ADMINISTRATIVE ACTION

I-26 ASHEVILLE CONNECTOR
Buncombe County, North Carolina
Federal Aid Project No. NHF-26-1(53)
WBS Element 34165.1.2
STIP I-2513

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 OF 2

U.S. Department of Transportation
Federal Highway Administration
and
North Carolina Department of Transportation

Submitted Pursuant to the National Environmental Policy Act 42 U.S.C. 4332(2)(c)

1/9/2020 DERRICK WEAVER
Date of Approval

Derrick Weaver, P.E.
Environmental Policy Unit -Unit Head
North Carolina Department of Transportation

1/9/2020 for Clarence W. Coleman, Jr.
Date of Approval

John F. Sullivan, III, P.E.
Division Administrator
Federal Highway Administration

The following persons may be contacted for additional information concerning this document:

John F. Sullivan, III, P.E.
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601-1418
(919) 856-4346

Derrick Weaver, P.E.
North Carolina Department of Transportation
1582 Mail Service Center
Raleigh, NC 27699-1582
(919) 707-6253

The documented needs for the transportation project in Buncombe County are presented in the report. The existing conditions of the study area are described and the alternatives are assessed in terms of environmental impacts, compatibility with local planning goals, relative cost-effectiveness and public opinion.

ADMINISTRATIVE ACTION

I-26 ASHEVILLE CONNECTOR
Buncombe County, North Carolina
Federal Aid Project No. NHF-26-1(53)
WBS Element 34165.1.2

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 OF 2

January 2020

Prepared by:

AECOM (URS Corporation – North Carolina)

January 8, 2020
Date — Joanna H. Rocco, AICP
Project Manager

Jan 08, 2020
Date — Neil J. Dean, P.E.
Project Engineer

For the:

North Carolina Department of Transportation

January 9, 2020 Kevin E. Moore
Date — Kevin E. Moore, P.E.
Project Management Unit

APPENDIX A

TUNNEL FEASIBILITY EVALUATION MEMORANDUM

MEMORANDUM TO FILE

To: Project File

From: Tom Hepler
AECOM

Date: September 6, 2017

RE: Tunnel Feasibility Evaluation
NCDOT STIP Project I-2513 (I-26 Connector)

Tunneling Concept for I-26 in Asheville

This memorandum considers the feasibility and practicality of a subsurface passage of the French Broad River by I-26 and the I-240 connection ramps in Asheville, NC. The location of the crossing is north of the existing Patton Avenue crossing of the river. The alignment of I-26 is controlled by the design speed, (60 mph), the corresponding maximum grade (4 percent for rolling terrain), and the minimum horizontal curve radius (1,200 feet). However, for special conditions in mountainous areas, up to 6 percent grade could be employed. The connecting ramps of I-240 to I-26 cross the river and have a design speed of 50 mph with maximum grade of 5 percent and minimum horizontal curve radius of 833 feet. AASHTO recommends holding upgrades on ramps between 2 percent and 5 percent and downgrades the same, with special cases where the downgrade could be up to 7 percent. The DEIS alignment of I-26 passes under Patton Avenue and elevates to provide vertical clearance over two railroads, the river and US 19/23/70. Both I-240 ramps must clear these vertical obstacles and the westbound ramp must cross over I-26. Other vertical controls include the on-ramp from Patton Avenue west of the river and the crossing of Hill Street on the east side of the river. The proposed structures are slightly higher in elevation (approximately 10 to 15 feet) than the Captain Jeff Bowen bridges.

Tunnel construction can be classified in two major categories: 1) tunnels constructed by mining methods, and 2) tunnels constructed by cut and cover methods. The first category (mining) can be subdivided into two groups based upon the specific construction method: a) tunnel boring machine and b) drill and blast. Drill and blast is less expensive and can be employed to tunnel through stable homogeneous rock. Tunnel boring machine methods are used in unstable conditions, especially through softer soils and unstable rock material. This latter method is becoming more common method due to environmental issues, geologic conditions and technology advancements.

The second category (cut and cover) is suitable for shallow tunnels where disturbance of the surface above the tunnel during construction is acceptable. Two methods of construction can be employed under this category: a) trenching and b) cut and cover. Trenching methods are normally used for long expansive subaqueous tunnels where pre-cast tunnel sections are hauled to an excavated trench and

connected and upon completion, dewatered. This method may be used where environmental, stream flow, sedimentation issues are of little concern and accessibility and staging areas are available.

Site conditions, environmental issues, accessibility and subsurface geology must be evaluated in determining what type of tunnel construction is appropriate.

Geology: The geology of the area was reviewed based upon information provided by the NC Geological Survey (see attachment). Generally it can be expected to encounter a metamorphic suite of material referred to as Schistose Metagraywacke, which is a non-foliated to weakly foliated; fine to medium grained; granoblastic to lpidoblastic.(35-58% quartz, 20-41% plagioclase, 2-15% K-feldspar, 10-20% biotite, 0-10% muscovite, 0-5% almandine). In general this material lends itself to both 1) drill and blast: and 2) tunnel boring machine. The preferred method to be used will be based upon more detailed geology data, tunnel size, local concerns and conditions, and contractor preference.

Site Conditions: The area is urban with extensive development and infrastructure in place. Cut and cover methods would impact and/or displace all within the corridor. The river front contains a lot of development, utilities, roadways, trails and railroad corridors on both sides of the river. Staging for trenching would be difficult due to the surrounding urban development. Although the river is not used for commercial navigation it is used extensively for sports recreation and it is a FEMA regulated narrow floodplain. Outside of the floodplain the terrain becomes rolling to mountainous. Temporary impacts to the flow and floodplain would need to be considered. Cut and cover and trenching methods are not practical for the most part of this alignment nor would they be acceptable from an impact standpoint.

Environmental Issues: In addition to the accessibility and economic issues, the river environment is protected via wildlife resources and pollution control. The French Broad River is classified as a trout stream and trenching would be prohibited due to the negative impact it would have. Trenching would also create downstream sediment pollution.

Recommended Method:

Based upon information available, if a tunnel is deemed an option to carry forward, the tunnel method recommended would be "mining", consisting of either drilling and blasting or tunnel boring machine. Further geologic exploration is needed to verify which method would be most appropriate. The following considerations would apply to both methods.

Depth and clearances: The primary obstacle which must be cleared is the riverbed. For mining operations the depth below the bed of the river will depend upon the stability of the riverbed material. Based upon the information available, a conservative depth would be a distance equal to the actual width of the tunnel. If adequately stable material exists this depth can be reduced to as little as one-half the width. This study assumed the material below the riverbed as reasonably stable and therefore a cover of two-thirds the width of the tunnel has been assumed.

Number of I-26 Tunnels and geometry: The number of tunnels required is based upon the number of lanes to be carried and the requirement for redundancy to assure safe escape and alternative routing of

traffic when necessary. Due to the required arch of the tunnel, the wider the tunnel the higher the ceiling. A three-lane roadway width tunnel is the practical maximum. For a multilane divided facility it is most practical to employ two tunnels, one in each direction. For more than three lanes in one direction additional tunnels may be necessary or stacking the traffic (2 x 2) in a single large tunnel. The latter requires vertical transitions at entrances and exits to the tunnel. I-26 is a six-lane divided freeway therefore two tunnels (3 lanes each) constructed parallel with connecting passages between the two would be the most practical. AASHTO recommends that left and right shoulder widths, adequate to store a disabled vehicle, be carried through the tunnel. In curved tunnels stopping sight distance requires shoulders so that adequate stopping sight distance is provided. Taking this into consideration, a clear width of 58 feet under the following conditions will provide adequate stopping sight distance: 3 12-foot lanes, a 5-foot inside shoulder plus a 5-foot walkway, and a 10-foot outside shoulder along with a 758-foot minimum horizontal curve. A minimum vertical clearance of 17.5 feet must also be provided (see attached typical section). A minimum 60-foot diameter tunnel would be needed for a tunnel bore and a 60-foot width for a drill and blast. The grade point of the roadway to the structural ceiling of the tunnel would be approximately 39 feet and would not differ greatly due to the method of mining. Assuming two-thirds diameter or width of the tunnel for cover under the river bed and the 39 feet from ceiling to grade point, the grade point would be 79 feet below the riverbed at a minimum.

Grades and I-26 Tunnel Geometry: The minimum radius for a Tunnel Boring Machine is 1,500 feet; however, as concluded in the foregoing discussion in order to provide adequate stopping sight distance, the minimum radius is 2,750 feet. The existing alignment of I-26 would need adjusting to flatten the reverse curves west and east of the river crossing. Assuming a maximum grade of 6 percent and a 79-foot elevation below the river bed, entry points for the excavation would potentially be located just north of Patton Avenue and north of the Montford Area Historic District.

I-240 Tunnel: It is impractical to tunnel I-240 in conjunction with I-26 due to the fact that it is not safe to have entrances and exits within a tunnel and crossing I-240 over I-26 is vertically impractical. For this reason I-240 connector ramps would cross the French Broad River and other obstacles with aerial grade separations similar to the designs presented in the Public Hearing Map.

Conclusions and Challenges: The following is a summary of findings resulting from a conceptual alignment study for tunneling of I-26. This is not a comprehensive list and many others will arise once preliminary design is entered.

1. The grade of I-26 at Patton Avenue drops approximately 20 feet to an elevation of at least 45 feet or more below the Patton Avenue bridge on the north side. This would present major challenges in making ramp ties as discussed later.
2. The alignment would require curves within the tunnel with both entrances and exits on curves. This would require greater shoulder widths to provide adequate sight distance. The resulting width of 60 feet is pushing the maximum limit for a tunnel boring machine. The horizontal curves must be flattened, which changes the alignment from that shown on the 2015 Public Hearing Map. This means the bank to bank river crossing would increase from 400 feet to 700 feet.

3. Smith Mill Creek would require significant relocation at the southern entrance to the tunnel. The alignment assumes the vertical clearance under the relocated Smith Mill Creek could be less than 40 feet.
4. The northbound entrance ramp from Patton Avenue to I-26 would place the gore at the tunnel entrance which is prohibited under AASHTO guidelines, and is not possible with the entrance to the tunnel being so close to Patton Ave. The grade differential from Patton to I-26 discussed in item 1 would result in a ramp grade greater than 10 percent, making the ramp tie impractical. This is a 3-lane ramp and could not be reconfigured into a loop, and even if it was possible it would create a weaving problem. Diverting this traffic east across the existing Patton Avenue bridges would create a major traffic issue that would not be addressed with improvements.
5. The I-240 eastbound ramp exit would need to be shifted south prior to Patton Avenue. This would force the Patton Avenue exit ramp farther south, both of which would increase impacts to the C.F. Worley House, which has been determined eligible for listing on the National Register of Historic Properties.
6. The I-240 eastbound ramp would remain aerial and follow the grade of the I-26 aerial alignment, thereby slightly lowering it.
7. The I-240 westbound ramp entrance would be shifted south, which would create a weaving issue between the entrance and the Patton Avenue exit loop. The grade differential discussed in item 1 forces the loop grade beyond the maximum loop grade. Elimination of the loop forces the traffic to I-240 eastbound and exiting onto Patton Avenue east of the existing bridge
8. The I-240 westbound ramp would remain aerial. The alignment should be evaluated to determine if it can be shifted such that bridge piers can be strategically placed between the tunnel and the river as not to impact either. Long spans would be required, potentially incorporating special bents or structures.
9. The US 19/23/70 northbound connection to I-26 could be lowered to reduce the retaining wall height adjacent to the Riverside Cemetery. However, US 19/23/70 northbound must follow to east of I-26 until north of the tunnel entrance. Although the grade would be lowered significantly, the alignment would be forced to the east, impacting the Montford Area historic property.
10. The capacity of the tunnel is fixed and cannot under the current design criteria, be increased by widening. Addition of lanes via additional tunnels or surface facilities would be possible but presents spatial problems of tying to other facilities outside the tunnel.
11. Construction costs of a tunnel would be at least double that of the bridge structure and maintenance costs would also be greatly elevated with the inclusion of storm water pumps, lighting, ventilation, and constant monitoring for accidents and disabled vehicles.

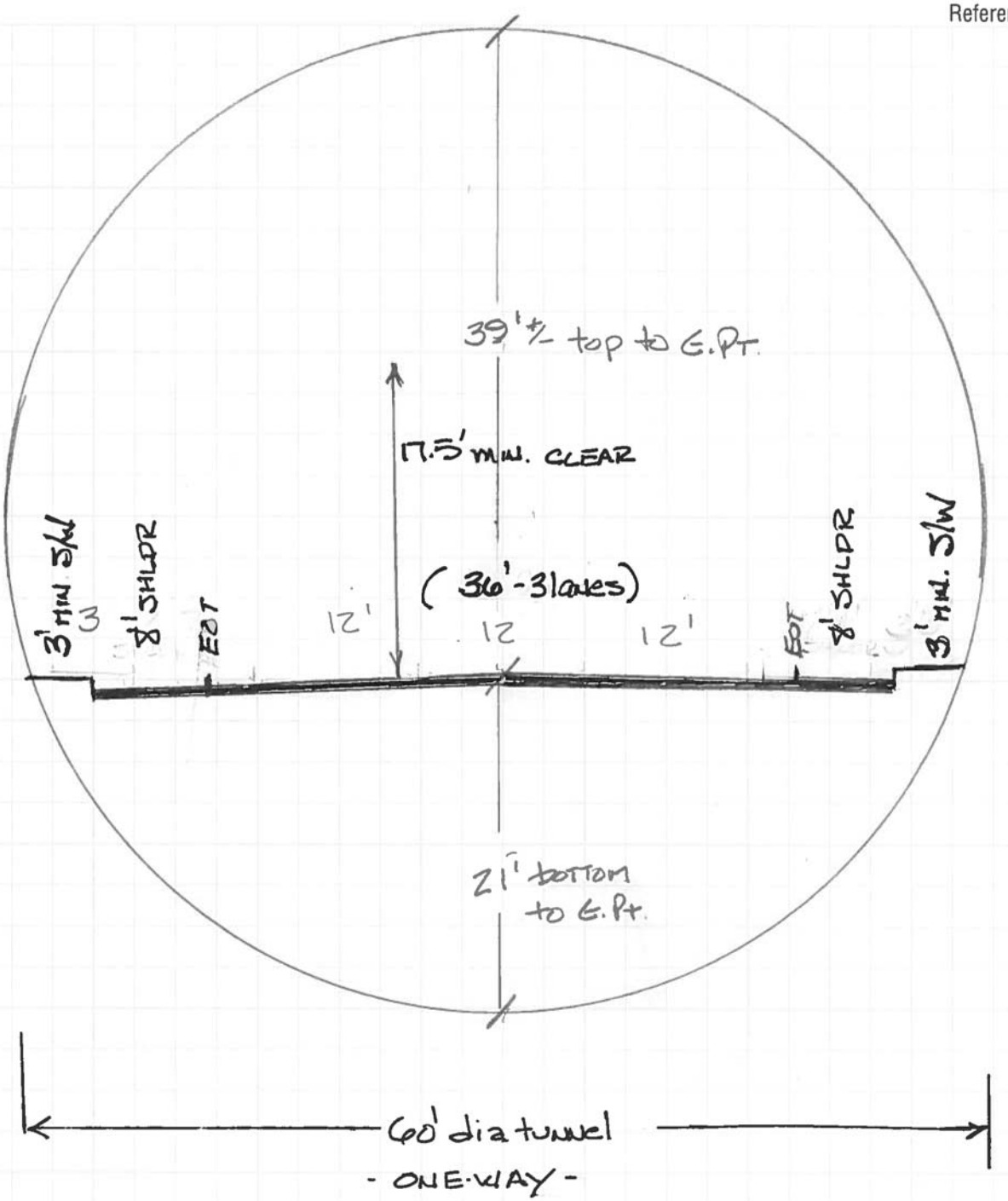
URS

Job I-2513 (I-26 CONNECTOR) Project No. _____ Page _____ of _____

Description TUNNEL CONCEPT ASHEVILLE NC Computed by TRH Sheet _____ of _____

Checked by _____ Date 9/1/17

Reference



BEDROCK GEOLOGIC MAP OF THE ASHEVILLE 7.5-MINUTE QUADRANGLE, NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES
James D. Simons, Director and State Geologist

