Report*, the SPUI and Traditional Diamond alternatives are recommended for consideration as the Preferred Alternative during a future NEPA process because these alternatives meet the

Purpose and Need to the highest degree while minimizing environmental and community impacts.

The SPUI and Traditional Diamond alternatives are recommended for consideration as the Preferred Alternative during NEPA scoping.

Technical Team members agreed to the identification of the SPUI and Traditional Diamond alternatives as the recommended alternatives. Meetings with stakeholders and a public open house were held to present the alternatives development and evaluation results and recommendations. Comments from the public and stakeholders indicated concurrence with the evaluation results with the highest level of support for the SPUI and Traditional Diamond alternatives.

These two recommended alternatives were refined to add more definition to the design elements of the alternatives, considering design solutions to minimize costs and property and business impacts while maximizing multimodal benefits. This information may be utilized for further assessment during a future NEPA process.

The potential phasing opportunities for each recommended alternative were also identified with the associated costs. To implement the project in phases, care must be taken to ensure that the transportation system operates acceptably at the conclusion of each phase. The ability of each phase to operate on its own is referred to as "independent utility". Also, mitigation measures needed in response to project impacts must be implemented with the phase in which the impacts occur and not deferred to a later phase of the ultimate project.

The separate project phases should meet the following criteria:

- **Independent Utility** – Each phase should have independent utility to the extent that the phase provides a functional transportation system even in the absence of other phases.
- **Elements of the Purpose and Need** – Each phase should contribute to meeting the Purpose and Need for the overall project.
- **Environmental Impacts** – Individual phases should avoid the introduction of substantial additional environmental impacts that cannot be mitigated.
- **Mitigation Directly Related to Impacts** – Each phase should include appropriate mitigation measures to match the environmental impacts of that phase.

Conceptual Design Assumptions

The recommended alternatives' conceptual designs were developed using the applicable CDOT and Wheat Ridge design standards. The plan set documenting the conceptual design of the recommended alternatives is included in **Appendix E**.

In order to accommodate multimodal connections, it is assumed a bi-directional shared use path will run on both sides of Kipling Street, consistent with local agency planning. The path will be ten feet wide, following the CDOT standard width. The opportunity to reduce the width of the shared use path to a sidewalk (five feet wide) on one side of Kipling Street to mitigate property impacts may be considered during the future NEPA process(es).

In order to accommodate multimodal connections, an on-street bicycle lane is assumed on Kipling Street in all alternatives, consistent with the *Jefferson County*

Bicycle Plan. The bike lanes are six feet wide, following the CDOT recommended width. A decision to not include on-street bike lanes along Kipling Street to mitigate property impacts may be considered during the future NEPA clearance process(es).

The project does not include additional through lane capacity on I-70 or Kipling Street.

The scope of this project does not include additional through lane capacity on I-70 or Kipling Street. The recommended alternatives include additional lanes through the interchange and at intersections, but the conceptual designs assume there is no widening of I-70 or Kipling Street outside of the interchange area. However, the bridge structure and ramps would be designed to accommodate future widening of I-70. It is assumed that the ramp meter for the Eastbound I-70 On Ramp would remain, although the need for the ramp meter may be reevaluated during the NEPA and/or final project phases.

Single Point Urban Interchange

The SPUI configuration consists of a single signalized intersection on Kipling Street serving all movements to/from the I-70 ramps and Kipling Street. The layout of the SPUI is shown in **Figure 4**. With the SPUI alternative, the frontage road intersections north and south of the interchange remain in the current locations as signalized intersections.

On I-70, the diverge for the Westbound Off Ramp will be modified to provide a shared exit lane with the current drop lane. Eastbound I-70 will also be modified to add an outside lane from the Eastbound On Ramp to connect to the outside lane that forms east of Garrison Street. This will provide an auxiliary lane for merge operations.

Property Impacts

The SPUI alternative will result in the full acquisition of the Conoco gas station and the car wash facility in the southeast quadrant due to Kipling Street widening and on-site circulation issues.

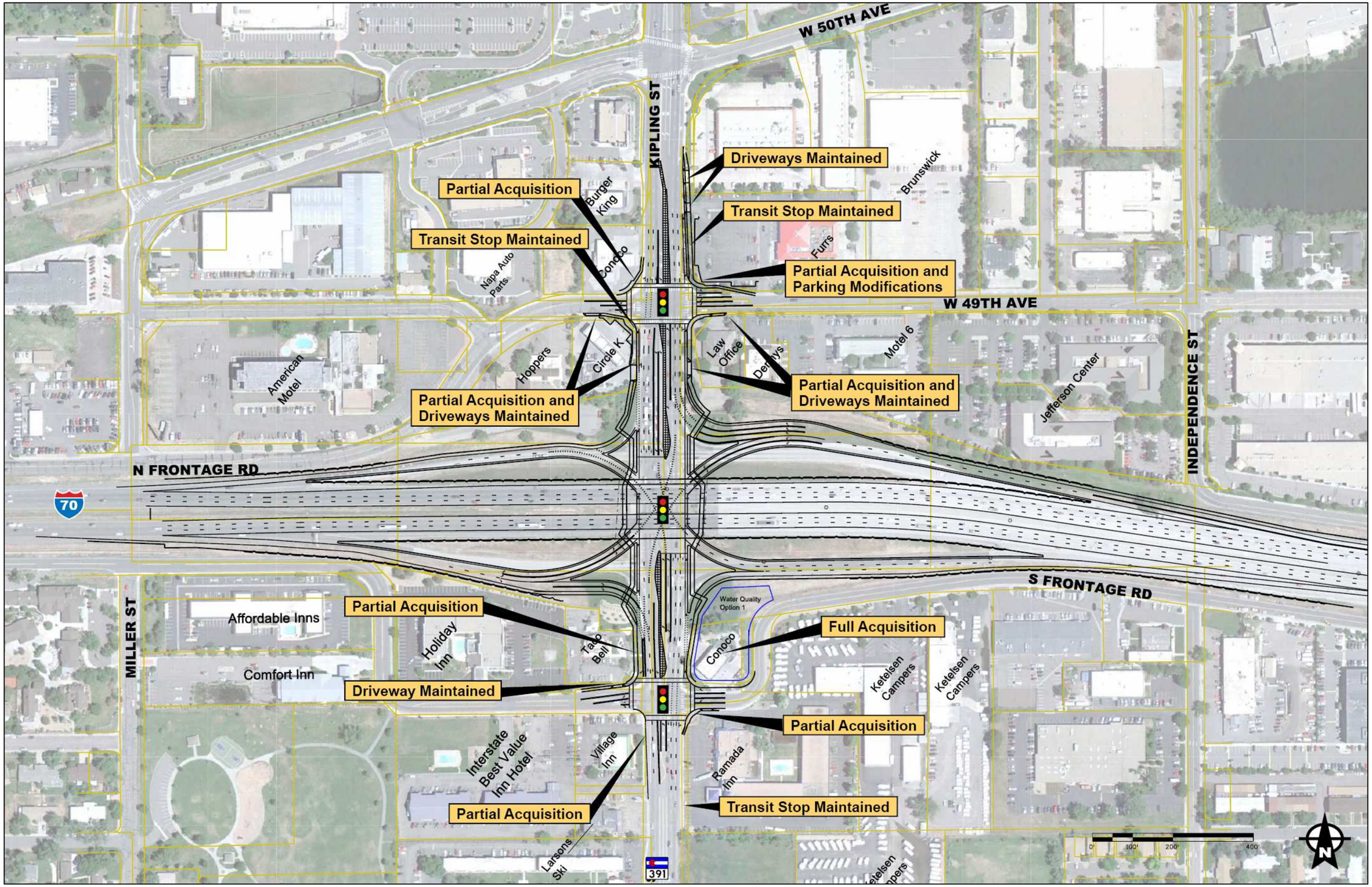
The SPUI alternative is expected to result in one full and seven partial property acquisitions.

There are seven properties with expected partial acquisitions related to the widening of Kipling Street through the interchange and at the corners of the frontage road intersections. For these properties, the driveways are assumed to be reconstructed and maintained in the current locations with minimal site circulation impacts. However, decisions to close driveways that create operational and/or safety concerns may be made during the future NEPA clearance process(es).

Providing the shared use path and transit stop north of 49th Avenue impacts the parking lot of the Furr's property on the northeast corner of the 49th Avenue/North Frontage Road intersection. It is a relatively large parking lot and circulation impacts are not expected at this conceptual level of evaluation. However, the number of parking spaces impacted and the need to mitigate will be considered during the future NEPA process(es).

The acquisition of the Conoco property in the southeast quadrant due to access and site impacts creates an opportunity for location of the required water quality detention for interchange stormwater treatment. Based on conceptual calculations, the size of the property may be adequate for water quality detention needed.

Figure 4. Alternative 1 – Single Point Urban Interchange



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Operations

With the SPUI layout, the locations of the existing transit stops are maintained. Pedestrian and bicycle connections to the transit stops are accommodated with the shared use paths and on-street bicycle lanes. The transit stops are located near the north and south frontage roads and the frontage road traffic signals provide signalized pedestrian crossings of Kipling Street.

The American Association of State Highway and Transportation Officials uses the term level of service (LOS) to describe the operational characteristics of intersections and roadways. LOS is related to control delay at intersections and is a measure of traffic flow and level of congestion, measured on a scale of A to F. LOS A describes conditions with essentially uninterrupted flow and minimal delay. LOS F describes a breakdown of traffic flow with excessive congestion delay. In urbanized areas, LOS D is generally considered to be acceptable for peak hour operations.

The 2035 traffic volumes and levels of service (LOS) for the SPUI are included in **Appendix F**. The traffic signal timing through the interchange would be optimized for the key movements. The Westbound I-70 Off Ramp is widened to provide three right turn lanes. The right turn lanes are signalized and the signal timing is synchronized with the 49th Avenue/North Frontage Road intersection to provide progression for the heavy right turn movement off the freeway to northbound Kipling Street. Double left turn lanes are provided to and from each of the ramps. The frontage road approaches to Kipling Street are also widened to optimize the side street capacity of the traffic signals and minimize the green time taken from Kipling Street.

The SPUI configuration provides a signalized triple right turn lane for the Westbound I-70 Off Ramp to northbound Kipling Street movement.

Currently, drivers do not effectively utilize the free flow right turn lane from the Westbound Off Ramp to northbound Kipling Street and the outside lane of Kipling Street at 49th Avenue is underutilized through the intersection. However, with the three right turn lanes and signalized control coordinated with the 49th Avenue/North Frontage Road signal, the traffic analysis shows that Kipling Street does not need to be widened north of 50th Avenue to achieve acceptable operations.