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

NORTH CAROLINA GEOLOGICAL SURVEY
Geologic Map Series - 14

BY
J. WILLIAM MILLER
AND KAREN H. FRYER
2008

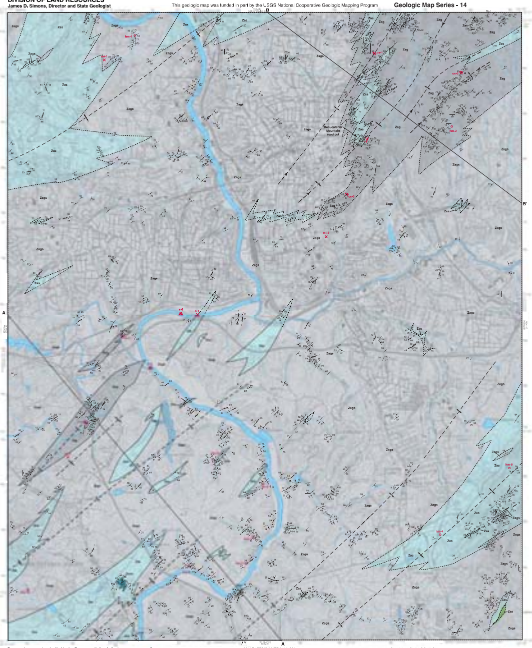
Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number 00HQPA0002. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

ACKNOWLEDGMENTS

For helpful guidance and discussion, we thank Carl Merschat, Mark Carter*, and Bart Cattanach, North Carolina Geological Survey (NCGS); also helpful for discussion and reviews were Leonard Wiener (NCGS, retired), and Steve Yurkovich (Western Carolina University, Emeritus). Thanks are due Karen Thomas (University of North Carolina Asheville**) for heavy mineral collection and analyses and Nick Bozdog (NCGS) for drafting assistance.
*Currently with Virginia Department of Mineral Resources
**Currently Environmental Consultant, Decatur, AL.

Field reviews by: Carl Merschat, Mark Carter, Tyler Clark, Richard Wooten, Phil Bradley, and Leonard Wiener.

Map preparation and editing by William Miller, Nick Bozdog, Bart Cattanach, Carl Merschat, and Ken Taylor.



Topography mapped and edited by the Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA
Revised by TVA in 1961 by photogrammetric methods using aerial photographs taken in 1960 and by reference to TVA/USGS quadrangle dated 1942. Map field checked by TVA, 1961

Polyconic projection. 10,000-foot grid ticks based on North Carolina coordinate system
1,000-meter Universal Transverse Mercator grid ticks, zone 17

North American Datum of 1983 (NAD 83) is shown by dashed corner ticks. The values of the shift between NAD 27 and NAD 83 for 7.5-minute intersections are given in USGS Bulletin 1875.

UTM GRID AND 2008 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

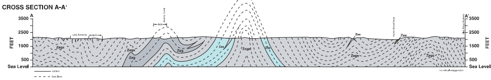
SCALE APPROXIMATELY 1:24000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

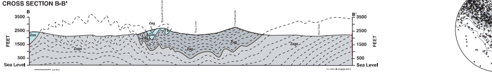
QUADRANGLE LOCATION

ASHEVILLE, N.C.
1961
PHOTOREVISED 1991

CROSS SECTION A-A'



CROSS SECTION B-B'



MAP UNITS

ASHE METAMORPHIC SUITE

Late Proterozoic — Stratigraphic relations uncertain

- **Zags** Schistose Metagraywacke
- **Zag** Metagraywacke
- **Zas** Sillimanite-Garnet-Chlorite-Mica Schist
- **Zaa** Amphibolite
- **Zasc** Chloritoid-Garnet-Chlorite-Quartz-Muscovite Schist

STRUCTURAL FEATURES

CONTACT

Stratigraphic Contact (inferred)

STRIKE AND DIP OF PLANAR FEATURES

Observation sites are centered on the strike bar, or one of the intersection point of multiple symbols.

Foliation — Shear zone — Joint — Vertical foliation — Vertical joint

BEARING AND PLUNGE OF LINEAR FEATURES

Fold axis — Vertical fold axis — Horizontal fold axis — Mineral lineation

MAP SCALE STRUCTURAL FEATURES

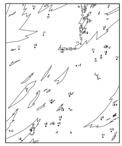
Axis of map-scale synform inferred — Axis of map-scale antiform inferred

ELEMENTS OF METAMORPHIC CONDITIONS

Prograde metamorphic minerals observed in stream sediment heavy mineral samples and thin sections shown. Stream sediment heavy mineral sample site localities shown on geologic map.

- o Stream sediment heavy mineral sample site
- ▲ Thin section sample site

bt - biotite; ctd - chloritoid; gt - garnet; hbl - hornblende; ky - kyanite; sill - sillimanite; st - staurolite



DESCRIPTION OF MAP UNITS

ASHE METAMORPHIC SUITE — The Ashe Metamorphic Suite is predominantly schistose metagraywacke (Zags), less abundant metagraywacke (Zag) and garnet-mica schist (Zas), and minor amphibolite (Zaa) and chloritoid-garnet-chlorite-quartz-muscovite schist (Zasc). Garnet granofels, garnet-biotite schist, actinolite schist, and amphibole-biotite granofels are widely scattered in non-mappable amounts. The protolith of the amphibolite is a mafic rock or a sedimentary derivative of a mafic igneous rock, and the calc-silicate rocks (garnet granofels, garnet-biotite schist, actinolite schist, and amphibole-biotite granofels) originated from sedimentary derivatives of mafic rocks. The sequence in the Asheville 7.5 minute quadrangle is composed dominantly of continentally derived clastic sediments with minor amounts of interlayered volcanics. Deposition occurred in a marine basin. The Ashe Metamorphic Suite has been metamorphosed to sillimanite grade, amphibolite facies. Muscovite porphyroblasts (≤1 cm) are abundant regardless of rock type in varying amounts throughout the quadrangle.

Schistose Metagraywacke (Zags) — Light to medium gray; nonfoliated to weakly foliated; fine to medium grained; granoblastic to lepidoblastic; layering ranges from centimeters to several meters. Consists of 35-65% quartz, 20-41% plagioclase, 2-15% K-feldspar, 10-20% biotite, 5-10% muscovite, 0-5% almandine, widespread traces of zircon, and occasional traces of apatite, calcite, rutile, ilmenite, pyrrhotite, pyrite, and chalcopyrite.

Metagraywacke (Zag) — Light to dark gray; nonfoliated to strongly foliated; fine to medium grained; granoblastic to lepidoblastic; layering ranges from centimeters to several meters. Consists of 20-70% quartz, 10-50% plagioclase, 0-60% K-feldspar, 10-20% biotite, 0-7% almandine, 0-5% muscovite; traces to locally minor epidote, clinozoisite, kyanite, sillimanite, staurolite; and traces of cummingtonite, zircon, apatite, calcite, rutile, ilmenite, magnetite, hematite, pyrrhotite, pyrite, and chalcopyrite.

Garnet-Mica Schist[1] (Zas) — Dark, silvery bluish to greenish gray, strongly foliated, fine to medium grained, lepidoblastic; layering in meters. Consists of varying amounts of micas, with 5-60% muscovite, variable but persistent (1-30%) chlorite and (0-30%) biotite; highly variable (0-45%) quartz, (0-45%) plagioclase, and (0-30%) almandine; widespread traces of sillimanite; and rare traces of clinozoisite, zircon, ilmenite, magnetite, pyrrhotite, pyrite, and chalcopyrite.

Amphibolite (Zaa) — Black to mottled black and white, weakly foliated, fine- to coarse-grained, hypidioblastic; some fine-grained amphibolites contain hornblende in the main rock matrix as well as porphyroblasts (≤ 2 mm); decimeter to meter-scale layering. Consists of 50-70% hornblende and 25-50% plagioclase, 0-5% biotite, and traces of chlorite, zircon, apatite, calcite, rutile, ilmenite, magnetite, hematite, pyrrhotite, chalcopyrite, and pentlandite (always as inclusions in pyrrhotite). Occurs most often as small lenticular fragments a few meters in outcrop dimension. One 30-meter-thick conformable layer occurs in the central-east end of the Beaucatcher Mountain road cut. Protolith is mafic rock or sedimentary derivative of a mafic rock.

Chloritoid-Garnet-Chlorite-Quartz-Muscovite Schist (Zasc) — Mottled silvery white to silvery medium gray, strongly foliated, fine to medium grained; in meters-thick layers. Consists of 40-70% muscovite, 5-60% quartz, 10-15% chlorite, 10-15% almandine as porphyroblasts (≤1 mm), and 2-10% chloritoid as porphyroblasts (≤ 10 mm), and traces of pyrrhotite and magnetite.

DESCRIPTION OF OTHER ROCK TYPES

The following rock types also occur on the Asheville 7.5-minute quadrangle, but individual bodies are too small and discontinuous to be shown at this scale.

PALEOZOIC INTRUSIVES

Pegmatite — Mottled white to very light gray, nonfoliated, very coarse grained, and lenticular to tabular; thickness ranges from centimeters to meters. Consists primarily of plagioclase and quartz with minor microcline, muscovite, biotite, and garnet. Pegmatites typically cross-cut foliation of other rock units. Not found in mappable units.

Trondhjemite — Very light gray to nearly white; fine to medium grained; granoblastic. Thickness ranges from centimeters to meters. Consists of 50-70% plagioclase, 25-45% quartz, 2% biotite, 5-10% muscovite, and traces of K-feldspar, chlorite, and zircon. Trondhjemites typically cross-cut foliation of other rock units. Not found in mappable units.

MINOR ASHE METAMORPHIC SUITE ROCKS

Garnet Granofels — Mottled pink and white and non-foliated; fine- to coarse-grained garnet-biotite schist is mottled pink and brown and strongly foliated. These two rock types are end-members of the same unit that are distinguished by increasing amounts of biotite from granofels to schist. They may be interlayered or graded between the two end members. Thickness of layering is in decimeters to meters. Consist of 30-40% plagioclase, 30-60% almandine, 2-10% sillimanite, 2-5% biotite, 0-10% K-feldspar; 0-1% each kyanite, muscovite, titanite, and pyrrhotite; and traces of zircon, apatite, calcite, rutile, ilmenite, chalcopyrite, and pentlandite. The largest layer in outcrop reaches 30 meters thick at the northwest end of the Beaucatcher Mountain road cut.

Actinolite Schist — Mottled dark green and white, moderately to strongly foliated, fine- to medium-grained, xenoblastic to hypidioblastic; layering ≤ 4 meters. Consists primarily of actinolite-rich (90%) and actinolite-poor quartzofeldspathic sub-layers < 1 centimeter thick, with 0-90% actinolite, 2-80% quartz, 0-30% K-feldspar (microcline), 3-10% plagioclase, 2-5% biotite, 0-1% titanite, and traces of apatite, calcite, and pyrite. Not exposed in mappable units. One 4-meter-thick layer occurs at the west end of the Beaucatcher Mountain road cut on I-240.

Amphibole-Biotite Granofels — Mottled medium-dark gray, granoblastic to weakly foliated, medium-grained, xenoblastic to hypidioblastic; layer is in meters. One sample from the Beaucatcher Mountain road cut contained 74% plagioclase, 10% chlorite, 5% biotite, 5% hornblende, 5% cummingtonite, and traces of apatite, calcite, ilmenite, hematite, goethite, pyrrhotite, chalcopyrite, and pentlandite.

[1] Mineral adjectives are arranged in order of increasing abundance.

TRAVERSE MAP

Green lines show paths of field traverses made to collect geologic control.

MINERAL RESOURCES

PROSPECTS, QUARRIES, AND SAND RESOURCES

Map Number	Description	Latitude; Longitude (decimal degrees)	NC COORDINATES (State Plane, NAD 83 meters)
mi-1	Ethel Rice Heirs mica prospect	35.61565 N; 82.60157 W	212,888N; 283,423E
mi-2	H.D. McDowell mica prospect	35.58047 N; 82.54747 W	208,811N; 288,181E
mi-3	Lora Lee Mathews mica prospect	35.53867 N; 82.61023 W	204,160N; 282,320E
cs-1	Unnamed stone quarry	35.61663 N; 82.53643 W	212,781N; 289,414E
cs-2	Unnamed stone quarry	35.61335 N; 82.51448 W	212,350N; 291,298E
cs-3	Unnamed stone quarry	35.58872 N; 82.54250 W	209,710N; 288,664E
cs-4	Unnamed stone quarry	35.56097 N; 82.59702 W	206,811N; 283,615E
cs-5	Pond Road crushed stone quarry	35.54322 N; 82.60663 W	204,871N; 282,763E
s-1	Harrin's Sand Company dredge	35.56487 N; 82.57882 W	207,183N; 285,279E
s-2	Harrin's Sand Company dredge	35.56497 N; 82.58247 W	207,207N; 284,949E
s-3	Harrin's Sand Company dredge	35.55407 N; 82.59002 W	206,023N; 284,221E

o **hm-9**: Stream sediment heavy mineral sample site. Sample numbers correspond to stream sediment heavy mineral analyses listed in table below.

mi-2: Mineral resource number referred to in accompanying Mineral Resource Summary. Commodity indicated by letter symbol.