An important component of the SPUI layout is that the frontage road intersections north and south of the interchange remain in the current locations as full-movement, signalized intersections. That characteristic of the interchange configuration minimizes potential impacts to business access and residential neighborhoods surrounding the interchange. However, if operational issues related to the close signal spacing of the frontage roads are identified with changes in the anticipated land use or traffic volume conditions, the frontage road traffic signals may need to be removed or relocated to preserve the operations and safety of the interchange. If the 49th Avenue/North Frontage Road traffic signal is removed, improvements would likely be needed at the side street approaches of the 50th Avenue intersection to accommodate diverted turn movements.

Phasing Opportunities

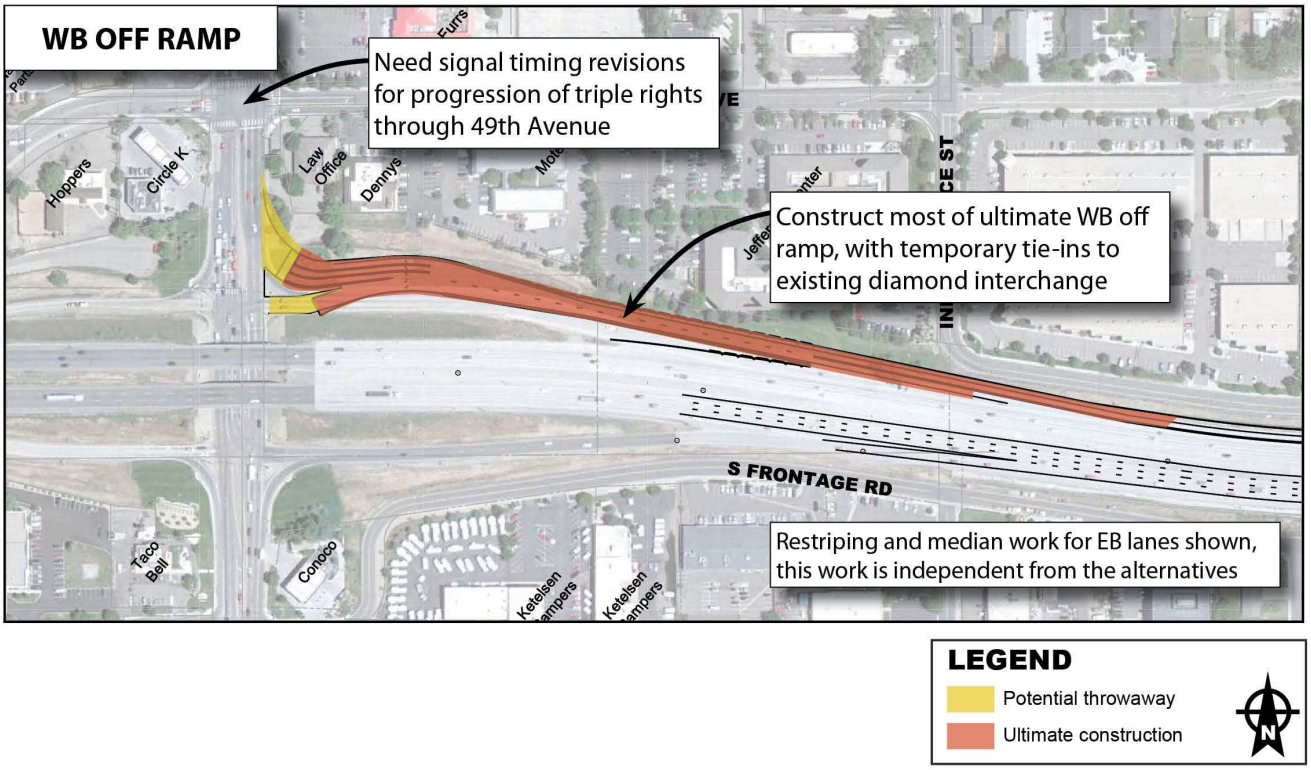
Limited opportunities exist for project phasing under the SPUI alternative.

Potential opportunities to construct the ultimate SPUI configuration in separate project phases were evaluated to identify the independent utility, potential environmental impacts and related mitigation, ROW impacts and cost. The single signalized intersection at the interchange requires a clear-span bridge for I-70 over Kipling Street because there cannot be a bridge pier in the intersection. Because the configuration of the ramps requires the new bridge, there are limited opportunities to reconstruct the interchange in separate, smaller-scale projects.

A potential separate project phase to construct the Westbound Off Ramp with temporary tie-ins at Kipling Street is illustrated in **Figure 5**. The area at Kipling Street would be potential throwaway pavement that would need to be reconstructed with the ultimate SPUI interchange construction. However, most of the ramp could be constructed in the ultimate location.

This project phase would provide the three, signalized right turn lanes on the Westbound I-70 Off Ramp to increase capacity for the heavy right turn movement from the ramp to northbound Kipling Street. The signal timing would also be modified to provide progression for the right turn movement through the 49th Avenue/North Frontage Road intersection. This would reduce peak hour queues on the ramp and improve safety for traffic exiting the freeway.

Figure 5: SPUI Alternative - Separate Project Phase Option



The characteristics of the project phase option are summarized in **Table 1**. As shown, the phase would contribute to meeting the project Purpose and Need by reducing congestion, optimizing operations, and improving safety (as a result of the reduced peak hour queues on the ramp). The phase would not accommodate multimodal connections. No environmental resources were identified within the area of the project phase option. The conceptual cost estimate for the Westbound Off Ramp phase of the SPUI is $3.3 million.

There are no other separate project phase options for the SPUI that would meet independent utility and provide substantial operational, safety, or multimodal benefits.

Table 1: Evaluation of Separate Project Phases – SPUI Alternative

Criteria	Separate Project Phase Westbound Off Ramp
Independent Utility	**Yes** Project provides operational and safety improvements independent of the completion other phases
Purpose and Need Elements	• Reduces congestion • Optimizes operations • Improves safety
Potential Environmental Impacts	No resources identified within area
Potential Mitigation Requirements	Standard Best Management Practices (BMPs) during construction within CDOT ROW
ROW Impacts	**None**
Construction Duration	**2 -3 months**
Conceptual Cost Estimate	Construction = $ 3.3 M ROW = $0.0 M **Total = $3.3 M**

Traditional Diamond

The Traditional Diamond layout consists of two signalized intersections on Kipling Street serving the I-70 ramps with increased spacing between the signals. The 49th Avenue/North Frontage Road intersection is limited to an unsignalized right-in/right-out intersection. The South Frontage Road is relocated with a traffic signal on Kipling Street south of the interchange, a minimum of 600 feet south of the traffic signal at the eastbound I-70 ramps. The layout of the Traditional Diamond is shown in **Figure 6**. On I-70, the ramp merge and diverge areas are in the same location and match the configuration of the SPUI alternative.

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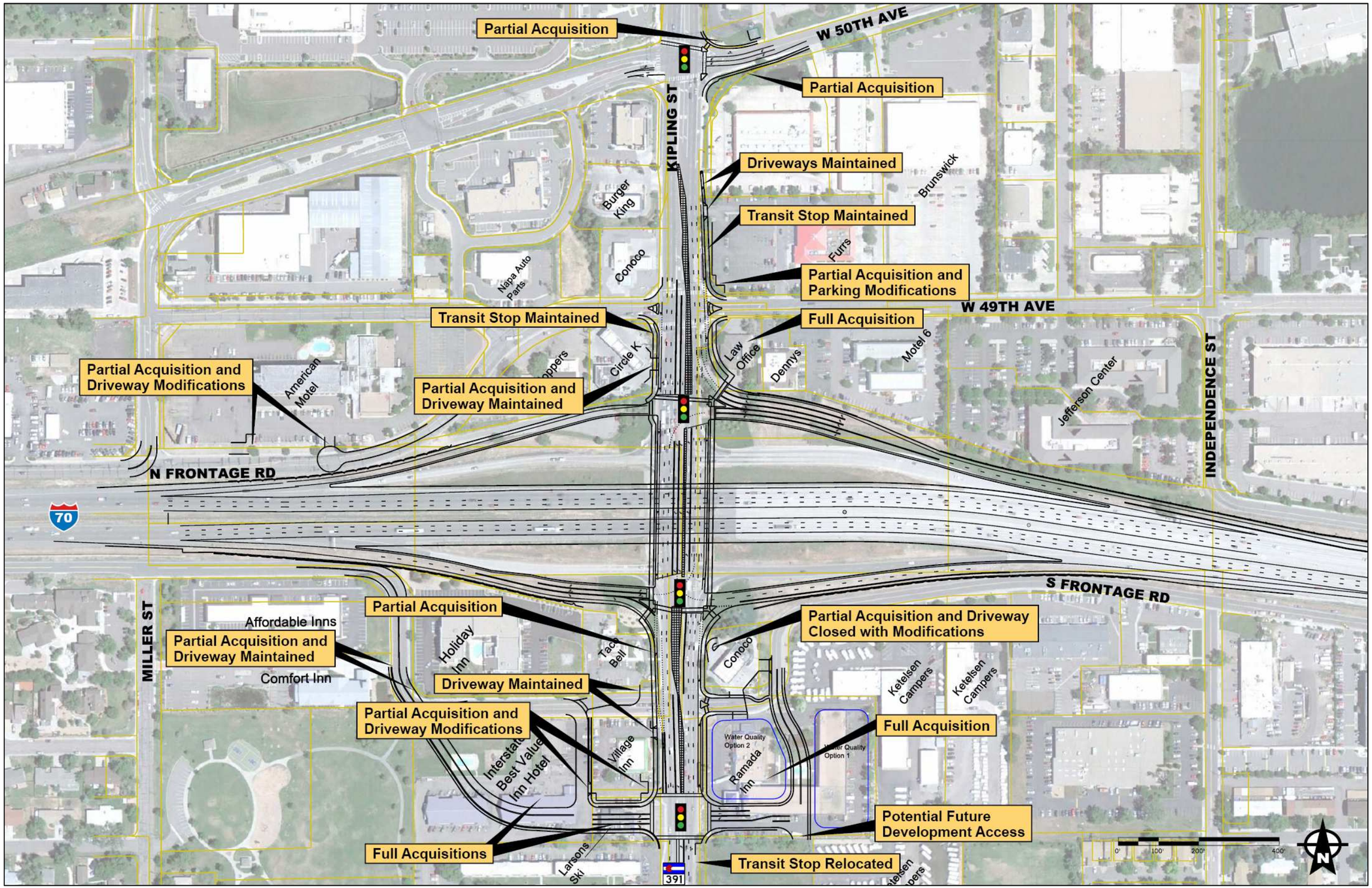
Figure 6. Alternative 12 – Traditional Diamond



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Property Impacts

The Traditional Diamond alternative will result in the full acquisition of four properties. The law office property in the northeast quadrant is assumed to be a full acquisition due to the shift of the Westbound Off Ramp. The relocation of the South Frontage Road is expected to require full acquisition of the Interstate Best Value Hotel and Larson's Ski Shop west of Kipling Street and the Ramada Inn east of Kipling Street.