- Sand dredging operation
- Abandoned sand dredge
- Abandoned quarry
- × Prospect

COMMODITY LETTER SYMBOLS:

- **cs** Crushed stone
- **mi** Mica
- **s** Sand

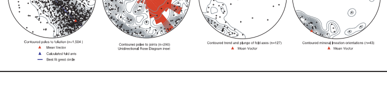
STREAM SEDIMENT HEAVY MINERAL ANALYSIS

Approximately 14 kg of stream sediment was panned to approximately 300 g of heavy mineral concentrate, which was further separated with tetrabromoethane. At least 200 grains were identified with a petrographic microscope and refraction oil of n=1.47.

SAMPLE[1]	LATITUDE; LONGITUDE (decimal degrees)	NC COORDINATES (State Plane, NAD 83 meters)	MAP UNITS DRAINED[2]	% hm IN SAMPLE[3]	PERCENT HEAVY MINERALS IN SAMPLE[4]										
					Mag	Op	Gt	Hbl	Zr	Ep	Sil	Rt	Ky	St	Tt
hm-1	35.62073 N; 82.59408 W	213,427N; 284,121E	Zag, Zas	tr	9.4	26.3	3.3	14.1	10.3	12.2	0.0	2.3	4.7	17.4	0.0
hm-2	35.60247 N; 82.51682 W	211,152N; 291,044E	Zag	tr	7.0	22.2	26.4	21.7	5.2	3.8	1.4	0.0	3.3	9.0	0.0
hm-3	35.51542 N; 82.56662 W	201,662N; 286,188E	Zag	tr	33.0	15.4	14.4	6.5	18.1	0.6	8.0	0.9	0.6	2.5	0.0
hm-4	35.52108 N; 82.51963 W	202,137N; 290,469E	Zas	0.04	21.9	30.6	20.3	13.8	7.9	2.1	1.4	0.0	1.0	1.0	0.0
hm-5	35.53452 N; 82.50300 W	203,574N; 292,029E	Zas	tr	70.6	1.6	14.3	3.1	5.2	1.6	0.4	0.0	0.1	2.8	0.3
hm-6	35.53120 N; 82.56302 W	203,399N; 286,577E	Zag, Zas	0.04	18.4	20.9	17.3	7.2	19.3	5.8	5.8	0.4	1.6	3.6	0.0
hm-7	35.52078 N; 82.56493 W	202,250N; 286,362E	Zag	0.08	9.5	33.9	18.7	3.9	11.3	11.7	9.1	0.0	0.0	1.7	0.0
hm-8	35.53613 N; 82.57493 W	203,985N; 285,517E	Zag	0.05	16.8	30.3	16.1	8.1	20.6	2.0	4.0	0.0	0.0	1.6	0.4
hm-9	35.51487 N; 82.59060 W	201,647N; 284,900E	Zag	0.61	3.1	34.3	21.2	15.1	11.6	6.1	3.5	0.0	1.0	3.0	1.0
hm-10	35.51043 N; 82.62042 W	201,285N; 281,291E	Zag, Zas	0.01	29.3	20.5	39.9	0.0	2.3	2.7	0.0	0.0	0.0	5.3	0.0

[1] Sample numbers correspond to heavy mineral sample localities shown on geologic map
[2] Map units contributing to the drainage basin, listed in descending order of map area
[3] Weight percent heavy minerals in stream sediment sample
[4] Weight percent of heavy minerals: Mag=magnetite, Op=opaques other than magnetite in heavy minerals, Gt=garnet, Hbl=hornblende, Zr=zircon, Ep=epidote minerals (epidote, clinozoisite), Sil=sillimanite, Rt=rutile, Ky=kyanite, St=staurolite, Tt=titanite. Monazite was not observed but is expected to occur in Ashe heavy mineral samples.

SCHMIDT EQUAL AREA STEREONET DATA



Contoured poles to foliation (n=1,504) — ▲ Mean Vector; ▲ Calculated fold axis; — Best fit great circle

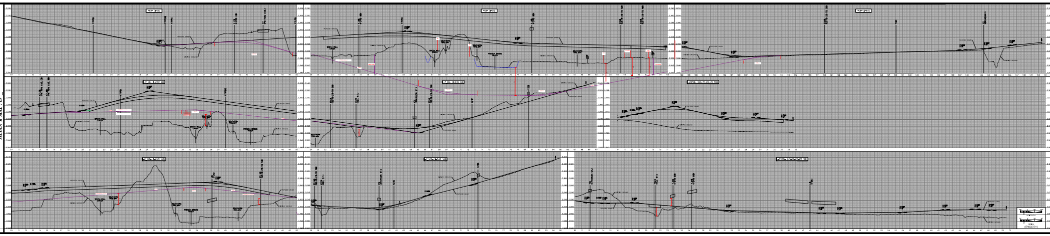
Contoured poles to joints (n=290) — Unidirectional Rose Diagram inset

Contoured trend and plunge of fold axes (n=127) — ▲ Mean Vector

Contoured mineral lineation orientations (n=43) — ▲ Mean Vector


Grade Change extends to this area.
tunnel staging area
End of Tunnel make NB tunnel first along with US 23NB tie.
clearance under railroad, Riverside and US 19-23
Grade on US 23NB will drop to tie with tunnel but the tie cannot be made until north of the tunnel. US 23NB must be spaced adequate distance from I-26 until north of the tunnel entrance. A significant cut is requiring retaining walls and combined with the alignment change will impact historic area.
Investigate realignment of ramp to cross river and tunnel simultaneous
Grade on 240WB Ramp is controlled by clearance over US23SB but can be lowered with Tunnel of I-26. US 23NB must follow the grade on 240WB until it diverges causing it to be high above existing ground. Retaining wall height can be reduced.
YWB
special bents required
Hill Street controls. With I-240 and US 19-23-70 going over. Hill St. is at max. grade to tie with Atkinson St. Hill St. and Atkinson are new connections across freeway.
I240 EB is controlled by clearance over Railroad and US23SB
The horizontal curves for I-240 are both at minimum radius for the design speed and cannot be squeezed together. The Patton Ave. ramp is as compressed as it can be in order to vertically clear I-240. Moving this closer to I-240 increases the bridge length which will in turn increase the bridge depth with the result of moving the I-240 merge point to the north and thereby shorting the weave distance below the minimum.
Begin Tunnel
Stream relocation required with tunnel
Entrance of I-240 WBRamp would be near the Patton Ave underpass which creates unacceptably short weave between ramp and loop.
I-26 passing ~45 feet under Patton Ave in a cut.
I-240 EB Ramp would exit in this area which along with grade change moves Patton Exit Ramp south and into Worley Historic property.
Grade change begins here
CORRIDOR STUDY LIMITS
To I-40
END TIP PROJECT I-2513A
SR 3556 (AMBOY ROAD)
ASHEVILLE CITY LIMITS

CORRIDOR PRELIMINARY PROFILES
WBS 34165.1.2 (I-2513B)
F.A. PROJECT MANHF 26-1(53)
BUNCOMBE COUNTY
I-26 CONNECTOR
I-40 TO US-19-23-70 NORTH OF ASHEVILLE
SECTION B ROLL 1 OF



PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CORRIDOR PRELIMINARY PROFILES
WBS 34165.1.2 (I-2513B)
F.A. PROJECT MANHF 26-1(53)
BUNCOMBE COUNTY
I-26 CONNECTOR
I-40 TO US-19-23-70 NORTH OF ASHEVILLE
SECTION B ROLL 1 OF _

MEMORANDUM TO FILE

To: Project File

From: AECOM

Date: June 17, 2019

RE: Tunnel Feasibility Evaluation
NCDOT STIP Project I-2513 (I-26 Connector)

Tunneling Concept for I-26 in Asheville

This memorandum serves as an addendum of the Tunnel Feasibility Memorandum, dated September 5, 2017. That memo considers the feasibility and practicality of constructing a tunnel for either I-240 or I-26 traffic in Asheville, NC. Discussions include the potential location of tunnels, right-of-way considerations, and comparisons to other tunnels of similar nature for a high-level cost analysis.

Preliminary Design of the Preferred Alternative

As studied in the I-2513 Final Environmental Impact Statement, the preferred alternative completes I-26 across the French Broad River and re-connects the existing highway network. The proposed configuration includes three bridges over the French Broad River; the northernmost bridge carries I-240 westbound, the middle bridge carries I-26, and the southernmost bridge carries I-240 eastbound (See Figure 1). Additionally, to provide connectivity between Patton Avenue and I-26/I-240, a tight diamond interchange is shown west of the Jeff Bowen Bridges. To provide connectivity with US 19/23, the designs include one entrance ramp and one exit ramp to Patton Avenue east of the Jeff Bowen Bridge. The design criteria for this project is derived from AASHTO's *A Policy on Geometric Design of Highways and Streets,* (2011, 6th Edition).

Potential I-240 Tunnel Option

A tunnel option was explored which would eliminate the I-240 eastbound and westbound flyover bridges (See Figure 2). In this scenario, the new bridge proposed to carry I-26 over the French Broad River would still be constructed. The I-240 eastbound and westbound tunnels would proceed along a new route and follow parallel alignments. These alignments begin southwest of the Jeff Bowen Bridges, would begin south of Dellwood Street, proceed under the French Broad River south of the Jeff Bowen Bridges, cross under Patton Avenue, and then surface just before Montford Avenue to tie into existing I-240. Due to the proximity of the tunnel entrances to the north of the Haywood Road ramps, the northern ramps at Haywood Road would likely be eliminated. The I-240 connections to Patton Avenue would also be eliminated in this scenario. Additionally, US-23 southbound traffic would lose the proposed connection to I-240 eastbound and I-240 westbound traffic would lose the proposed connection to US 23 northbound.

Figure 1: I-26/I-240 Flyover Vicinity

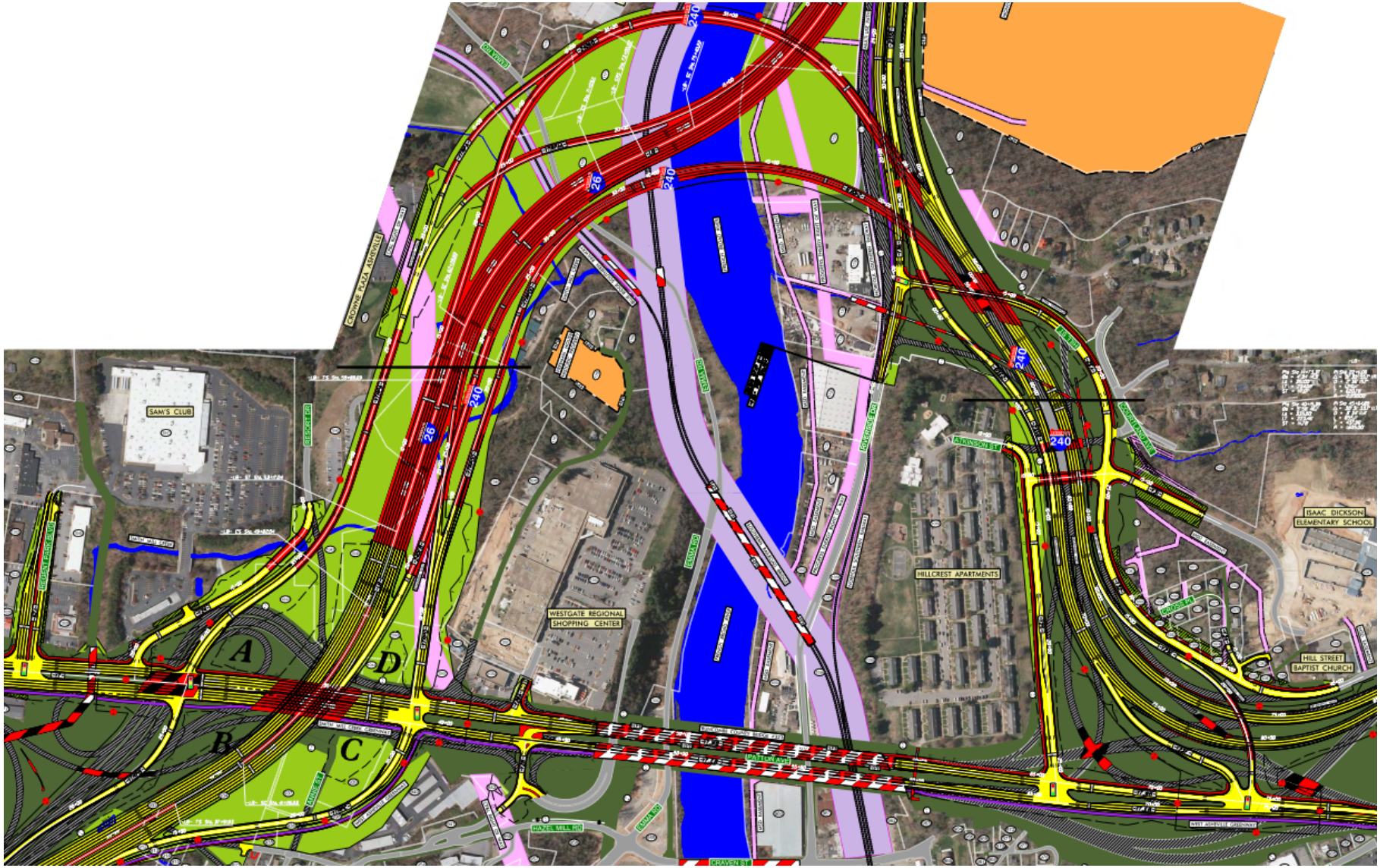
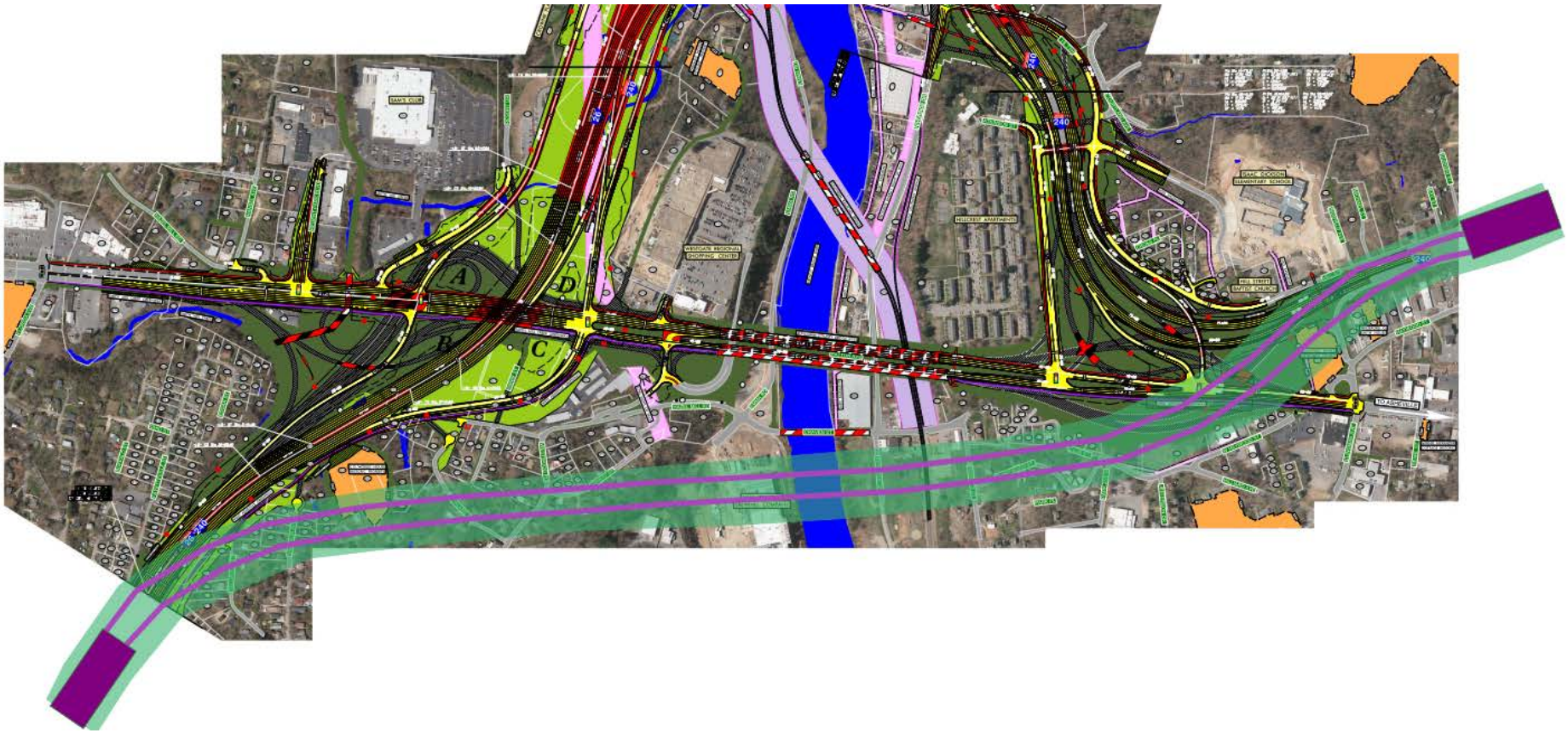