The Traditional Diamond alternative is expected to result in four full and ten partial property acquisitions.

There are ten properties with expected partial acquisitions related to the Kipling Street widening, freeway ramp shifts, and relocation of the South Frontage Road. Several properties with expected partial acquisitions are also assumed to have modifications to driveway access. In the northwest quadrant of the interchange, the removal of a section of the North Frontage Road requires the closure of one driveway for the American Motel. However, the property will still have two driveways on the North Frontage Road and three driveways on 49th Avenue.

In the southeast quadrant of the interchange, the driveway on Kipling Street for the Conoco gas station is assumed to be closed. The existing driveway on the south side of the property is assumed to be maintained via a right-in/right-out intersection on Kipling Street with a new driveway added on the east side of the property for access to the relocated South Frontage Road. Site modifications may also be required to mitigate circulation to the car wash facility.

In the southwest quadrant of the interchange, the Taco Bell property does not currently have direct access to Kipling Street and the existing driveways on the south side of the property are maintained. However, the driveways will access a side street north of the relocated South Frontage Road rather than directly accessing the frontage road. The relocation of the South Frontage Road requires the closure of one of the Village Inn direct accesses to Kipling Street. The other driveway on Kipling Street is assumed to be maintained with a new driveway added on the west side of the property for access to the relocated South Frontage Road.

Some properties with expected partial acquisitions are assumed to have driveways reconstructed and maintained in the current locations. However, decisions to close driveways that create operational and/or safety concerns may be made during the future NEPA process(es).

The acquisition of the Ramada Inn property in the southeast quadrant due to the South Frontage Road relocation creates an opportunity for the required water quality detention for interchange stormwater treatment. Based on conceptual calculations, the size of the property may be adequate for the water quality detention needed on one or both sides of the relocated South Frontage Road.

Operations

With the Traditional Diamond layout, the locations of the existing transit stops north of the interchange are assumed to be maintained. However, the traffic signal at the 49th Avenue/North Frontage Road intersection is removed, so pedestrians must walk to the 50th Avenue or westbound ramps intersection for a signalized crossing of Kipling Street. The transit stop south of the interchange is relocated south of the

The Traditional Diamond configuration provides a signalized triple right turn lane for the Westbound I-70 Off Ramp to northbound Kipling Street movement.

relocated South Frontage Road. The relocated South Frontage Road traffic signal provides a signalized pedestrian crossing of Kipling Street in the vicinity of the stop. Pedestrian and bicycle connections to the transit stops are accommodated with the shared use paths and on-street bicycle lanes.

The 2035 traffic volumes and LOS for the Traditional Diamond are included in **Appendix F**. The traffic signal timing through the interchange would be optimized for the key movements. The Westbound I-70 Off Ramp is widened to provide three right turn lanes with signalized control. The removal of the 49th Avenue/North Frontage Road traffic signal increases the distance to the next signal for the heavy right turn movement off the freeway to northbound Kipling Street. Double left turn lanes are provided to and from each of the ramps, except from northbound Kipling Street to westbound I-70, which is a single left turn lane. The frontage road approaches to Kipling Street are also widened to optimize the side street capacity of the traffic signals and minimize the green time taken from Kipling Street. In order to minimize impacts to the Circle K property in the northwest quadrant, a separate right turn lane for southbound Kipling Street to westbound I-70 is not provided. This does not notably degrade the peak hour operations of the intersection.

Because the 49th Avenue/North Frontage Road traffic signal is replaced with an unsignalized right-in/right-out intersection, traffic that would travel through or turn left from the side street at the intersection will need to divert to the 50th Avenue intersection to access Kipling Street. Due to this diversion, additional LOS analysis was conducted to identify any traffic impacts for the area in the northeast quadrant of the interchange under the Traditional Diamond alternative. This traffic analysis showed improvements would be needed on the westbound approach of the 50th Avenue intersection to accommodate the shift of the future traffic volumes for those movements.

The right-in/right-out intersection at 49th Avenue/North Frontage Road under the Traditional Diamond configuration results in diverted traffic to the 50th Avenue/Kipling Street intersection. Improvement to the westbound approach of this intersection would be needed.

The traffic analysis of the traffic diversion east of Kipling Street also showed the Independence Street intersections at 49th Avenue and 50th Avenue are able to accommodate the shift of future traffic volumes with acceptable operations. Under the Traditional Diamond 2035 traffic conditions, the operation of the all-way stop-controlled 49th Avenue and Independence Street intersection is projected to remain unchanged from the No Action 2035 condition. The intersection is projected to operate at LOS C in the AM peak hour and LOS B in the PM peak hour. The operation of the stop-controlled 50th Avenue and Independence Street intersection is projected to operate at LOS C in the peak hours under the Traditional Diamond 2035 traffic conditions and LOS B in the peak hours under the No Action 2035 condition.

Phasing Opportunities

Potential opportunities to construct the ultimate Traditional Diamond configuration in separate project phases were evaluated based on independent utility, potential environmental impacts and related mitigation, ROW impacts and cost. The configuration of the ramps and changes to the frontage roads north and south of the interchange create several opportunities to reconstruct the interchange in separate, smaller-scale projects.

The Traditional Diamond would provide several opportunities for project phasing.

The potential separate project phases are illustrated in **Figure 7**. The areas of potential throwaway pavement that would need to be reconstructed with the ultimate interchange are identified. The identified separate project phases were not developed to be built in succession and they may be constructed in any order. Any phase that includes the conversion of the 49th Avenue/North Frontage Road signal to an unsignalized right-in/right-out intersection also includes the lane construction on the westbound approach of the 50th Avenue intersection to accommodate the diverted turning movements.

The phases with the Westbound I-70 Off Ramp (with or without the Westbound I-70 On Ramp) would provide the three, signalized right turn lanes from the off ramp and remove the 49th Avenue/North Frontage Road traffic signal to increase capacity for the heavy right turn movement from the ramp to northbound Kipling Street. This would reduce peak hour queues on the ramp and improve safety for traffic exiting the freeway. The phase with both of the westbound I-70 ramps would provide additional circulation improvements for all westbound I-70 ramp movements through the Kipling Street intersection, although the southbound Kipling Street and Westbound I-70 Off Ramp left turn capacities would remain limited by the existing lanes under the I-70 bridge.

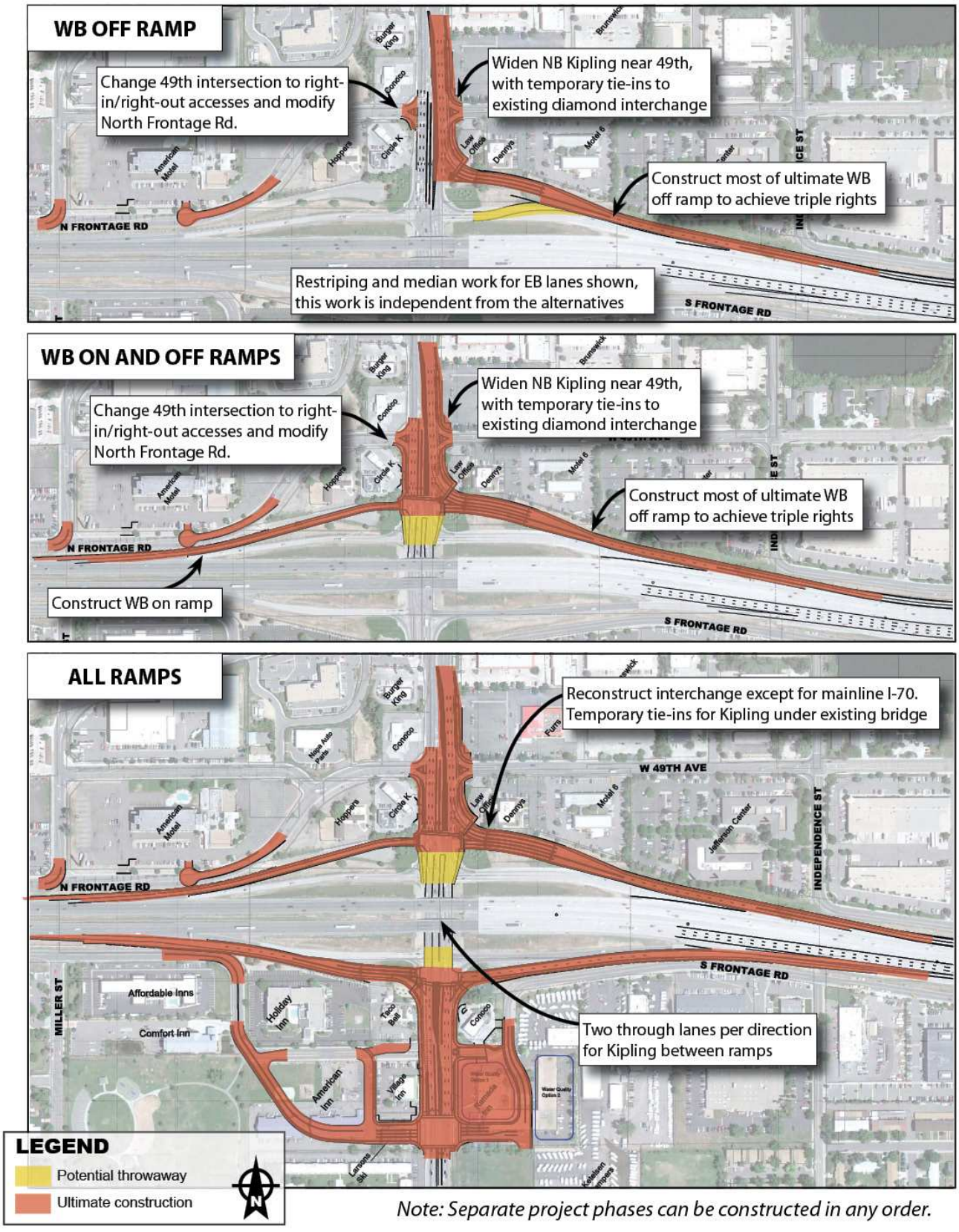
The project phases with the relocation of the South Frontage Road (with or without the eastbound I-70 ramps) would provide increased signal spacing and widen Kipling Street south of the freeway, which would increase capacity for the northbound Kipling Street to eastbound I-70 movement and improve safety with more maneuvering distance between signals. The phase with the relocation of the South Frontage Road and the eastbound I-70 ramps would provide additional circulation improvements with updated signalization, although the northbound Kipling Street capacity would remain limited by the existing lanes under the I-70 bridge.