Figure 2:



The I-240 eastbound and westbound tunnels would each be approximately 48 feet wide, carrying two travel lanes in each direction. It is assumed the distance between the tunnels should at minimum one tunnel width, 48 feet. Approach plazas would be constructed on either end of the tunnels. This includes the entrance/exit ramps, retaining walls, and necessary structures housing support facilities such as mechanical rooms, HVAC infrastructure, lighting controls, and tunnel management facilities. It is assumed the approach plazas would each be approximately 1,575 linear feet. Building upon the design assumptions discussed in the 2017 Tunnel Feasibility memo, the minimum turning radius would be approximately 2,750 feet. An I-240 tunnel could adhere to this design criteria for horizontal curvature as the alignment would be fairly linear as shown in Figure 2. From the approach plazas, the tunnel would descend approximately 200 feet vertically to provide the necessary clearance of the French Broad River. It is assumed the top of the tunnel would be approximately 40 feet below the riverbed. The design criteria used for the preliminary plans identifies utilizing maximum 4 percent grades. To minimize the footprint of the tunnel, 5 percent grades or steeper would be needed, triggering design exceptions. Based upon these assumptions, the full length of the tunnel would be approximately 11,650 linear feet (8,500 linear feet of underground tunnel).

In North Carolina, NCDOT owns right-of-way over tunnels. The required limits of right-of-way would extend approximately 100 feet beyond the outer limits of the tunnels. Based on the alignment described above, additional right-of-way impacts would occur in the Burton Street Community, East West Asheville, the River Arts District, and the residential area north of Clingman Avenue. Furthermore, the Burton Street Community Baptist Church and New Belgium Brewing Company, along with businesses along Haywood Street from Patton Avenue to Montford Avenue would be directly impacted. These impacts are in addition to those described in the Final Environmental Impact Statement, thereby increasing right-of-way costs and impacts to the human and natural environments. Right-of-way costs have not been determined for this level of analysis.

Potential I-26 Tunnel Option

The 2017 Tunnel Feasibility Memorandum studied a tunnel route which follows the I-26 alignment for the Preferred Alternative. Because of the required depth and the minimum practicable radius for boring the tunnel, this alignment was found to be infeasible. For the purposes of this memo, a second alignment was developed which follows a straighter path as shown in Figure 3. This tunnel would begin at the proposed Patton Avenue interchange, west of the Jeff Bowen Bridges, and extend north under the French Broad River, terminating at Broadway. The proposed I-240 flyover bridges would remain to allow for a connection to downtown Asheville. However, all proposed connections between US 23 and I-26 would be eliminated.

Figure 3: Potential I-26 Tunnel Option

The I-26 northbound and southbound tunnels would each be approximately 60 feet wide, carrying three travel lanes in each direction. As noted above, it is assumed the distance between the tunnels should be at minimum one tunnel width, 60 feet. Approach plazas would be constructed on either end of the tunnels. It is assumed the approach plazas would each be approximately 1,575 linear feet. From the approach plazas, the tunnel would descend approximately 200 feet vertically to provide the necessary clearance of the French Broad River. It is assumed the top of the tunnel would be approximately 40 feet below the riverbed. To minimize the footprint of the tunnel, a 5 percent grade would also be needed for the I-26 tunnels, triggering design exceptions. Based upon this information, the full length of the tunnel would be approximately 11,650 linear feet (8,500 linear feet of underground tunnel).

As discussed above, right-of-way above the tunnels would be acquired by NCDOT. Based on the alignment described, it is likely that additional right-of-way impacts would occur in the Montford Hills and Hibritten historic districts. Additionally, the Freeman House Historic property would potentially be adversely affected. Businesses along Riverside Drive would likely be directly impacted. Division of Highways and the Rail Division would need to coordinate regarding potential impacts to the Norfolk Southern Railway, which runs along Riverside Drive and the French Broad River. These impacts would be additional to the impacts currently reported in the Final Environmental Impact Statement, thereby requiring avoidance and minimization efforts to address impacts to historic resources and increasing right-of-way costs. Right-of-way costs have not been determined for this level of analysis.

Cost Considerations

It should be noted that tunnel construction methods and costs vary wildly between projects. Many considerations must be evaluated, including land constraints, elevation, construction method, soil type, and others. Six roadway tunnels in North America were referenced in order to prepare an assumed cost range for the I-26 Connector project. These tunnels traverse under marine environments, undeveloped mountainous regions, and developed mountainous regions. Table 1 includes a cost comparison of the tunnels and known design features. The costs shown below have been adjusted for inflation.

Table 1: Representative Tunnel Construction Cost Estimates

Tunnel	Tunnel Construction Cost	Number of Tunnels	Number of lanes in each tunnel	Tunnel Length (linear feet)[a]	Cost per foot	Single Tunnel Diameter	Features
John H. Bankhead Tunnel (1941)[b]	$73,000,000	1	2	3,389	$21,500	21 ft	• Marine Environment • Travel lanes are narrow, no large trucks permitted • Travels under Mobile River • Western terminus in downtown Mobile, Alabama
George Wallace Tunnel (1973)[c]	$287,000,000	2	2	3,000	$47,800	~30 ft	• Marine Environment • Travels under Mobile River • Located south of John H. Bankhead Tunnel in Mobile, Alabama
Eisenhower-Johnson Tunnel (1973)[d]	$965,000,000	2	2	8,976	$53,700	40 ft	• Mountainous undeveloped terrain • 1.64 percent grade • Additional $50 million cost in non-boring expenses during construction
Hamptons Roads Bridge Tunnel (1957 & 1976)[e]	$826,800,000	2	2	7,479	$55,000	~30 ft	• Marine environment • Travels under shipping lanes in Chesapeake Bay
Monitor Merrimac Memorial Bridge-Tunnel (1992)[f]	$728,500,000	2	2	4,800	$75,000	~30 ft	• Marine environment • 4 percent max grades • 60 mph design speed
Proposed I-240 & I-26 Tunnels							
I-240 Tunnels	-	2	2	8,500	-	48 ft[g]	• Developed mountainous terrain • Travels under French Broad River • Estimated 5 percent grade
I-26 Tunnels	-	2	3	8,500	-	60 ft[g]	• Developed mountainous terrain • Travels under French Broad River • Estimated 5 percent grade

[a] Note: Linear feet is per tunnel. When determining the cost per linear foot, the total length of both tunnels was divided by the total cost.

[b] Source: https://www.aaroads.com/alabama/mobile-city-guide-1/ , https://southalabama.edu/libraries/mccallarchives/bankhead.html

[c] Source: https://alletting.dot.state.al.us/OfficeEngineer/Docs/GeorgeCWallaceTunnelPublicationeditedforweb.pdf

[d] Source: https://www.codot.gov/travel/eisenhower-tunnel/description.html

[e] Source: http://www.roadstothefuture.com/I64_VA_HRBT.html

[f] Source: http://www.roadstothefuture.com/I664_VA_MMMBT.html

[g] Note: It is assumed the distance between the tunnels should be at minimum one tunnel width.

Using the number of tunnels for each example, the total length of tunneling, and the diameter of a single tunnel for each, the total tunnel volume in cubic yards (CY) was calculated for each tunnel, which was in turn used to calculate the cost per CY of tunnel (see Table 2).

Table 2

	Tunnel Construction Cost	Number of Tunnels	Total Length of Tunneling (linear feet)[a]	Bore/Tunnel Diameter (ft)	Total Tunnel Volume (CY)	Cost per CY of Tunnel
John H. Bankhead Tunnel (1941)[b]	$ 73,000,000	1	3,389	21	43,453	$ 1,680
George Wallace Tunnel (1973)[c]	$ 287,000,000	2	6,000	30	157,000	$ 1,830
Eisenhower-Johnson Tunnel (1973)[d]	$ 965,000,000	2	17,952	40	835,100	$ 1,160
Hamptons Roads Bridge Tunnel (1957 & 1976)[e]	$ 826,800,000	2	14,958	30	391,401	$ 2,210
Monitor Merrimac Memorial Bridge-Tunnel (1992)[f]	$ 728,500,000	2	9,600	30	251,200	$ 2,900

The minimum ($1,160) and maximum ($2,900) cost per CY calculated in Table 2 was used to estimate a potential range of costs for constructing a tunnel alternative for the I-26 Connector project using the assumed amount of total tunnel volume needed (Table 3).

Table 3

	Number of Tunnels	Total Length of Tunneling (linear feet)[a]	Bore/Tunnel Diameter (ft)	Total Tunnel Volume (CY)	Minimum Cost of Tunnel	Maximum Cost of Tunnel
I-240 Tunnels	2	17,000	48	1,138,773	$ 1,321,000,000	$ 3,302,400,000
I-26 Tunnels	2	17,000	60	1,779,333	$ 2,064,000,000	$ 5,160,100,000

Based on the comparison of tunnels constructed in the United States and by using the estimated number of CY needed, it can be assumed the construction costs of tunneling I-240 would range from $1,321,000,000 to $3,302,400,000 in current dollars. The estimated construction cost of tunneling I-26 is assumed to range from $2,064,000,000 to $5,160,100,000. This is based only on the cost per CY of tunnel. In comparison, construction cost estimates of bridges for the I-26 Connector project have been estimated to cost approximately $65 million to construct based on the current design. The I-26 mainline bridge is estimated to cost approximately $91 million to construct.

Maintenance costs of a bridge and tunnel must also be considered and compared. Generally, the annual maintenance cost of tunnels is significantly higher than that of bridges. Maintenance of tunnels includes traffic supervision for possible wrecks or other safety issues, management and operation costs, stormwater pumping, electricity for lighting and other needs, fire suppression maintenance, ventilation, and roadway maintenance. Some estimates note the operation and maintenance of tunnels is approximately 20 percent to 30 percent of the construction cost. For maintenance comparison purposes, the Lower Thames Crossing Capacity Options Report on Design and Costs[1] was referenced. This report analyzed the maintenance and operating costs for the three alternatives analyzed in the Dartford River Crossing Study (2009). Maintenance costs for an immersed tunnel for Option A, which resembles the potential length of a tunnel for I-26, were estimated to be approximately $4,850,000 per year for the 60-year lifespan. Maintenance costs for a bridge at the same location were estimated at approximately $537,000 per year for the same 60-year lifespan.

Bridge maintenance costs for the I-26 Connector Project have not yet been determined. It is anticipated maintenance costs will include roadway patching and resurfacing, bridge joint maintenance, deicing, lighting, and general upkeep due to damage from vehicle collisions.

Summary

Based upon the preliminary assumptions developed in this memorandum, constructing a tunnel for either I-240 or I-26 in Section B for the I-26 Connector Project would increase residential and business impacts, construction costs, and maintenance costs. Due to the proximity of the tunnel entrances to the north of the Haywood Road ramps for the I-240 tunnel scenario, the northern ramps at Haywood Road would likely be eliminated as well as the I-240 connections to Patton Avenue. Additionally, US-23 southbound traffic would lose the proposed connection to I-240 eastbound and I-240 westbound traffic would lose the proposed connection to US 23 northbound. For the proposed I-26 tunnel options, the I-240 flyover bridges would remain to allow for a connection to downtown Asheville; however, all proposed connections between US 23 and I 26 would be eliminated.

Due to the length of tunneling needed and the assumed tunnel diameters needed for either scenario, costs are assumed to range from $1,321,000,000 to $5,160,100,000 for construction cost only.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/199853/operating-costs-and-revenues-report.pdf

APPENDIX B

MEMORANDUM TO CITY OF ASHEVILLE FROM SAM SCHWARTZ CONSULTING, LLC

Sam Schwartz Consulting, LLC
322 Eighth Avenue, 5th Floor
New York, NY 10001
phone: (212) 598-9010
samschwartz.com

Sam Schwartz
Transportation Consultants

Memorandum

To:	Ken Putnam, City of Asheville
From:	Sam Schwartz Consulting, LLC
Date:	September 19, 2018
Re:	I-26 Connector Project, Final FEIS Technical Memorandum
STIP:	I-2513

Introduction

This technical memo is intended as an addendum to the North Carolina Department of Transportation (NCDOT) I-26 Connector Project's (STIP Number I-2513) Final Environmental Impact Statement (FEIS), as a means of officially recording the City's preferred vision for the I-26 project. That vision is for a project that separates the highway completely from the Captain Jeff Bowen Bridges and Patton Avenue, creating the conditions for a truly multi-modal, urban complete street on Patton Avenue that extends Downtown Asheville westward, filling a gap in the City's urban fabric. This includes:

- ➔ Creating a multi-modal corridor that is walkable, bikeable, and encourages the use of transit, and which has an adjacent greenway landscape;
- ➔ Creating property parcels that can be developed into downtown-type, mixed-use buildings that front onto Patton Avenue;
- ➔ Connecting the Hillcrest community to the adjacent neighborhoods and streets;
- ➔ Creating a new connection to the French Broad River from Patton Avenue and Burton Street;
- ➔ Supporting the creation of an integrated network of greenways (or at a minimum does not preclude one), and;
- ➔ Encouraging urban design that reflects these goals and enhances Asheville's unique downtown overall character.

This vision, which is detailed in the following sections, is based on decades of community planning and plans, culminating in a comprehensive vision for the future of Downtown Asheville, the Patton Avenue corridor, and the I-26 Connector Project.

The City of Asheville has been working with its consultant team, local elected officials, and community groups to develop its own vision for the I-26 Connector Project. This process has included close collaboration with NCDOT and their consultant. Since the winter of 2017, the City and NCDOT have had several correspondences and meetings to help the City understand the technical analysis and options being considered by the State for this project. This has included videoconference and in-person meetings in October 2017 and April 2018. This dialogue has helped the City to conduct its own analysis and develop its own preferred vision. It was also during

the course of these meetings that NCDOT asked the City to produce this memo as an addendum to the FEIS.

Previous Visions

Asheville has a rich history of citizen engagement and planning for the future. The City's vision for the I-26 Connector Project draws on previous community plans and official City plans to create a holistic vision for an urban corridor that extends the dense, mixed-use development patterns of downtown to the west.

WECAN Citizens Master Plan, 2000

The WECAN Citizens Master Plan, developed in 2000 and adopted by City Council on January 22, 2008, lays out clear vision that emphasizes quality urban design and an interconnected neighborhood. The plan includes new roadway connections from Patton Avenue to WECAN and to the Hillcrest community. The plan shows mixed-use development along Patton Avenue, and does not include an interchange with I-240 between Clingman Avenue and the Captain Jeff Bowen Bridges.

Figure 1: Excerpt from the WECAN Citizens Master Plan showing Patton Avenue as an urban boulevard

Michael McDonough, 2006

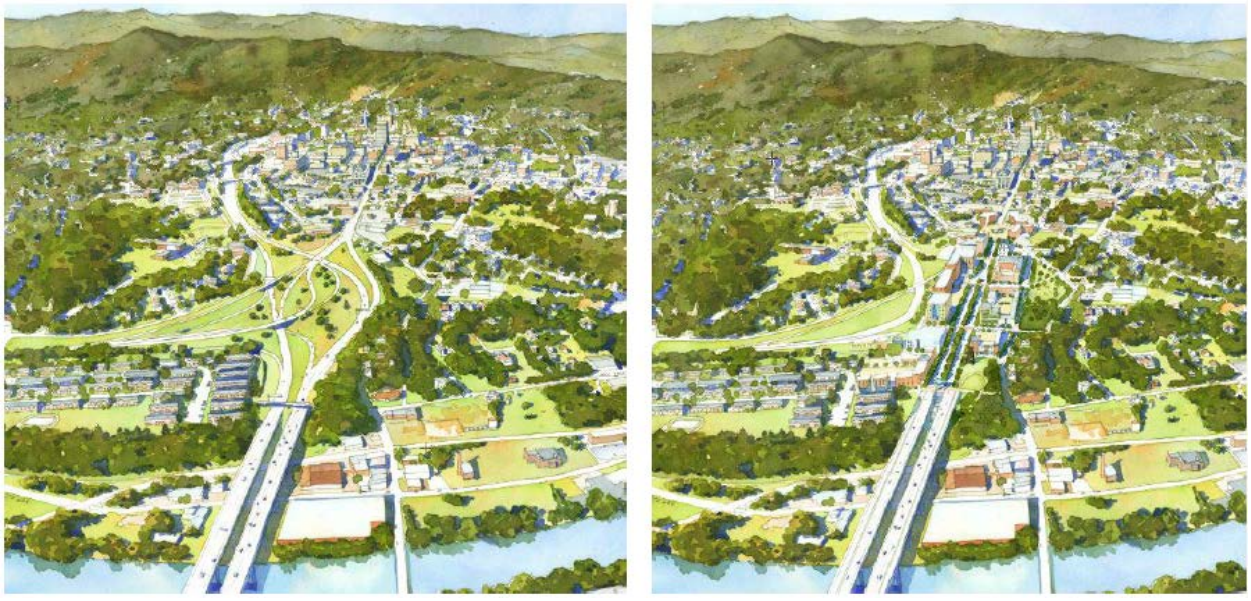
Michael McDonough, an architect with a practice based in Asheville, created a plan for the I-26 Connector Project that has new roadways that connect WECAN and Hillcrest to Patton Avenue, creates development lots along Patton Avenue, and has a ramp connection from Patton Avenue to I-240 between Clingman Avenue and Hillcrest.

Figure 2: The Michael McDonough vision for the I-26 Connector Project incorporates many of the elements from the WECAN Citizens Master Plan

Asheville Design Center, 2008

The Asheville Design Center created a community vision for the I-26 Connector Project that emphasizes Patton Avenue as a mixed-used, urban boulevard that support and connects local housing and retail. Similar to the previous plans, it also includes new roadway connections from Patton Avenue to Hillcrest and WECAN.

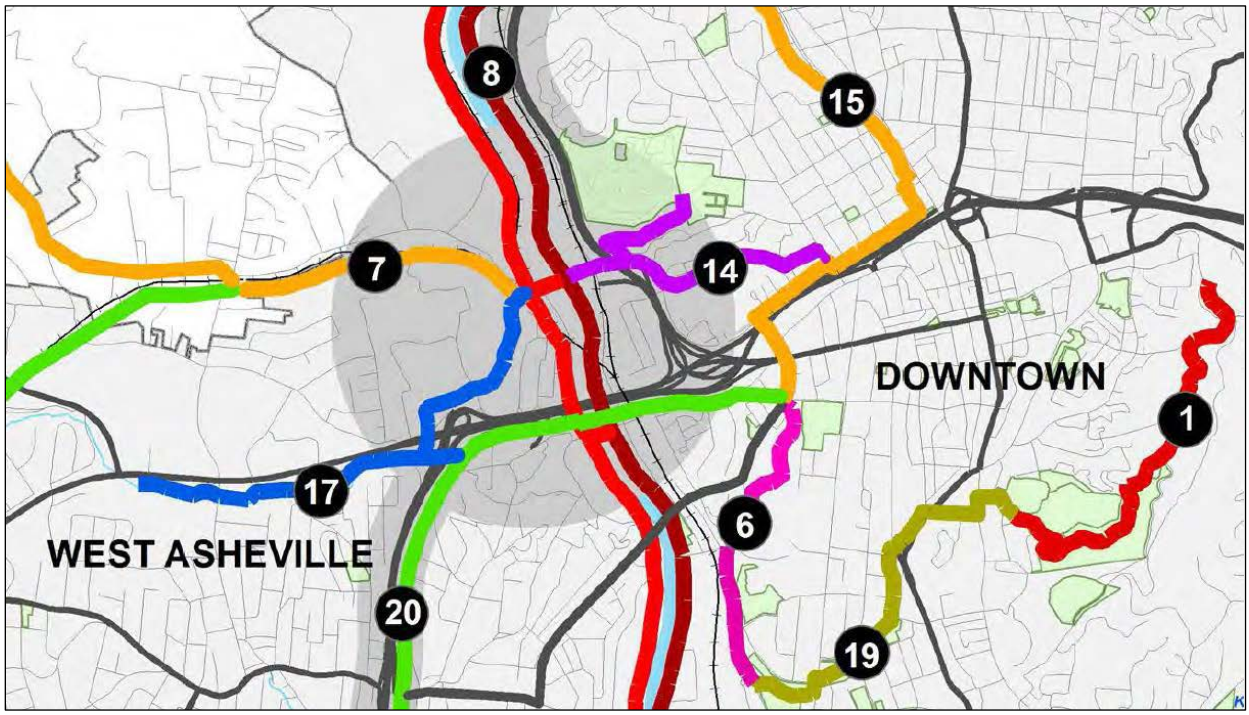
Figure 3: The Asheville Design Center compared the existing Patton Avenue with a vision for a mixed-use corridor that fills a large gap in the area's urban fabric.



Greenways Master Plan, 2013

The City's official Greenway Master Plan lays out a network plan for a series of interconnected, mostly off-street multi-use paths on both sides of and across the French Broad River. This includes a greenway along Patton Avenue, crossing the river on the Captain Jeff Bowen Bridges, and connecting West Asheville to Downtown. The plan specifically refers to the I-26 Connector Project by saying that the project should "enhance connectivity and not create barriers to the pedestrian[s] and cyclist[s]" or between the community and the river.

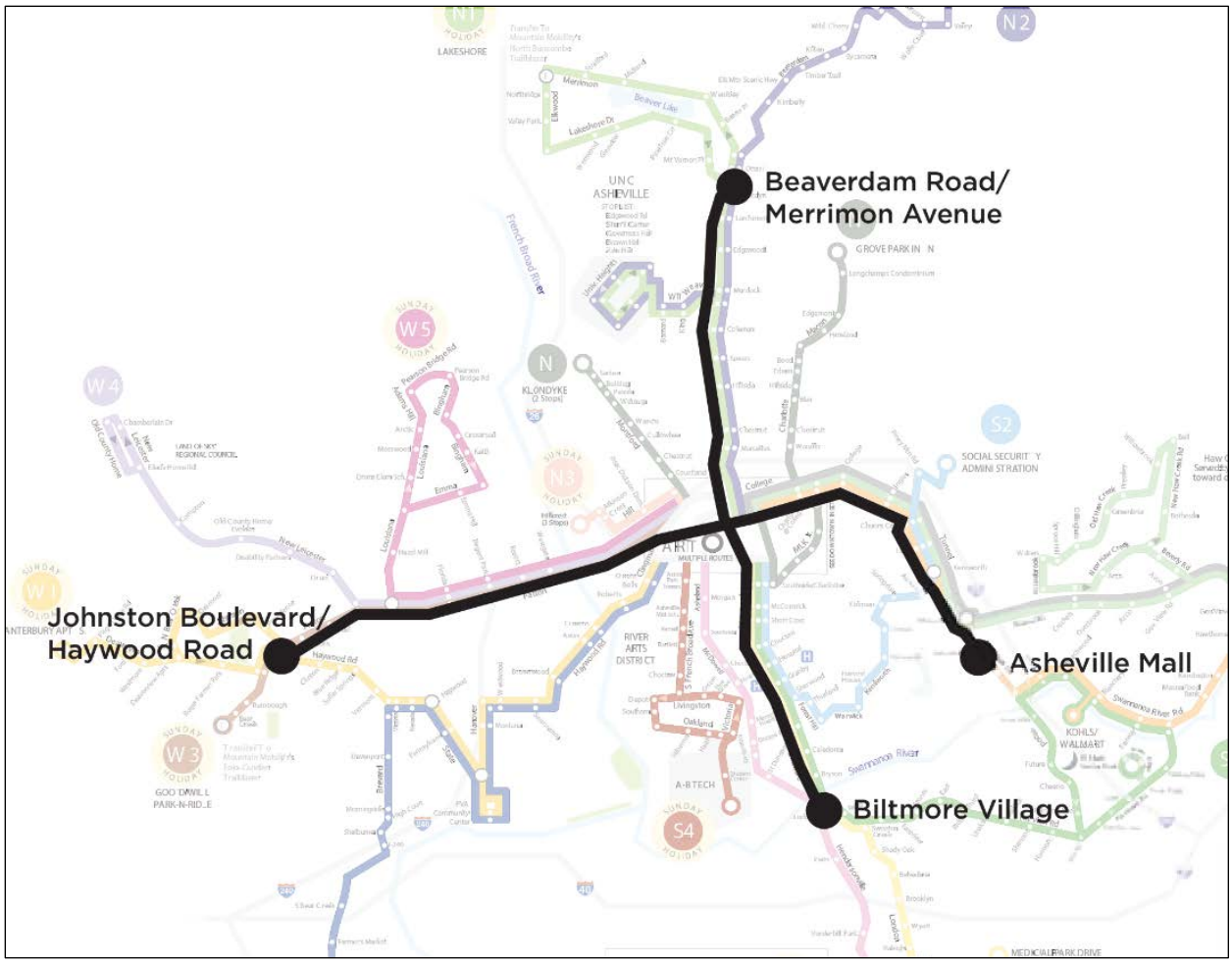
Figure 4: An excerpt from the City's Greenways Master Plan



Asheville in Motion, 2016

Asheville in Motion is a consolidation of a variety of modal plans into a cohesive strategy for Asheville and has a method for prioritizing projects and transportation investments. The plan includes the development of a core system of premium bus rapid transit on Patton Avenue for east-west travel and a network of connected bicycle facilities (see Greenways Master Plan).