The project phase with all ramp construction and the South Frontage Road relocation would provide the operational and safety benefits from the Westbound I-70 Off Ramp right turn movement to northbound Kipling Street and the increased signal spacing south of the freeway, in addition to the widening of Kipling Street north and south of the interchange. However, the benefits to traffic traveling under the I-70 bridge would be limited by the existing lanes under the bridge. This would impact the heavy movements for southbound Kipling Street to eastbound I-70 and the Westbound I-70 Off Ramp left turn, which would subsequently reduce the operational and safety benefits for other movements through the interchange.

The characteristics of the separate project phase options are summarized in **Table 2**. As shown, each of the separate projects would contribute to meeting the project Purpose and Need by reducing congestion, optimizing operations, improving safety (as a result of the reduced congestion), and accommodating multimodal connections (with construction of at least short sections of the shared use path).

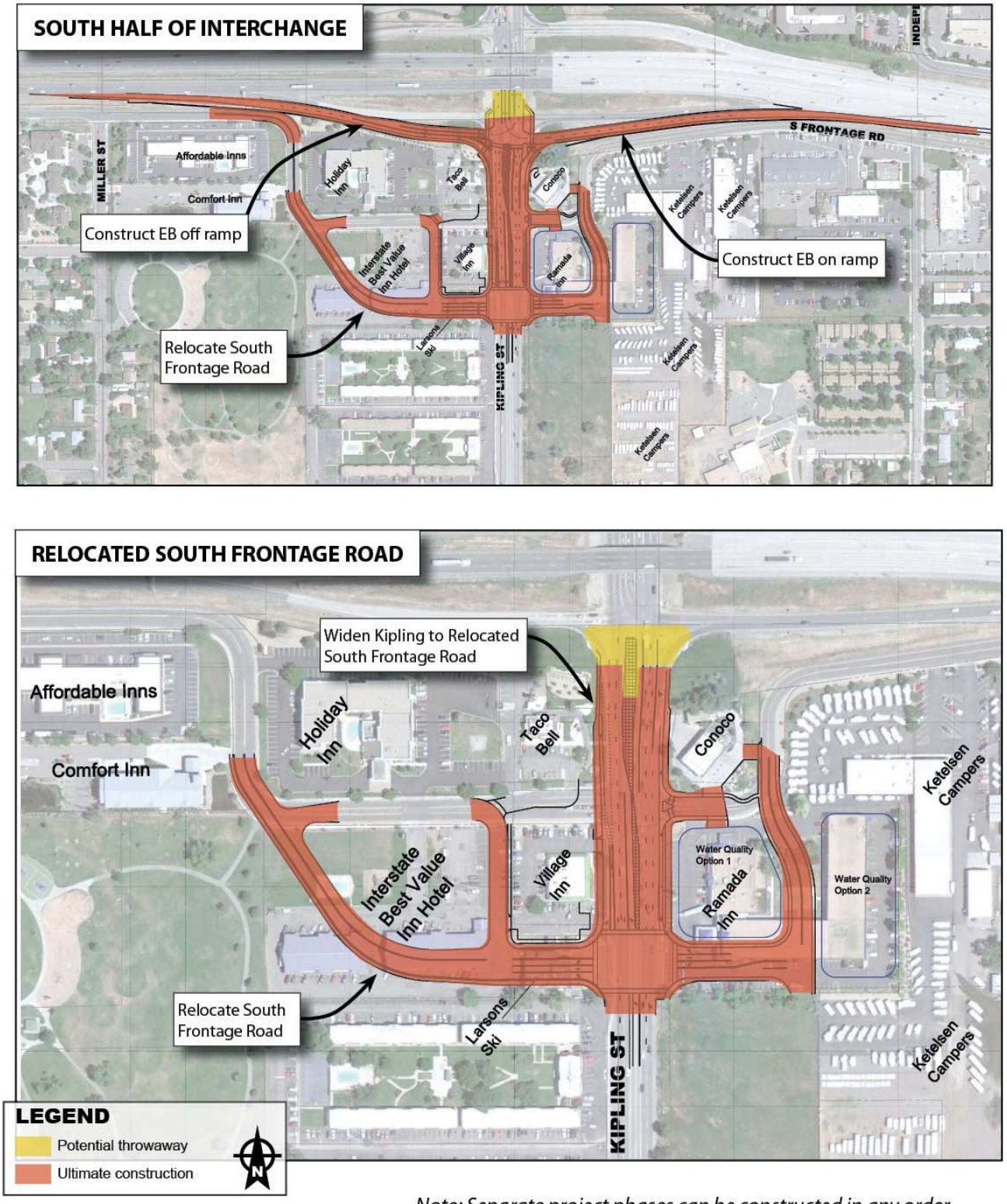
The project phases located north of the interchange would have potential impacts to hazardous material sites and wells. Expected mitigation requirements would be limited to standard BMPs during construction and avoidance or relocation of wells.

Figure 7: Traditional Diamond – Separate Project Phases



Note: Separate project phases can be constructed in any order.

Figure 7: Traditional Diamond – Separate Project Phases (continued)



Note: Separate project phases can be constructed in any order.

The project phases located south of the interchange would also have potential impacts to hazardous material sites and wells, as well as potential impacts to wetlands identified near the Eastbound On Ramp and noise receptors with the apartments adjacent to the relocated South Frontage Road. Expected mitigation requirements would be standard BMPs during construction and avoidance or relocation of wells, as well as potential noise mitigation and wetland permitting.

The ROW impacts for the project phase options range from less than one acre for the Westbound Off Ramp to 7.6 acres for the All Ramps project phase, which includes all of the ROW required for the ultimate Traditional Diamond alternative. The conceptual cost estimate for the project phases range from $6.6 million for the Westbound Off Ramp to $26.1 million for the All Ramps project phase. Implementing the All Ramps project phase would defer the estimated project cost of $22.0 million for the replacement of the I-70 bridge over Kipling Street.

Although other separate project phases are physically possible to construct separately (such as the Eastbound On and Off Ramps), no other separate project phases of the Traditional Diamond are expected to meet independent utility and provide substantial operational, safety, or multimodal benefits.

Table 2: Evaluation of Separate Project Phases – Traditional Diamond Alternative

Criteria	Separate Project Phase				
	Westbound Off Ramp	**Westbound On and Off Ramps**	**All Ramps (bridge not replaced)**	**South Half of Interchange**	**Relocated South Frontage Road**
Independent Utility	**Yes** Project provides operational and safety benefits independent of the completion other phases				
Purpose and Need Elements	• Reduces congestion • Optimizes operations • Improves safety • Accommodates multimodal connections				
Potential Environmental Resources Affected	Potential impacts to Hazardous Materials & Wells	Potential impacts to Hazardous Materials & Wells	Potential impacts to Hazardous Materials, Wells, Wetlands, Noise	Potential impacts to Hazardous Materials, Wells, Wetlands, Noise	Potential impacts to Hazardous Materials, Wells, Noise
Potential Mitigation Requirements	Standard BMPs during construction Avoidance/relocation of wells	Standard BMPs during construction Avoidance/relocation of wells	Standard BMPs during construction Avoidance/relocation of wells Noise mitigation 404 permitting	Standard BMPs during construction Avoidance/relocation of wells Noise mitigation 404 permitting	Standard BMPs during construction Avoidance/relocation of wells Noise mitigation
ROW Impacts	Full = 0.5 acres Partial = 0.3 acres Total = 0.8 acres	Full = 0.5 acres Partial = 0.5 acres Total = 1.0 acres	Full = 6.8 acres Partial = 0.8 acres Total = 7.6 acres	Full = 6.3 acres Partial = 0.4 acres Total = 6.7 acres	Full = 6.3 acres Partial = 0.4 acres Total = 6.7 acres
Construction Duration	**3 months**	**6 months**	**12 months**	**8 months**	**6 months**
Conceptual Cost Estimate	Construction=$5.4 M ROW = $1.2 M **Total = $6.6 M**	Construction=$7.1 M ROW = $1.4 M **Total = $8.5 M**	Construction=$15.1 M ROW = $11.0 M **Total = $26.1 M**	Construction=$8.0 M ROW = $8.8 M **Total = $16.8 M**	Construction=$4.7 M ROW = $8.8 M **Total = $13.5 M**

Evaluation of Recommended Alternatives

The recommended alternatives were evaluated in more detail with the prioritized evaluation criteria established from the Level 3 alternatives evaluation, as described in the Alternatives Evaluation Summary section of this report and in the *Final Alternatives Development and Analysis Report*. The prioritized criteria were the criteria from the Level 2 alternatives screening that were of most concern from input and comments received during meetings with the Technical Team and area stakeholders, presentations to local agency elected officials, and the open house held with the general public. The prioritized criteria were:

- Interchange Capacity
- Driver Expectancy
- Pedestrian and Bicycle Crossings
- Property (ROW) Impacts
- Business Access
- Phased Construction Opportunities
- Project Costs

The purpose of the project is to reduce congestion, optimize operations, improve safety, and accommodate multimodal connections at the I-70 and Kipling Street interchange.

Although safety was not specifically identified by project stakeholders as a prioritized evaluation criterion, the existing and projected safety issues at the interchange are closely related to the interchange capacity. Safety was also often discussed by project stakeholders as it relates to driver expectancy, since drivers unfamiliar with the area may make erratic maneuvers for complicated interchange movements. Pedestrian and bicycle crossings are inherently connected to multimodal safety based on potential vehicular conflicts.

The SPUI and Traditional Diamond alternatives were evaluated with additional conceptual design refinement and traffic operations analysis to further define alternative elements. The conceptual design details provided more detailed information on the potential property impacts, including changes in access/driveways, parking, and site circulation. Possible locations for additional infrastructure needs, such as grading, retaining walls, and water quality detention were also identified and considered in this evaluation.

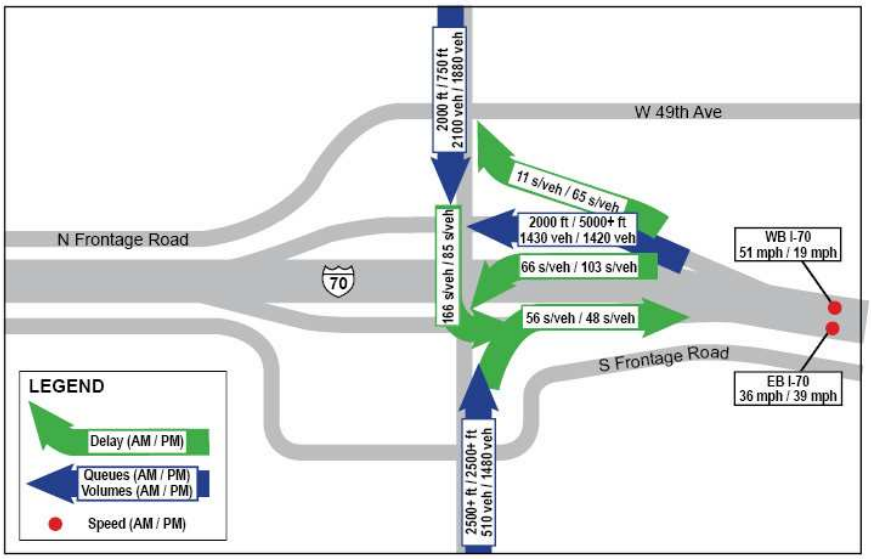
The traffic operations of the two recommended alternatives were analyzed in more detail using VISSIM (Version 5.30-10) traffic simulation software, in addition to the Synchro/SimTraffic analysis software. While the traffic analysis conducted with earlier screening provided comparative information about overall intersection operations and capacity, this analysis provided additional information on the vehicular interactions and delay for the key movements through the interchange, as well as the ramp merge and diverge operations on the freeway. Additional auxiliary lanes to optimize operations were included in the alternative refinements.

The evaluation is summarized in **Table 3**. The interchange capacity performance measures (delay, queues, volumes, and speed) are provided for the key movements through the interchange. These capacity performance measures are also illustrated by movement in **Figure 8**. This evaluation is not intended to provide a conclusion of a Preferred Alternative from this PEL study. The information is intended to streamline the identification of the Preferred Alternative in future NEPA process(es).

Table 3: Evaluation of Recommended Alternatives

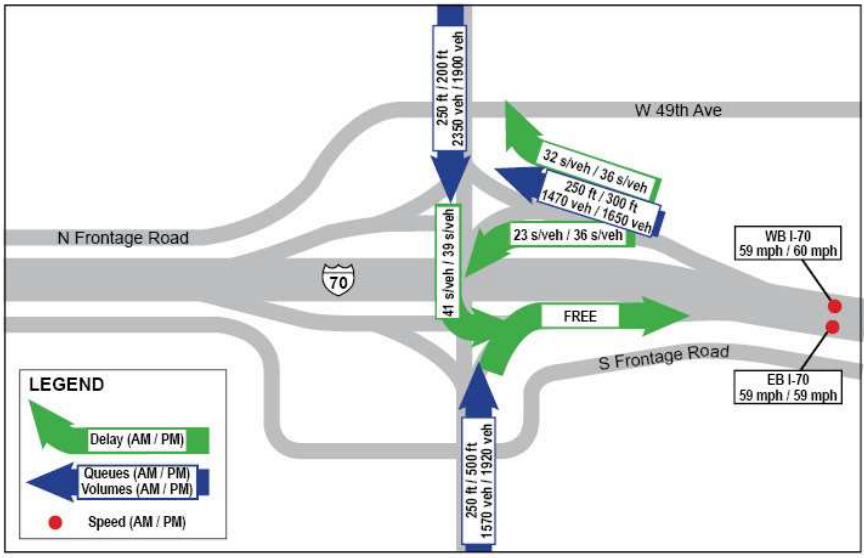
Category	Performance Measure	NA No Action	1 SPUI	12 Traditional Diamond
Interchange Capacity (2035 Conditions)	Peak hour avg vehicle delay approaching interchange (seconds per vehicle (sec/veh)) (AM/PM)	NB RT to EB I-70: 56 / 48 SB LT to EB I-70: 166 / 85 WB RT: 11* / 65 WB LT: 66 / 103 * Free RT w/low conflicting traffic	NB RT to EB I-70: Free SB LT to EB I-70: 41 / 39 WB RT: 32 / 36 WB LT: 23 / 36	NB RT to EB I-70: 18 / 18 SB LT to EB I-70: 56 / 48 WB RT: 30 / 37 WB LT: 35 / 37
	Peak hour queue lengths approaching interchange (feet) (AM/PM)	SB Kipling: 2000 / 750 NB Kipling: 2500+ / 2500+ WB Off-Ramp: 2000 / 5000+	SB Kipling: 250 / 200 NB Kipling: 250 / 500 WB Off-Ramp: 250 / 300	SB Kipling: 300 / 300 NB Kipling: 250 / 500 WB Off-Ramp: 250 / 300
	Traffic volumes through interchange (vehicles per hour (veh/hr)) (AM/PM)	SB Kipling: 2,100 / 1,880 NB Kipling: 510 / 1,480 WB Ramps: 1,430 / 1,420	SB Kipling: 2,350 / 1,900 NB Kipling: 1,570 / 1,920 WB Ramps: 1,470 / 1,650	SB Kipling: 2,310 / 1,900 NB Kipling: 1,580 / 1,920 WB Ramps: 1,470 / 1,650
	Travel speeds along I-70 east of Kipling (MPH) (AM/PM)	EB I-70: 36/39 WB I-70: 51/19	EB I-70: 59/59 WB I-70: 59/60	EB I-70: 58/58 WB I-70: 60/59
Driver Expectancy	Perceived Driver Expectancy	**Moderate** Directional interchange layout and typical urban interchange layout, but close signal spacing makes maneuvering difficult	**Easy** Directional interchange layout and full access to frontage roads with interchange layout familiar to Denver metro area	**Easy** Directional interchange layout and access to frontage roads with interchange layout familiar to Denver metro area
Pedestrian and Bicycle Crossings	User perception of comfort and safety of pedestrian and bicycle movements	**Difficult** Increasingly uncomfortable for pedestrians with increased vehicular congestion and sidewalks under the bridge with limited median refuge areas	**Easy** Shared use paths and bicycle lanes directly through the interchange and traffic signals at both frontage roads provide Kipling Street crossing	**Easy** Shared use paths and bicycle lanes directly through the interchange, but no signalized crossing at 49th Avenue/North Frontage Road
ROW Impacts	Full acquisitions and partial acquisitions required (acres)	None	Full = 0.5 acres Partial = 0.71 acres Total = 1.21 acres	Full = 6.76 acres Partial = 0.85 acres Total = 7.61 acres
Business Access	Perceived difficulty to access area business	**Moderate** Increased congestion creates issues for accessing businesses due to congestion in peak travel times	**Easy** Typical interchange layout and full access to frontage roads	**Easy** Typical interchange layout, but limited direct access to 49th Avenue/North Frontage Road and South Frontage Road access moved farther from interchange
Phased Construction Opportunities	Opportunities to construct in phases	N/A	**Difficult** Bridge with ramps must be constructed at once	**Easy** Opportunities for ramps to be constructed separately with bridge work later
Project Costs	Conceptual-level probable costs	None	Construction = $43 - 48 M ROW = $2 - 4 M **Total = $45 - 52 M**	Construction = $35 - 40 M ROW = $10 - 12 M **Total = $45 - 52 M**

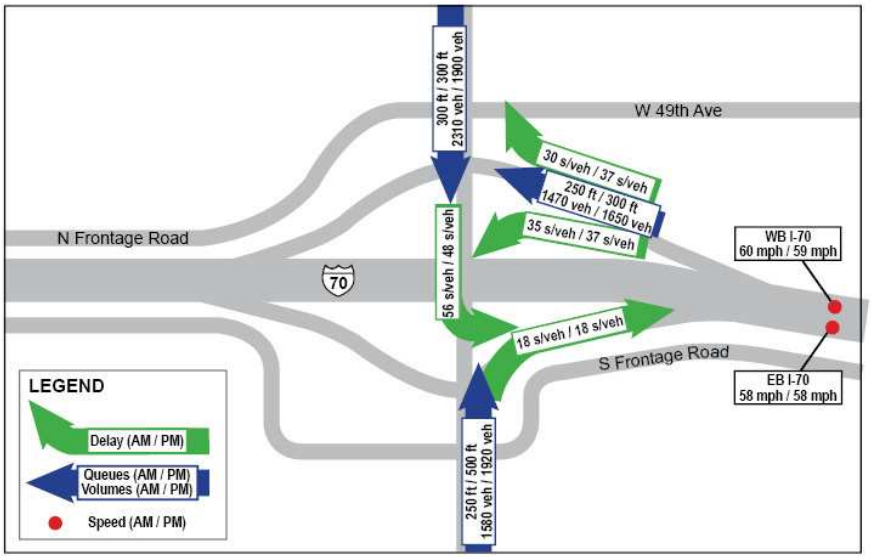
Figure 8: Interchange Capacity Evaluation of Recommended Alternatives



No Action

Alternative 1 - SPUI





Alternative 12 - Traditional Diamond Interchange

Interchange Capacity

Both the SPUI and Traditional Diamond alternatives provide similar interchange capacity benefits in expected 2035 conditions compared to the No Action alternative. The alternatives substantially reduce the peak hour average vehicular delay expected under the 2035 No Action conditions for the key movements approaching the interchange.

The increased capacity at the Westbound Off Ramp and Kipling Street traffic signal substantially reduces the peak hour queues on the ramp under both recommended alternatives, as compared to the No Action alternative. This will reduce the potential for traffic to routinely back up to the I-70 mainline, which is currently a documented crash issue.

With both recommended alternatives, the modification of the Westbound Off Ramp diverge to provide a shared lane with the current drop lane also increases the capacity of the diverging movement and increases the travel speeds along I-70, improving safety related to speed differential and lane-changing maneuvers on the freeway.

Driver Expectancy

Many of the drivers using this interchange are not from this area, so driver expectancy is important to optimize the operational efficiency of the interchange. Both recommended alternatives provide typical urban interchange configurations familiar to the Denver metropolitan area.

Pedestrian and Bicycle Crossings

Both recommended alternatives provide shared use paths and bicycle lanes directly through the interchange. The alternatives have uncontrolled pedestrian crossings across free right turn movements from Kipling Street to the on ramps and the locations and design of the crossings determined during final design will need to consider the sight distance and speed of the right turning traffic.

With the SPUI alternative, the frontage road traffic signals provide signalized pedestrian crossings of Kipling Street. With the Traditional Diamond layout, the traffic signal at the 49th Avenue/North Frontage Road intersection is removed, so pedestrians must walk to the 50th Avenue or westbound ramps intersection for a signalized crossing of Kipling Street.

ROW Impacts

There are seven properties with expected partial acquisitions and one full property acquisition assumed for the SPUI, totaling 1.21 acres of impact. There are ten properties with expected partial acquisitions and four full property acquisitions assumed for the Traditional Diamond, totaling 7.61 acres of impact.

Business Access

Both recommended alternatives provide typical urban interchange configurations. Because the frontage road traffic signals remain north and south of the interchange with the SPUI alternative, it would be relatively easy for drivers unfamiliar with the area to access the surrounding businesses, such as the gas stations, hotels, and fast food restaurants.