Figure 5: Figure of the core system of premium bus rapid transit from Asheville in Motion



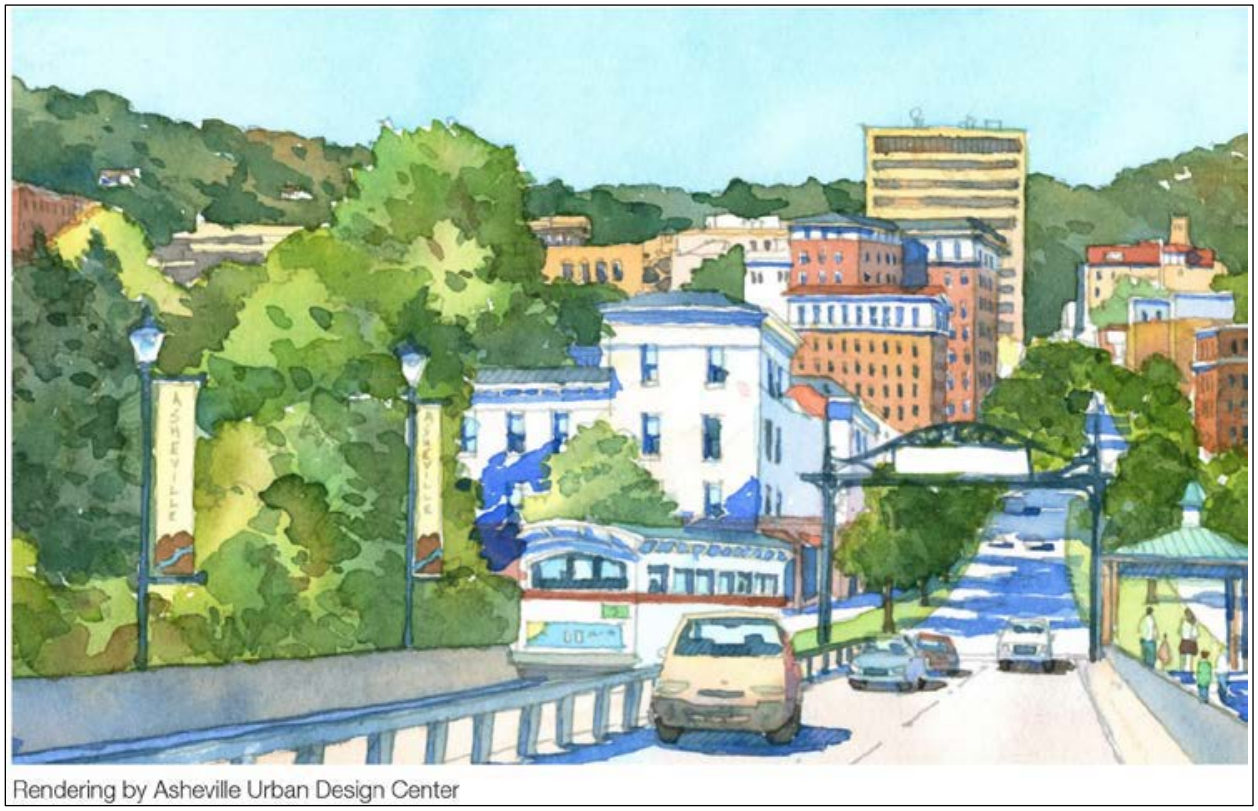
Asheville Comprehensive Plan, 2018

The now adopted Living Asheville Comprehensive Plan directly addresses Patton Avenue within the land use plan and with a stated vision for the corridor:

> "Return Patton Avenue to a local road knitting Downtown and West Asheville together with human-scale development, re-integrate Patton Avenue with traditionally underserved neighborhoods, improve access to the river and convert Patton Avenue to a multimodal boulevard with enhanced pedestrian, bicycle, transit and greenway connections."

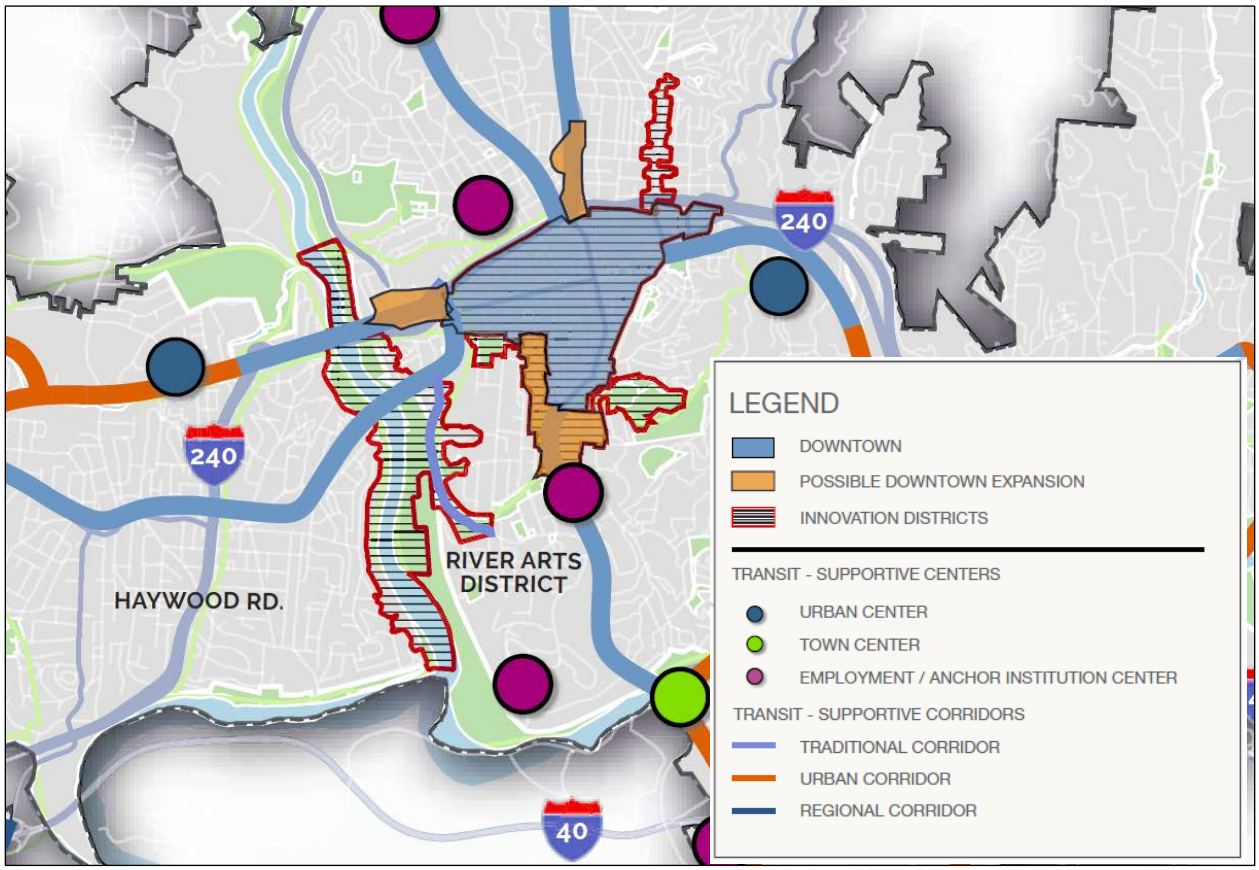
The desired land use patterns along Patton Avenue include "downtown," "urban center," and "urban corridor."

Figure 6: Vision for Patton Avenue, view looking east from the Captain Jeff Bowen Bridges



Rendering by Asheville Urban Design Center

Figure 7: Detail of the Preferred Growth Scenario from the Asheville Comprehensive Plan



City of Asheville I-26 Connector City Council Resolutions

City Council Resolution 15-232 asks NC DOT to reduce the impact of the project on neighborhoods and improve connectivity with more bicycle and pedestrian infrastructure as required by NC DOT's Complete Streets policy. The city also asks that NC DOT analyze alternatives in Section A and B in an effort to reduce congestion and maintain safety. City Council endorses Alternatives 4 and 4B for Section B, and Alternative F1 for Section C.

Resolution 16-163 further emphasizes the benefits of these endorsed Alternatives. Alternative 4B will make Patton Avenue a true urban boulevard and result in the least impact on the Burton Street community. In addition, City Council notes that more improvements are needed to make the project more neighborhood and context sensitive. The complete 15-232 and 16-163 resolutions are included as appendices to this memo.

Summary

The previous visions presented here come from a nearly 20-year time period and from community groups and City government. Despite their varied backgrounds, they have many common themes that build toward a shared vision for the Patton Avenue corridor as an extension of the downtown urban fabric westward. This vision is reflected in the City's goals for the I-26 Connector Project, which are explained in the next section.

City's Goals

The City's own vision for the Patton Avenue corridor and the I-26 Connector Project are informed by the previous visions and defined in seven goals, which were drawn from a variety of planning documents.

Goals

Separate

Fully separate the interstate traffic from Patton Avenue, allowing it to return to being an urban street.

Gateway

Patton Avenue and the Captain Jeff Bowen Bridges should serve as a gateway to the Downtown.

Mixed-Use

Set the stage for mixed-use development along Patton Avenue.

Complete Street

Transform Patton Avenue into a complete street that is safe for all road users.

Hillcrest

Improve conditions at Hillcrest to integrate this community into Downtown.

River Connection

Better connect Downtown to the river neighborhoods.

Greenways

Create a connected network of off-street multi-use paths to economic and recreational opportunities.

Goal Sources

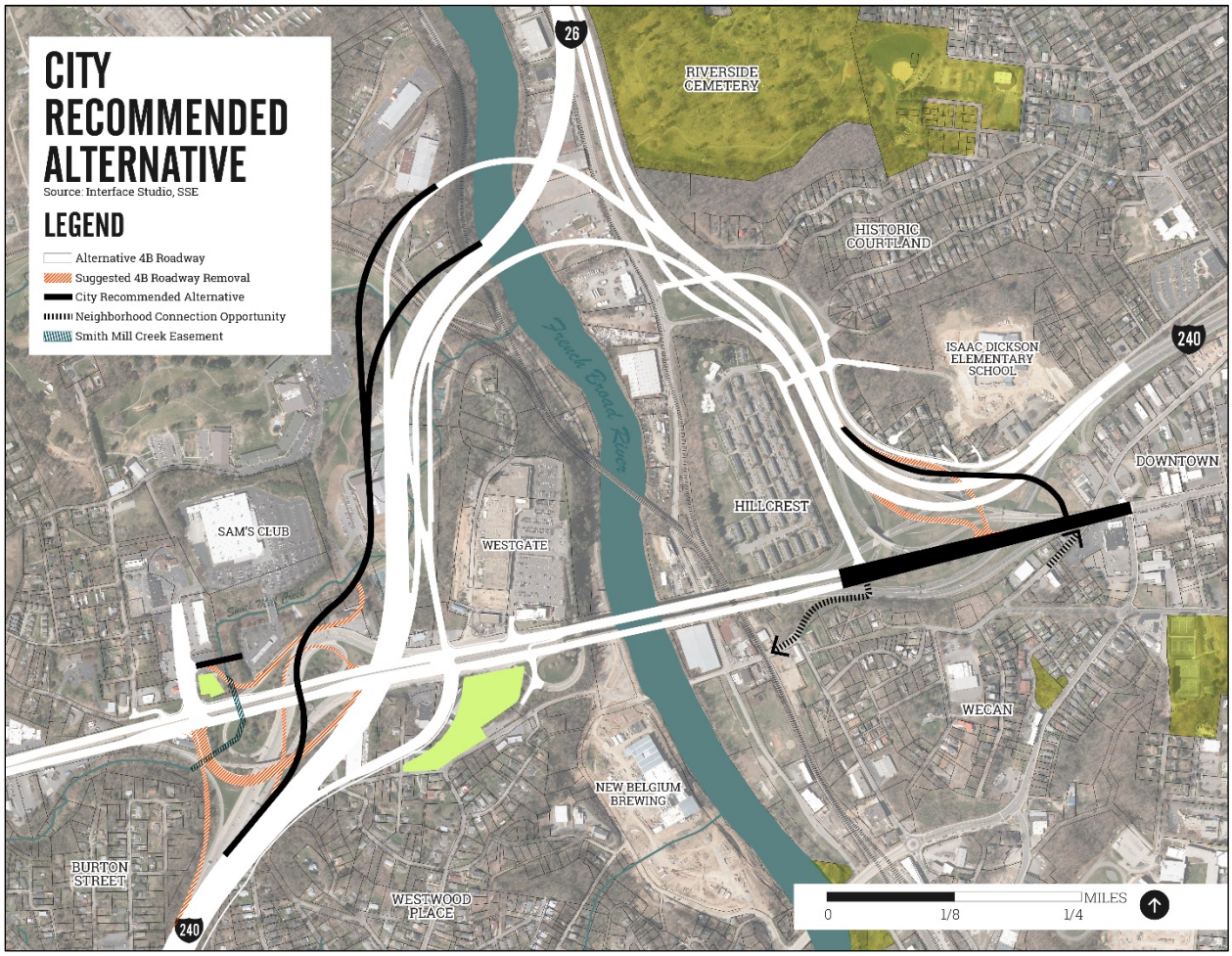
There are a variety of source documents for the City's goals, including the Draft Environmental Impact Statement (DIES) of the I-26 Connector Project.

Goal		Sources
1	Separate	DEIS Community Coordinating Committee
2	Gateway	Asheville Design Center (ADC) Asheville Draft Comprehensive Plan
3	Mixed-Use	
4	Complete Street	DEIS Community Coordinating Committee ADC Asheville in Motion (AIM) Asheville Draft Comprehensive Plan
5	Hillcrest	
6	River Connection	
7	Greenways	ADC Asheville in Motion (AIM) Asheville Draft Comprehensive Plan

Design Alternatives

Melding the previous visions, the City's goals, and new analysis, the City has developed its own preferred alternative for 4-B. One primary feature of this alternative is a redesigned Patton Avenue and interchange, on the east side of the river, that sets the stage for development and new roadway connections. On the west side of the river, the interchange is modified to increase the amount of land that could potentially be developed and creating the potential for improved connectivity for the Burton Street Neighborhood.

Figure 8: The City's preferred alternative for 4-B, with a design for Patton Avenue that opens up new options for development close to Downtown



West Side of French Broad River

A potential alternative concept for the interchange of I-26, I-240, and Patton Avenue on the west side of the French Broad River is shown in Figure 9. This concept replaces the ramps as currently proposed with a more traditional diamond interchange, which NCDOT's consultant AECOM confirmed could be feasible from a preliminary geometric analysis within the project requirements for horizontal and vertical alignments. Due to vertical clearance requirements over the Blue Ridge southern railway adjacent to Emma Road, the I-240 WB Flyover elevations will increase approximately 10'-12' higher than the current (NCDOT) plan proposes. In order to maximize the use of the 8 acres of potentially disposable land, the control of access boundary may need to be modified through the standard NCDOT control of access adjustment process.

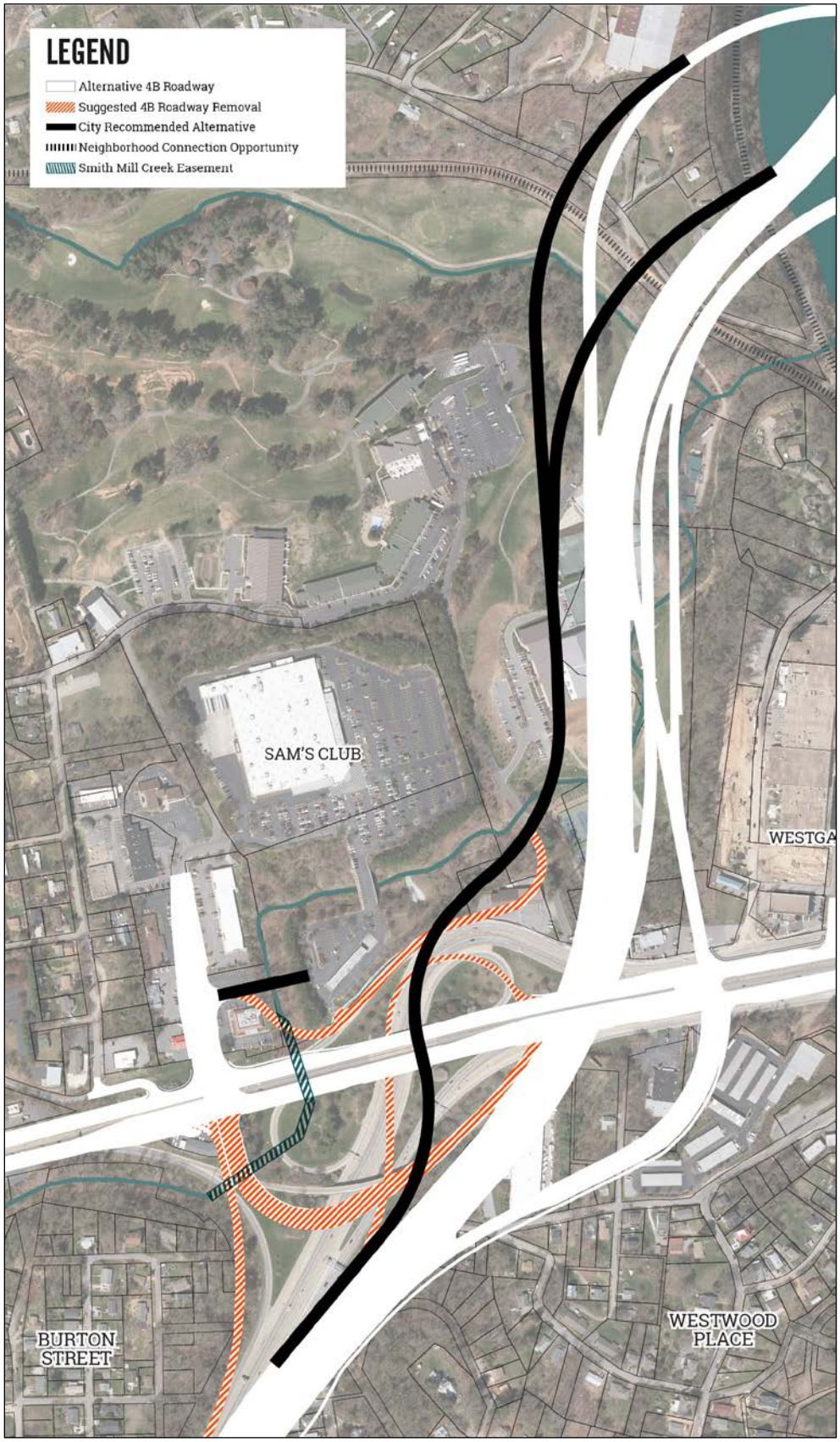
This alternative offers potential benefits including greater developable land and less highway ramp infrastructure around Patton Avenue, however it requires taking considerably more land in Emma, and the development potential of the parcels along Patton Avenue may be limited by the presence of the Smith Mill Creek. This alternative also has the possibility to provide traffic operations improvements, redirecting a currently-designed heavy left-turn movement from I-26 onto Patton Avenue into a proposed right-turn movement, increasing intersection capacity and throughput.

More generally, in line with the City's urban-style land use and complete street vision for Patton Avenue in this section of West Asheville, the corridor should be designed in a manner appropriate to a (future) walkable, mixed-use neighborhood: as a tree-lined boulevard with tight, comfortable intersections, minimal curb cuts, and a target speed, design speed, and speed limit of 30-35 mph. Likewise, in either scenario, the Smith Mill Creek should be daylighted to the extent possible.

City's Recommendation

Both alternatives have significant benefits and drawbacks that require more study. The City recommends that both alternatives be kept in consideration through the design process.

Figure 9: Conceptual drawing of SB I-26 ramps with Patton Avenue with alternative (black) ramps that could replace the original Alternative 4-b alignment (orange) and the remaining NCDOT proposed alignment (white)



Captain Jeff Bowen Bridges

The proposed configuration for the Captain Jeff Bowen Bridges includes four moving lanes on the westbound bridge (north span) and two moving lanes on the eastbound bridge (south span), allowing for a 12' wide multi-use path on this span. The City's alternative proposal narrows the moving lanes and removes a lane from the westbound span, allowing for a wide multi-use path on both spans. As the westbound roadway approaches the west side of the river, a third lane would open up for right turns into the Westgate development. Bike and pedestrian paths on both bridge spans would allow easier travel to Westgate, West Asheville, and downtown.

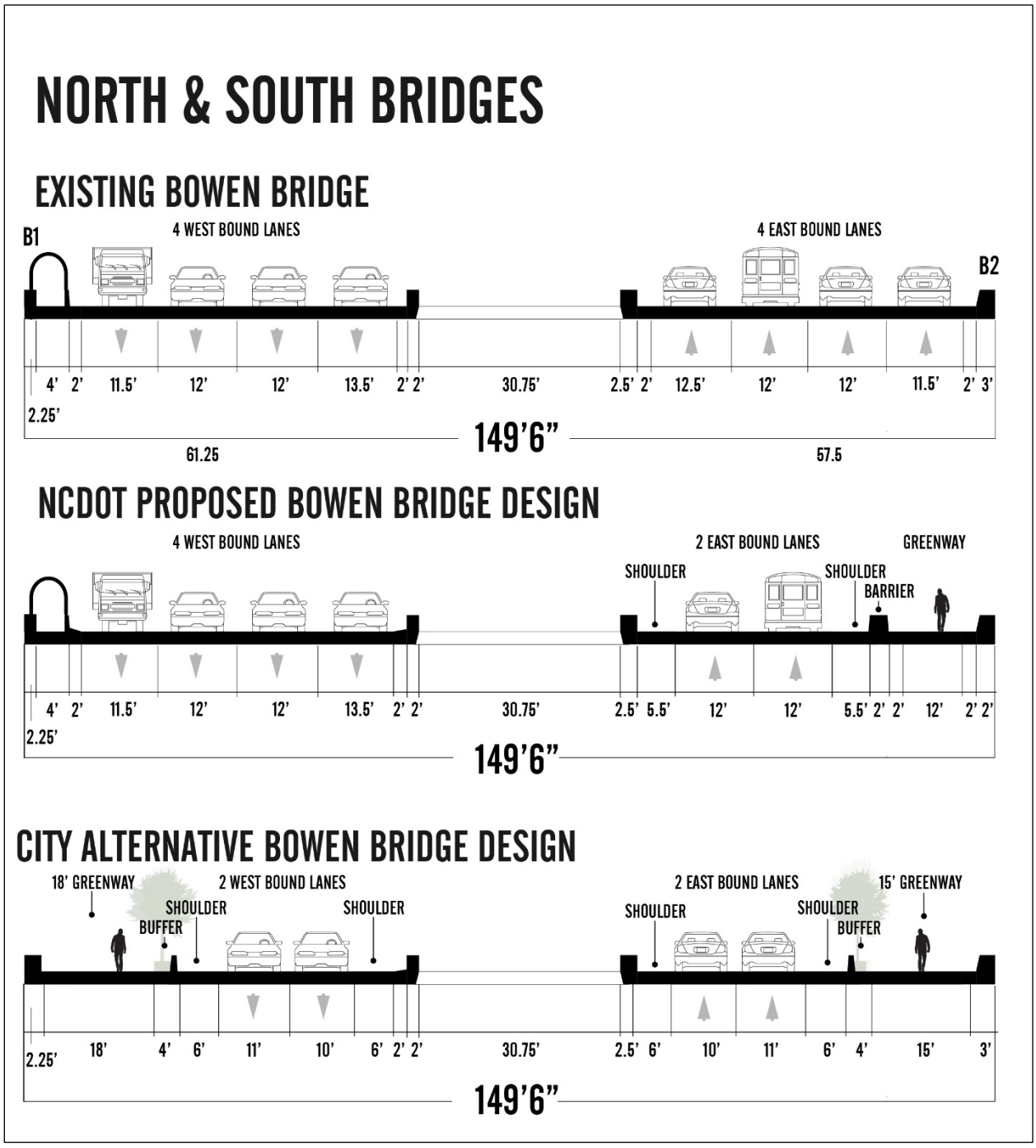
This alternative configuration has the key benefits of providing generous pedestrian and bicycle space on both bridges and calming traffic on this long stretch of roadway between traffic signals, while still being able to provide additional storage space to sufficiently accommodate queuing vehicles at the signalized intersections to the east and west of the Captain Jeff Bowen Bridges. AECOM has confirmed that the westbound bridge could theoretically be narrowed to 2 or 3 lanes but would likely have to widen to 4 lanes as it approaches the interchange with I-26/I-240. Further, while the state has committed to the multi-use path on the eastbound bridge, any such improvement on the westbound bridge may have to paid for by the City.

The City's preferred alternative would allocate as much space as feasible to a multi-use path, while still allowing for effective progression of vehicle traffic across the bridges. The City would prefer the bridges operate at a lower speed limit (e.g. 25 or 30 mph) with narrow travel lanes encouraging lower travel speeds as people enter and exit the Patton Avenue downtown extension. The City understands that significant further design work is necessary to finalize the specific design of the bridges.

City's Recommendation

As described above, the City recommends "right-sizing" the vehicular lanes on the bridges and creating pedestrian and bicycle connections over both spans of the bridge, per Figure 10.

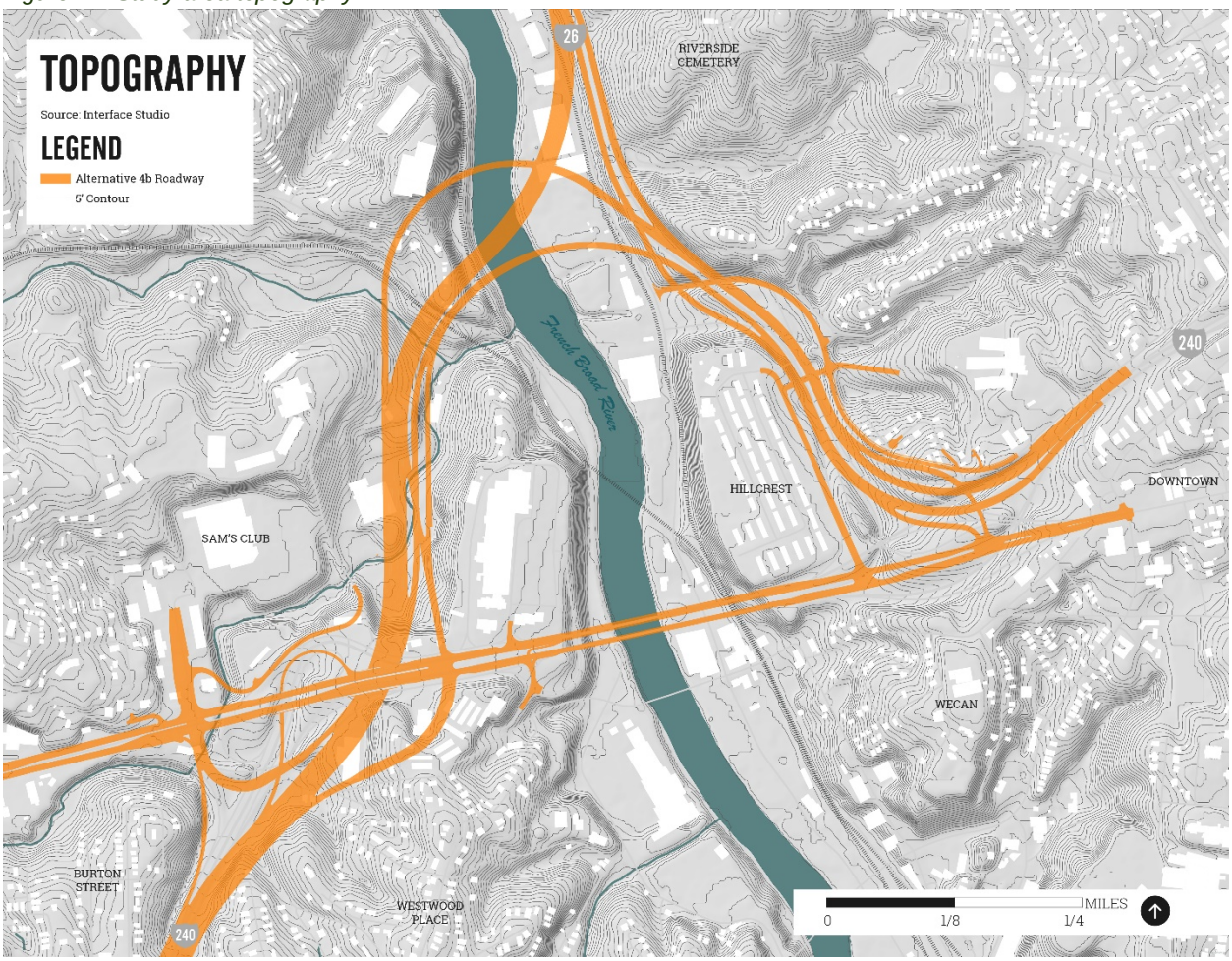
Figure 10: Existing, NCDOT proposed, and City alternative design for the Captain Jeff Bowen Bridges



East Side of the French Broad River

The existing interchange to the east of the French Broad River possesses widely varying topography, as shown in Figure 11 below.