The access to surrounding businesses with the Traditional Diamond alternative is typical to the Denver metropolitan area, but the 49th Avenue/North Frontage Road intersection is limited to unsignalized right-in/right-out movements and the South Frontage Road traffic signal is moved farther away from the interchange.

The potential business impacts for each of the recommended alternatives are described in more detail in the Land Use and Business Impacts Technical Memorandum in **Appendix A**.

Phased Construction Opportunities

The configuration of the SPUI requires the new bridge and ramps to be constructed together, so there are limited opportunities to reconstruct the interchange in separate, smaller-scale projects. This limits the ability to utilize available funding opportunities. The configuration of the Traditional Diamond ramps and changes to the frontage roads north and south of the interchange create several opportunities to reconstruct the interchange in separate, smaller-scale projects.

Project Costs

The conceptual cost estimates for the recommended alternatives result in similar expected overall project costs. The SPUI requires higher construction costs than the Traditional Diamond due to the clear-span bridge structure with retaining walls. However, the Traditional Diamond requires higher ROW costs due to more full property acquisitions. Total cost for both alternatives is estimated at $45 - $52 million.

The conceptual cost estimates are provided in **Appendix G**. The ROW cost estimates assume a square-foot unit cost for the amount of partial acquisitions and an acquisition, relocation, and demolition cost for the properties assumed as full acquisitions.

Early Action Improvements

Coordinating early action improvements with the recommended alternatives for ultimate interchange reconstruction allows the potential for projects to move forward that address existing deficiencies and fit within the ultimate interchange configuration. Early action improvements were evaluated for potential implementation prior to the long-term interchange reconstruction.

Improvements were developed and analyzed with the goal of addressing existing critical issues with reasonable costs and limited throwaway infrastructure that would need to be reconstructed with the ultimate interchange construction, considering the recommended alternatives of the SPUI and Traditional Diamond.

Because these improvements were considered to address existing issues, the improvements were analyzed under existing (2012) traffic conditions. The existing traffic capacity and safety issues for the interchange are described in the Purpose and Need section of this report with more details in the *Existing Conditions Report*. The highlighted critical issues are:

- Eastbound On Ramp short merge length
- Kipling Street queuing from Eastbound On Ramp merge congestion
- Westbound Off Ramp right turn delay and weave movement to 49th Avenue
- Westbound Off Ramp queuing to mainline I-70

These critical operational issues are focused on the capacity of the Eastbound On Ramp merge and the operations of the Westbound Off Ramp approach to Kipling Street. Therefore, options were considered to address these areas. The consideration of the different options is described in the Early Action Alternatives Technical Memorandum in **Appendix A**. The recommendations for the early action improvements are described below.

Eastbound On Ramp Continuous Lane

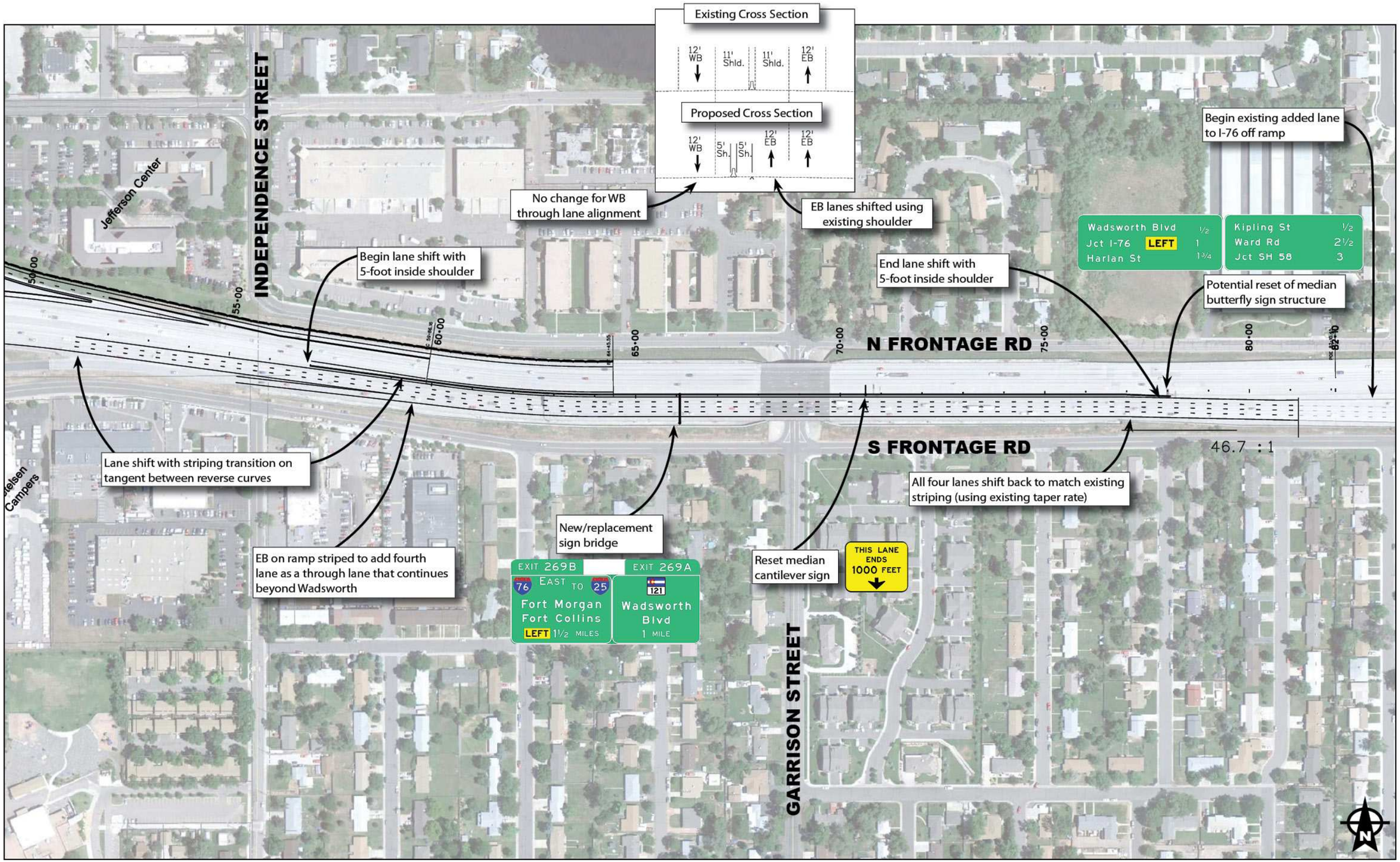
The segment of I-70 east of Kipling Street was reconstructed in the early 1990s to accommodate the final connection of I-76 and reconstruction of the Wadsworth Boulevard interchange. East of the Garrison Street bridge, a standard 10-lane template of I-70 was constructed, but only three eastbound lanes were constructed west of Garrison Street, while westbound I-70 has five lanes to Kipling Street.

A fourth lane on eastbound I-70 at Kipling Street would benefit the interchange traffic operations by reducing vehicle merge conflicts and allowing appropriate speeds to be maintained in all lanes. Also, the ramp meter signal on the Eastbound On Ramp would also be able to cycle more quickly, reducing the queue spillback to Kipling Street.

The concept for the Eastbound On Ramp continuous lane improvement is illustrated in **Figure 9**. With this improvement, the existing median barrier is shifted six feet to the north and the inside shoulders for the westbound and eastbound directions, which are currently 11 feet wide, are narrowed to five feet. There is no change for the lanes along westbound I-70 and the lane shift ends to meet the existing striping where an outside lane is added east of Garrison Street. This results in a continuous outside lane from the Eastbound On Ramp at Kipling Street to match the existing striping east of Garrison Street.

This Eastbound On Ramp improvement is consistent with either of the two recommended alternatives, so it can be implemented prior to the identification of a Preferred Alternative. There are no regional plans to widen this segment of I-70, so the implementation of this improvement would result in limited, if any, throwaway infrastructure with either the SPUI or Traditional Diamond alternative.

Figure 9: Eastbound On Ramp Continuous Lane Early Action Improvements



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The evaluation of the Eastbound On Ramp continuous lane improvement is summarized in **Table 4**. As shown, the early action improvement provides increases in speed on I-70 within the Eastbound On Ramp merge area. There are also travel time benefits along I-70.

Table 4: Evaluation of Eastbound On Ramp Continuous Lane

Condition	Eastbound I-70							
	Travel Time (seconds)				Kipling On Ramp Merge			
	Ward to Wadsworth		Kipling to Wadsworth		Speed (MPH)		Density (veh/hr/lane)	
	AM	PM	AM	PM	AM	PM	AM	PM
Existing	149	147	107	116	50	44	32.0	42.1
EB On Ramp Continuous Lane	142	143	93	109	58	59	25.3	19.6

The conceptual construction cost estimate for the improvement is $600,000 - $800,000, which includes shifting the median barrier, resetting three overhead sign structures, and restriping.

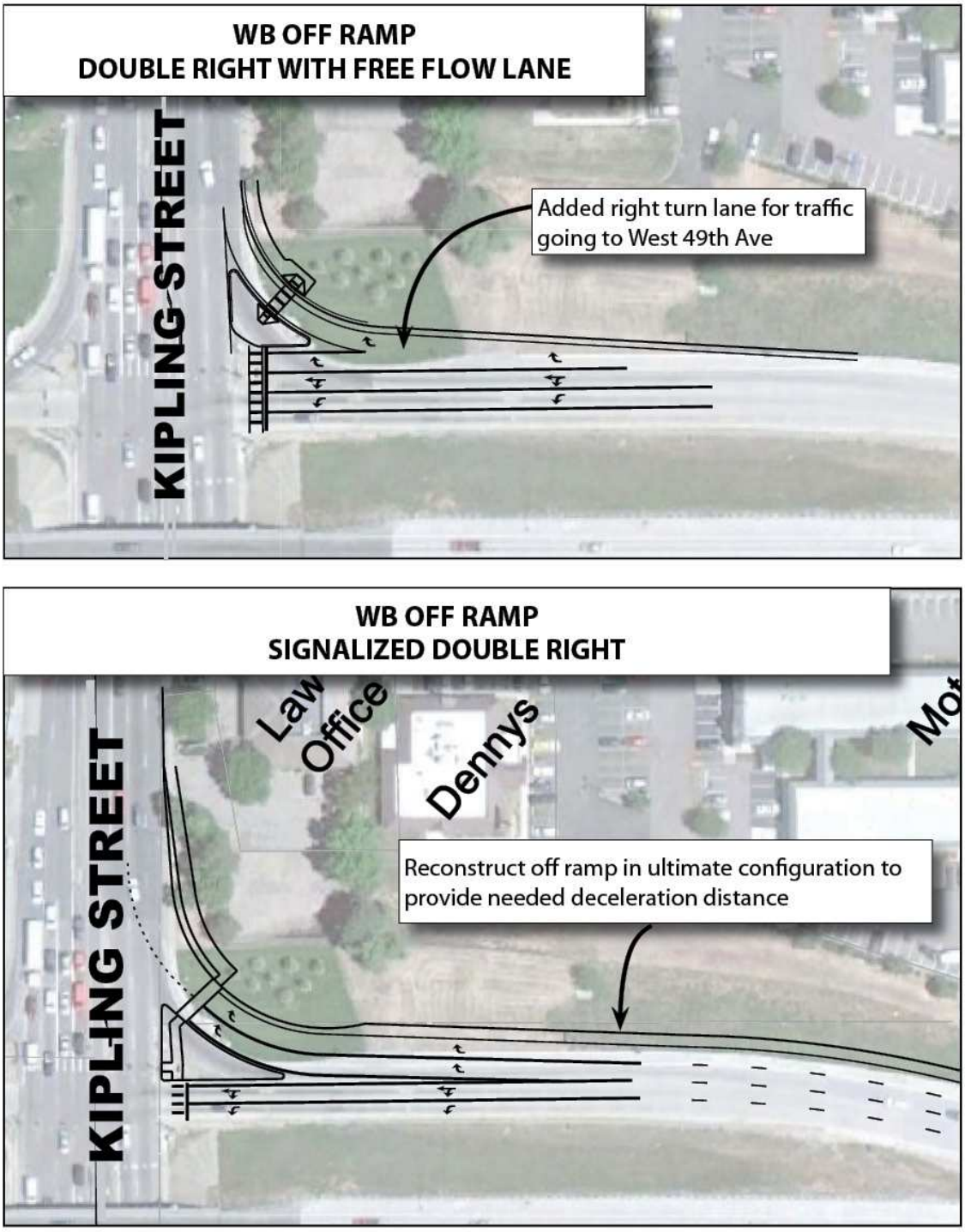
Westbound Off Ramp

Two options may be considered for addressing the operations of the Westbound Off Ramp approach to Kipling Street. The two options are:

- Double Right with Free Flow Lane – Construct a short right turn lane for use by drivers weaving to westbound 49th Avenue, leaving the far right lane as a free right continuous lane
- Signalized Double Right – Reconstruct the right turn lanes and signalize the double right turn movement

The concepts for the Westbound Off Ramp early action improvements are illustrated in **Figure 10**.

Figure 10: Westbound Off Ramp Early Action Improvements



The evaluation of the Westbound Off Ramp improvement is summarized in **Table 5**.

Table 5: Evaluation of Westbound Off Ramp Early Action Improvement

Condition	Westbound Off Ramp Approach					
	Delay (sec)		LOS		95th % Queue (ft)	
	AM	PM	AM	PM	AM	PM
Existing	76.0	75.4	E	E	560	1310
Double Right with Free Flow Lane	26.6	19.3	C	B	490	870
Signalized Double Right	26.2	21.4	C	C	290	425

As shown, the option with the double right with free flow lane substantially reduces the delay at the intersection and improves the operations to LOS C in the AM peak hour and LOS B in the PM peak hour. The reason drivers ignore the current restriction on weaving to 49th Avenue from the right turn lane is because they share the lane and wait at the signal with the heavy left turning traffic. The weaving traffic is less than 100 veh/hr, so the storage needed is minimal. However, the change of having those drivers in their own lane, with appropriate signing and enforcement, may effectively separate the right turning drivers based on their destination and result in reduced queuing along the off ramp. The continuous right turn lane would also be modified in the immediate area of the interchange and signing and striping would be improved to maximize the efficiency of this concept and reinforce the continuous flow aspect of the right turn lane. However, there are concerns that drivers would continue to not utilize the free flow lane since it is similar to the existing condition and the operational benefits reported with the traffic models would not be accomplished. The conceptual construction cost estimate for the improvement is $250,000 - $300,000.

The signalized double right option would also substantially reduce the intersection delay and improve operations to LOS C in the peak hours. The option was developed to control the weave movement of traffic turning right at the ramp and turning left at 49th Avenue. Double right turn lanes should have enough capacity for near-term traffic demand, although triple rights are necessary for the ultimate capacity needs when the full interchange is reconstructed (with either recommended alternative). This option would also provide safety benefits for pedestrians with a signalized crossing of the right turn lanes, rather than a free flow lane. The conceptual construction cost estimate for the improvement is $400,000 - $450,000.

Because the location of the Westbound Off Ramp is different between the SPUI and Traditional Diamond alternatives, either of these options would include throwaway pavement that would need to be reconstructed with the ultimate interchange configuration. Since this “interim” status is true with either recommended alternative, this improvement can be implemented prior to the identification of a Preferred Alternative.

Vacant lot in northwest quadrant of Kipling interchange

Environmental Overview

One of the goals of the PEL process is to identify potential impacts early in the planning process so that impacts can be avoided or minimized to the extent possible. The recommended alternatives from this study have been conceptually designed to minimize environmental impacts while meeting the project Purpose and Need. Specific mitigation measures for remaining environmental impacts will be determined during subsequent NEPA evaluation process(es), and will be included in final plans for incorporation into the project design.

Construction of the interchange improvements may result in direct, indirect, and cumulative impacts to environmental resources depending on the type and location of the resource in proximity to the improvements. The resources that may be impacted were evaluated in the *Environmental Scan Report* (May 2012). A summary of the overview findings is described below for the two recommended interchange alternatives (SPUI and Traditional Diamond alternatives).

Potential Impacts

Air Quality

Air quality is generally assessed by comparing concentrations of air pollutants to National Ambient Air Quality Standards, which are set to protect human health and welfare. Air pollutants related to transportation that are of concern include carbon monoxide, ozone, particulate matter (particulate matter with an aerodynamic diameter less than 10 microns), and Mobile Source Air Toxics (MSAT). MSATs are hazardous air pollutants, and six priority MSATs have been identified by the Environmental Protection Agency (EPA) as the priority transportation toxins to monitor.

The determination of regional air quality conformity is completed by DRCOG through their conformity analysis for the RTP. The I-70 and Kipling interchange reconstruction project is included as a funded roadway capacity improvement project in the RTP, so regional conformity for the interchange project has already been demonstrated.

Moving forward with the NEPA process, air quality impact analysis would be conducted for the identified Preferred Alternative for carbon monoxide and particulate matter. A local analysis may consist of hot-spot modeling for carbon monoxide concentrations at intersections or other locations where vehicle idling may result in higher carbon monoxide concentrations. A qualitative analysis for particulate matter hot-spots would be needed and potentially calculation of daily emission levels of the MSATs. Often a concurrence letter from the Colorado Department of Public Health and Environment, Air Pollution Control Division on conformity is required.

Noise

The FHWA has established activity categories based on various land uses to determine what is considered an acceptable noise level, known as Noise Abatement Criteria (NAC). If the NAC will be exceeded after the construction of roadway improvements, mitigation needs to be considered and may be warranted depending on the land use category. There are currently areas within the study area with noise exposures that exceed acceptable NAC levels (e.g., the commercial properties along I-70 west of Kipling Street, where no noise barriers currently exist). The potentially impacted properties are commercial, so interior noise levels may be the only consideration. Mitigation may be warranted as noise levels may increase with either recommended alternative and a noise barrier along I-70 west of Kipling Street may be considered. For Kipling Street south of 51st Place within the study area, noise barriers would probably not be feasible because of the many openings required for intersecting roadways and property access.

A detailed noise study will be required during future NEPA process(es). During construction, a common-sense approach to controlling noise impacts of construction equipment and activities should be considered. BMPs can be incorporated to minimize the effect of construction on local residents and sensitive receivers while not affecting construction schedules.

Water Wells

Approximately 250 existing water wells in the study area were identified through a survey of GIS data from the Colorado Division of Water Resources (2012). Approximately two-thirds of the wells are used as monitoring wells, which are constructed for the purpose of locating water, pump or aquifer testing, monitoring ground water, or collection of water quality samples. The remaining one-third of wells are used primarily for domestic or residential uses, and a few wells are used for municipal, commercial, or irrigation purposes.

Both recommended alternatives could potentially impact six wells clustered around the southeastern corner of I-70 and Kipling. Additionally, in the northwestern

corner, the SPUI alternative would impact three wells and the Traditional Diamond alternative would impact one well. With the exception of one well categorized for domestic use, all of the other potentially-impacted wells are classified as "other" usages, which means that they are likely used as monitoring wells.

Consideration of water well resources during the NEPA process will be necessary and will include a detailed analysis of the project design impacts to existing water wells, a plan for avoidance of existing wells during and after construction, and identification of the necessary permits for construction activities.

Land Use

The land adjacent to the recommended alternatives is currently zoned for commercial uses, with the exception of a small portion of residential units at the eastern project terminus. A significant portion of both alternatives lies within the I-70/Kipling Corridors Urban Renewal Area, which will guide future development (Wheat Ridge 2009). Future land uses around the interchange area are primarily planned for mixed use/commercial. Although the change between current and future land uses is subtle (commercial to commercial/mixed use), the footprint of the recommended alternatives is bigger than what currently exists. Additionally, the Traditional Diamond alternative extends farther south than the SPUI alternative and reaches to the border of an existing residential area which could negatively impact those residents.

Mitigation measures should be evaluated as part of the NEPA process for each particular business or residence affected by the identified Preferred Alternative. Because land use planning is under the purview of local agencies, ongoing coordination with local planners and other city officials is an important part of the process and will be an essential part of future project development. Ongoing conversations with property owners, businesses, and residences potentially affected will also be a critical part of future project development.

Additional analysis should be undertaken during the NEPA process to ensure that the identified Preferred Alternative does not exacerbate the existing community barrier effect presented by I-70. This may include a mitigation plan to address additional barrier effects brought by the new interchange configuration.

Neighborhood/Business Displacement

ROW within the study area is generally owned by CDOT and local municipalities, though the recommended alternatives will also impact local commercial and residential property. The potential land use and business impacts of the recommended alternatives are described in more detail in the *Land Use and Business Impacts Technical Memorandum* in **Appendix A**.

During the NEPA process, impacts to neighborhoods, businesses, and individual residences should be identified and avoided or minimized where possible. If property acquisition is required for ROW, acquisition proceedings will conform to the requirements set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (as amended) and the Uniform Relocation Act Amendments of 1987 (as amended).

Wetlands and Waters of the U.S.

Based on U.S. Geographic Survey data (1994) and GIS data (2012), one irrigation ditch located in the southeast corner of the study area would be impacted by the recommended alternatives. This ditch has been identified as a potential wetland and/or historic resource.

Under the Section 404 of the Clean Water Act, impacts to Waters of the U.S., including wetlands and open water features, must be avoided, minimized, or mitigated to ensure that there is no net loss of functions and values of jurisdictional wetlands. To the extent practicable, future design should incorporate avoidance and minimization of impacts to known wetland areas. Where avoidance and minimization would not be practicable, mitigation for impacts to wetlands could be achieved through the use of temporary and permanent BMPs.

A Section 404 permit would likely be required from the USACE to authorize placement of dredge or fill material in any Waters of the U.S. including wetlands and open water features. Impacts under 0.5 acres can be permitted under existing Nationwide Permits. Impacts greater than 0.5 acres would require obtaining an Individual Permit. An Individual Permit includes a public notice and would trigger additional NEPA coordination with the USACE. Generally, mitigation would be required under either permit type for impacts exceeding 0.1 acre of jurisdictional Waters of the U.S., including wetlands and open water features. Prior to application for a permit, a wetland delineation survey should be conducted including a jurisdictional determination. This would include documented wetland boundaries and a determination of impacts.

CDOT regulates wetlands regardless of USACE jurisdiction. A CDOT Wetland Findings report may be required if permanent wetland impacts exceed 500 square feet or if temporary impacts exceed 1,000 square feet, regardless of whether USACE has jurisdiction.

Noxious Weeds

The project team reviewed the State of Colorado and Jefferson County noxious weed lists (Colorado Department of Agriculture, 2012; Jefferson County, 2012) and visited the study area on March 29, 2012 to map noxious weeds. While the site visit was conducted out of the growing season, noxious weeds were still present in the study area. The eastern terminus of both recommended alternatives would affect the Slough Ditch (located between Oak and Miller Street) which was found to have a noticeable weed infestation. It is expected that additional weeds are present in the study area, so a second site visit and weed mapping are recommended to occur in the growing season.

As the project moves into the NEPA process, CDOT will require the preparation of an Integrated Noxious Weed Management Plan which would include steps to control existing noxious weeds. Additionally, the construction contractor for any project phase would be required to follow the revised CDOT Standard Specifications and implement the standard CDOT BMPs.

Threatened and Endangered Species and Wildlife

The project team reviewed State and County information on wildlife and Threatened, Endangered, and Special Status species that could occur within the study area. While no suitable habitat was observed for any of the 12 federally-listed species with potential to occur in Jefferson County, there are state-listed species present.[1] Black-tailed prairie dogs habitat was observed in all quadrants of the study area in open fields and vacant areas. Although no active prairie dogs were observed, there would be potential for this species to inhabit these areas. Prairie dog habitat and some of the culverts may provide habitat for migrating burrowing owls which are a state Species of Concern and also protected under the Migratory Bird Treaty Act (MBTA). There is moderate potential for the northern leopard frog and the common garter snake, both State Species of Concern, to occur in the wetland habitat ditch that could potentially be impacted by the recommended alternatives.

Tree removal, vegetation grubbing and other construction activities have the potential to destroy nests of bird species protected under the MBTA. Nearby construction activities during the breeding season may cause raptors to abandon nests. Several potential raptor nests were observed in the study area, and the mature trees throughout the study area provide additional raptor nesting habitat. In addition, the mature trees may also provide winter roost sites for bald eagles. Similarly, winter construction activities may cause bald eagles to abandon roosting areas and the USFWS has published guidelines to minimize disturbance (USFWS, 2007).

Due to the raptor nests and nesting habitats that were observed in the study area, careful construction practices will be necessary. Construction activities should schedule clearing and grubbing operations and work on structures to avoid impacting migratory birds protected by the MBTA. Pre-construction surveys for nesting birds should be completed and should follow the methods set forth by the USFWS, the CPW or CDOT Section 240 Protection of Migratory Birds Standard Specification (CDOT, 2011).

Cliff swallows often nest under bridges and within box culverts and were observed nesting under the I-70 overpasses over Carr Street, Garrison Street and Kipling Street. Nesting locations may change from year to year, and areas should be re-surveyed prior to construction. No bridge or box culvert work may take place if there are nesting birds present. Bridge or box culvert work that may disturb nesting birds should be completed before birds begin to nest or after the young have fledged (typically between April 1 and August 31). If work activities are planned between these dates, old swallow nests should be removed before nesting begins and appropriate measures taken to assure no new nests are built prior to construction. Appropriate measure to keep birds from nesting include installing plastic sheeting to prevent swallows from accessing the bridge or removing any new nests within three days. Failure to keep new nests from becoming established may postpone project construction.

[1] CPW also designates State-Specific Species of Concern (CPW, 2012a)

Hazardous Materials

The hazardous materials review provided information about properties within the study area that pose a potential risk of environmental contamination from hazardous materials. Sites with known (current and historic) soil and/or groundwater contamination are distinguished as sites with "recognized environmental conditions."[2] After review of the database search of local, state, tribal, and federal environmental agency databases and a windshield survey, a total of 41 sites with recognized environmental conditions were "flagged" within and adjacent to the study area.

The SPUI alternative could potentially impact the Circle K gas station in the northwest corner with a partial acquisition and driveway reconstruction. The Conoco gas station in the southeast corner of the interchange is expected to be a full acquisition and potential location for water quality retention. The Traditional Diamond alternative could potentially impact the Circle K and Conoco gas stations with partial acquisition and driveway modifications.

Moving into the NEPA process, a hazardous materials assessment, such as a Modified Phase I Environmental Site Assessment, would typically be needed as part of future project development. During the final planning and design process, this information can be used to identify avoidance options, when possible, and to assist with the development of specific contaminated soils/groundwater material management or mitigation measures to protect worker health and safety. It is anticipated that properties targeted for construction undergo further site assessments and/or preliminary site investigations as part of the ROW acquisition process, and may require remediation prior to acquisition or development.

Historic Resources

A file search for historic resources was conducted in the study area. This file search identified only one site, the Colorado Central and Colorado and Southern Railroad, as an Officially Eligible site. It was listed on the National Register of Historic Places in 1998. The railroad parallels Ridge Road through the northern portion of the study area and is therefore out of the impact area for both recommended alternatives. The Slough Ditch has been identified as a potentially historic resource, but based on a survey in 2000 it was determined that the ditch is not officially eligible as historic.

Parks and Recreation

Section 4(f) of the Department of Transportation Act of 1966 stipulates that FHWA and other Department of Transportation agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or

[2] Recognized environmental conditions, as defined by the American Society for Testing and Materials Standard E 1527-05, include sites with "*the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property*."

public and private historic sites unless there is no feasible and prudent alternative to the use of land, and the action includes all possible planning to minimize harm to the property resulting from use.

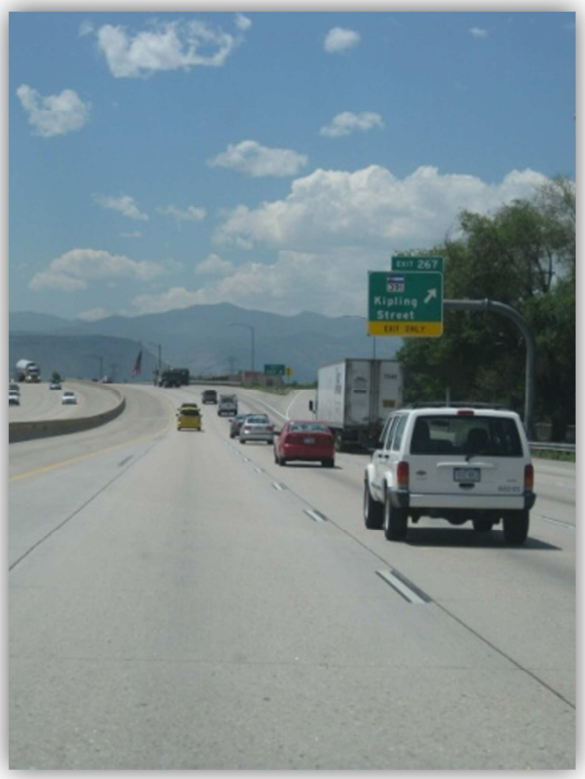
Two potential Section 4(f) resources exist within the study area, Fruitdale Park and an unnamed off-street trail along Kipling Street. Fruitdale Park is under the jurisdiction of the City of Wheat Ridge and located southwest of the I-70 and Kipling Street interchange. The unnamed, off-street paved trail is maintained by the City of Arvada and originates at West 50th Avenue on the west side of Kipling Street and terminates north of the study area. Neither of these two potential Section 4(f) resources would be impacted by the recommended alternatives.

Additionally, the Land and Water Conservation Fund (LWCF) Act of 1965 established a Federal funding program to assist states in developing outdoor recreation sites. Section 6(f) of the act prohibits the conversion of property acquired or developed with these funds to a non-recreational purpose without the approval of the National Park Service (National Park Service, 2008).

A file search was conducted in April 2012 to determine whether LWCF 6(f) funds were used on either recreation facility within the study area. Neither facility was constructed using 6(f) funds. Therefore, neither recommended alternative would impact 6(f) resources.

Cumulative Impacts

During the NEPA process, additional analysis and agency coordination will need to be performed, based on the environmental scan that was conducted. Resources that may be cumulatively impacted by future projects when combined with other past, present, and reasonably foreseeable future projects may include noise impacts to local residents, economic impacts to local businesses, and direct/indirect loss of wetlands due to surface disturbance and increased impervious surface area. Wildlife habitat loss may also occur due to planned development.



Westbound I-70 approaching Kipling interchange

Next Steps

The PEL process is intended to provide the framework for the long-term implementation of the recommended interchange improvements as funding is available and to be used as a resource for future NEPA documentation.

FHWA has developed a standard questionnaire to summarize the planning process and ease the transition from planning to a NEPA analysis. That questionnaire, included in **Appendix H**, summarizes the information that has been analyzed with the PEL study and the issues a future project team should be aware of to efficiently move forward in future NEPA process(es). Letters of agency support are included in **Appendix I**.

The next steps in the overall interchange reconstruction implementation process are outlined and illustrated in **Figure 11**. As described with the recommended alternatives and potential short-term improvements, separate project phases may be implemented if funding is available. These steps include:

- Secure necessary funding to move projects forward into the NEPA process
- Complete NEPA analyses of interchange alternative or phased project elements
- Complete design
- Obtain ROW
- Complete Intergovernmental Agreement with local agencies regarding maintenance
- Complete construction

These steps will be coordinated with FHWA to ensure consistency with the NEPA process for the recommended alternatives, short-term improvements, or phased project elements. Individual projects may be initiated as funding becomes available for elements of the interchange reconstruction. It is anticipated that these improvement projects could move forward with individual NEPA processes with this PEL study providing the documentation of the intent to implement the full interchange improvements over time, as funding becomes available.

Figure 11: Overall Project Process