Figure 11: Study area topography

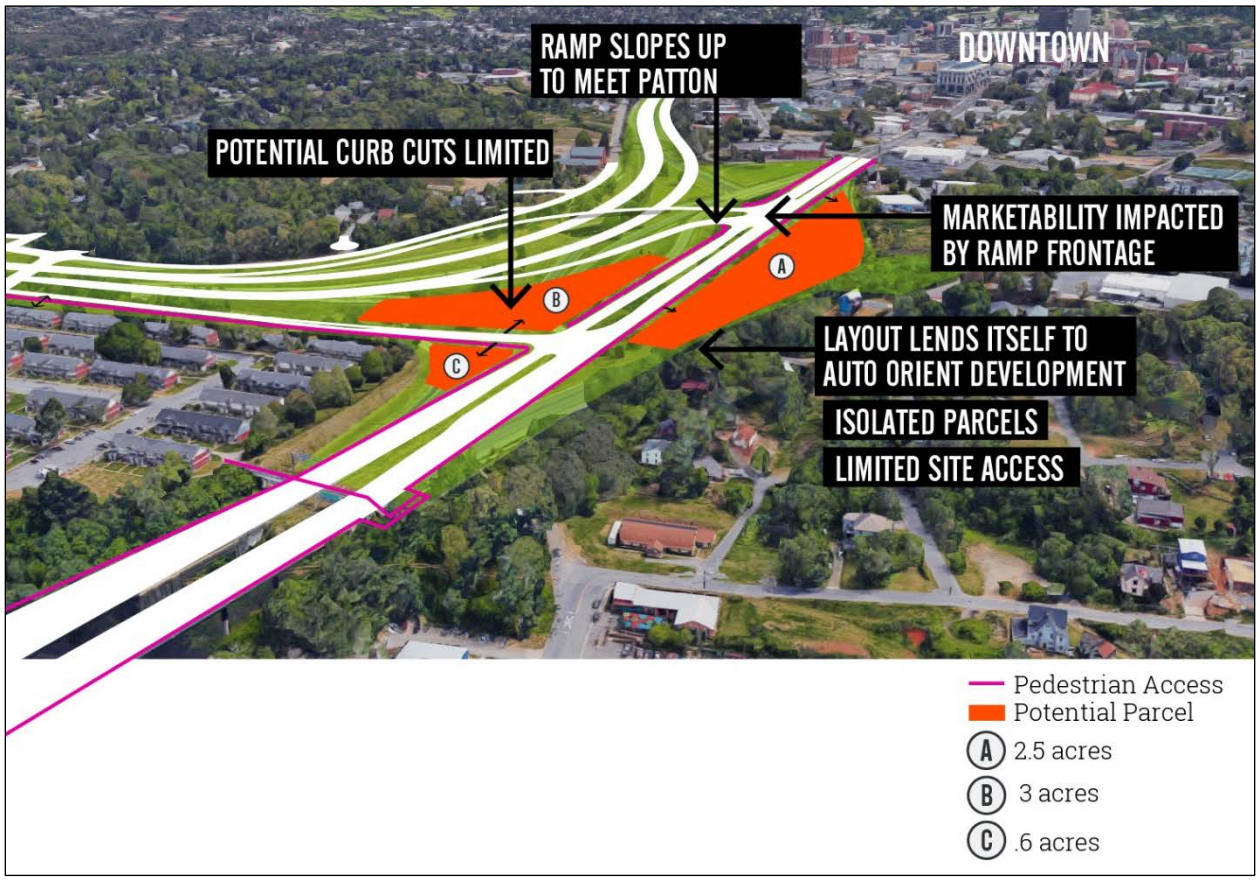


Under the current proposed design, the existing topography in this area would need to be significantly altered to site the new roadways and ramps. The City recognizes that significant additional regrading would also be necessary to make the adjoining land developable.

Highway Interchange Alternatives

As currently designed (see Figure 12 below), the proposed on and off ramp onto Patton Avenue on the east side of the French Broad River inhibits the City's vision in a number of ways. If the ramps were to be built as proposed, the number of curb cuts would create a discontinuous street wall, the elevations of the ramps would impact developability, the fragmentation of developable land would lend itself to auto-oriented land uses, and the overall land value would be impacted by this type of highway-related infrastructure.

Figure 12: East side development potential



Given these reasons, three alternatives were explored for this segment of Patton Avenue and its associated highway interchanges:

1. **Option 1: No interchange with I-240**
   This alternative removes the on- and off-ramps that currently intersect with the proposed Patton Ave. This is the most preferred alternative from the City's perspective, but the potential impacts to the adjacent interchanges and roadways would need to be studied further.
2. **Option 2: Tie the I-240 ramps in at the northern end of the Hillcrest Connector**
   The team explored integrating the ramps into the proposed street along Hillcrest. This would impact the existing low-income housing development with more vehicular traffic in line with that of a typical urban street, but would also help create a more walkable connection to and from Hillcrest, particularly along Patton Avenue, better integrating the community into Downtown. Therefore, from a land use planning perspective, the increased traffic along this proposed street could be justified. However, further analysis by NCDOT's consultants concluded that this alternative may impact the Riverside Cemetery with a new retaining wall.
3. **Option 3: Remove I-240 off-ramp and relocate on-ramp east**
   This alternative is a compromise between Options 1 and 2. The off-ramp from I-240 to Patton Avenue is removed due to the other existing options available to WB I-240 traffic wishing to access downtown Asheville, while the on-ramp is relocated as close as possible

to the Patton Avenue intersection with Clingman Avenue. The on-ramp could be accessed via both westbound right turns and eastbound left turns, although restricting access to right turns only (to reduce pedestrian crossing distance and optimize signal timing) would also be a possibility given the availability of the I-240 on-ramp located just across the river. This alternative would significantly increase the amount of contiguous developable land and limit the amount of ramp roadway a pedestrian would have to cross when walking from Downtown.

Because Options 1 and 2 have some significant challenges, Option 3 may be a strong alternative that achieves many of the City's stated goals. With this configuration, control of access issues are minimized because the highway ramps are moved to the extremes of the segment, allowing for a potential 13.8 acres of developable land.

The removal of the off-ramp would increase traffic volumes at other interchanges along I-240, and possibly the I-26/Patton Avenue interchange west of the river. However, these intersections with expressway traffic exiting onto local surface streets are already timed to prioritize the traffic exiting the expressway, with the proposed on-ramp providing a needed alternative for traffic on local surface streets traveling to the north and east via the I-240 expressway.

Based on the traffic assignments and origin-destination models used by AECOM in developing expected traffic volumes, nearly all (95%+) traffic destined to the subject ramp pair in the currently proposed condition are traveling to and from the east. This supports the possibility of restricting left-turn movements onto the highway at this on-ramp. Traffic entering the expressways from the west would likely enter the interstate system via the interchange on the west side of the French Broad River.

City's Recommendation

The City recommends Option 3, omitting the redundant I-240 off-ramp while relocating the on-ramp as far to the east as possible to maximize developable land. The desirability of allowing eastbound left turns onto the on-ramp, vs. restricting access to right-turns, should be studied further to weigh the relative safety, land development, and traffic capacity benefits.

Patton Avenue Alignment Alternative

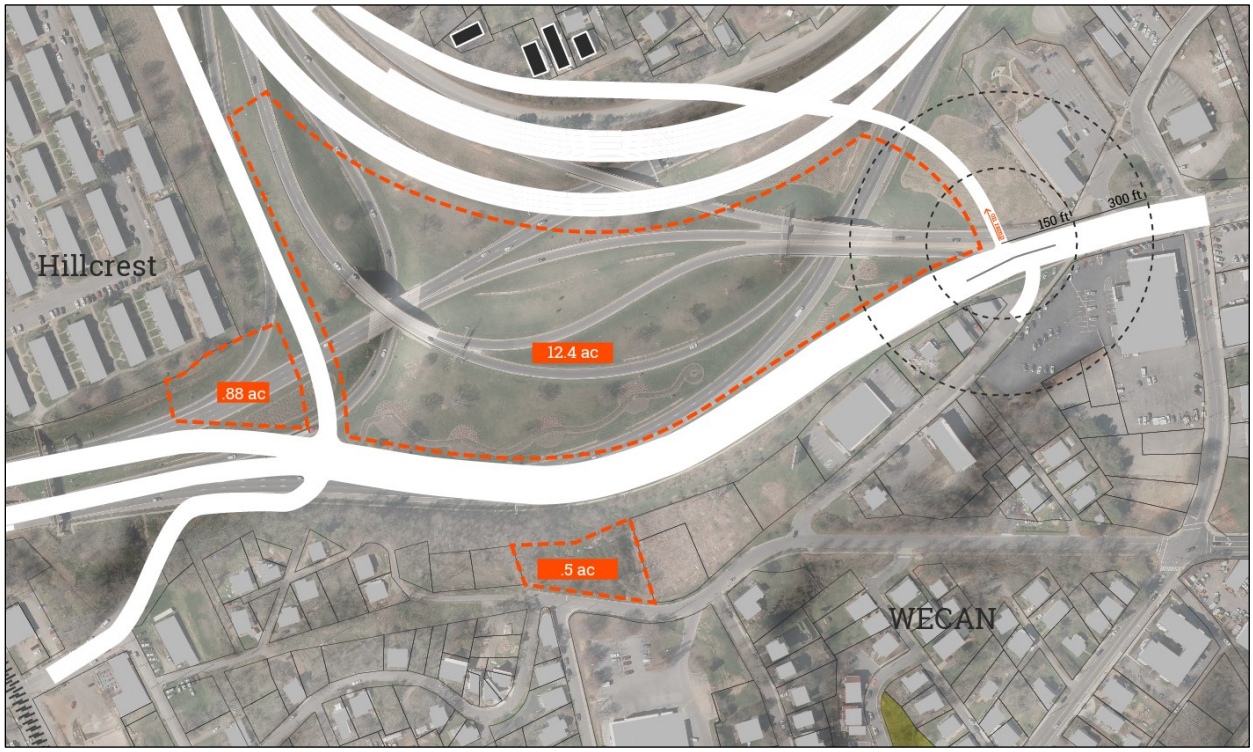
As currently drawn, the proposed Patton Ave in Alternative 4-B is aligned as a straight connection from the Jeff Bowen bridge to the Clingman Ave intersection. Alternatively, "bending" Patton Avenue in a southward arc along today's eastbound Patton Avenue alignment (see Figure 13) would result in the largest contiguous developable parcel possible. This would attract larger, higher quality development proposals, thus maximizing the economic development potential of the site. It also has the added benefit of not being dependent on NCDOT's proposed design of Patton Avenue, which, as currently proposed as part of the I-26 Connector project, may end up as a 132-foot right-of-way with a highway-like aesthetic.

In general, all three options for the I-240 ramps described above could be accomplished through either the straight or curved Patton Avenue alignment. As can be seen in Figure 13, Option 3 may be more feasible with the extra space afforded by the curved Patton Avenue alternative.

City's Recommendation

Per discussions with NCDOT, the City recommends a straight alignment for Patton Avenue.

Figure 13: A conceptual drawing of a new alignment for Patton Avenue, with an on-ramp on the eastern end of the segment



Patton Avenue Design

The design of Patton Avenue is a critical piece of the overall 4-B plan, determining if this restored surface street will foster an urban extension of downtown as desired. The City has therefore recommended a design for Patton Avenue that maximizes adjacent development opportunities, connects to the Hillcrest community, and minimizes the overall cross-section of the roadway. By altering the location of the highway ramps, the amount of land disposed of can be increased and the impedance of control of access can be reduced, increasing the overall urban character of the corridor.

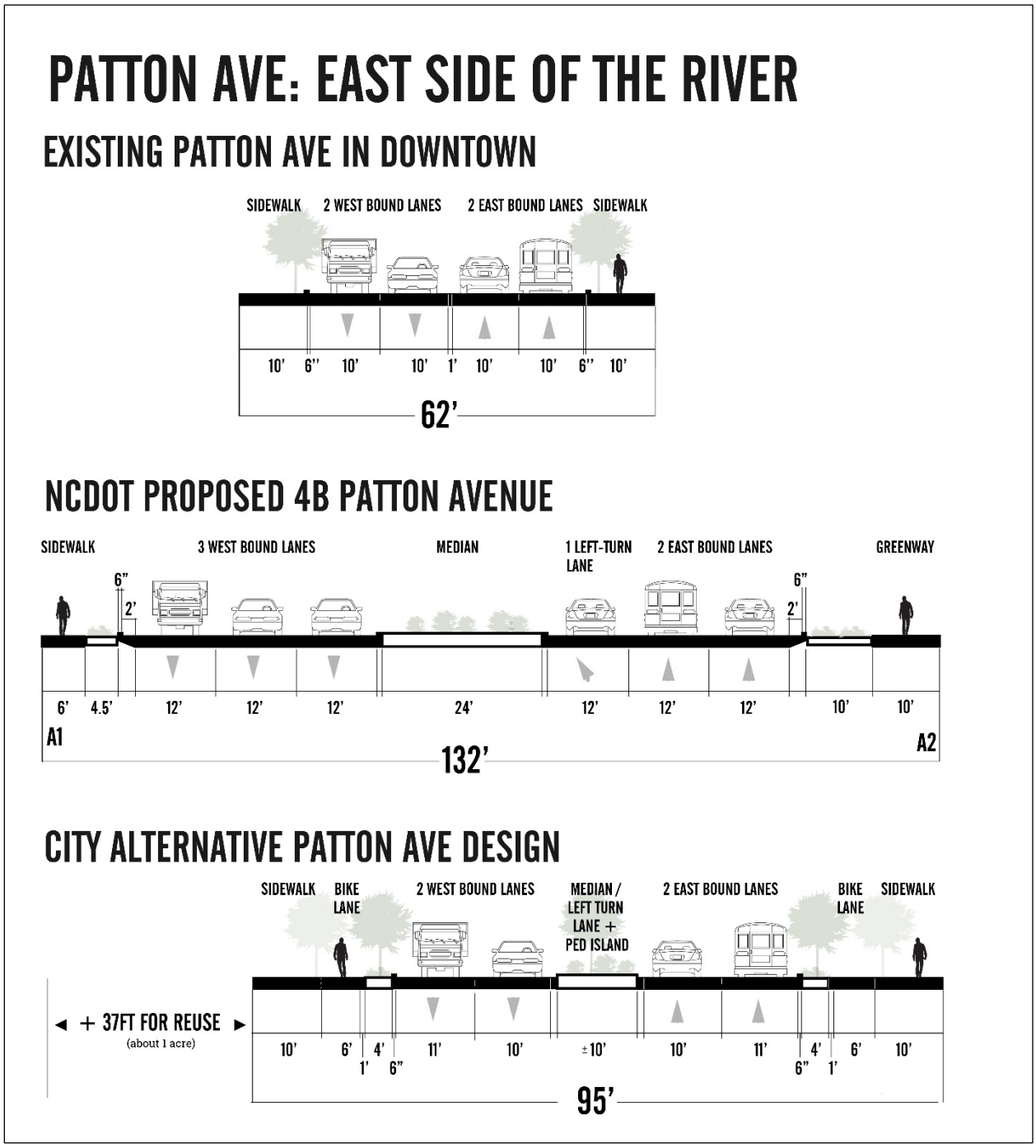
The alternative design calls for two primary moving lanes in each direction, widening to include turning lanes at intersections (where appropriate). This design also reduces the width of the planted median. The overall impact is a cross section that is 97', as opposed to the proposed 132'. This significantly reduces the distance for pedestrians to cross the roadway, and, depending on urban design and curb cuts, can change the perception of the roadway from a suburban arterial to a downtown street. As noted in the "West Side of the French Broad River" section, Patton Avenue in this section should also be designed as a tree-lined boulevard with tight, comfortable intersections, minimal curb cuts, and a target speed, design speed, and speed limit of 30-35 mph.

This design aligns more closely with the street's current configuration east of Clingman Avenue. In order to accommodate the anticipated traffic volumes, the roadway will widen at ramps, intersections, and on the west side of the river as it approaches the interchange with I-26/I-240. Additionally, the City's recommendation would see the proposed speed limit of Patton Avenue reduced to 30 mph, reflecting the City's desire for Patton Avenue to operate as an urban collector roadway as opposed to a suburban arterial.

City's Recommendation

As described above, the City recommends that Patton Avenue be designed as a walkable, tree-lined urban boulevard with a greenway along the southern side, while minimizing the street's footprint to the extent possible, per Figure 12: Existing, NCDOT proposed, and City alternative design for Patton Avenue east of the French Broad River.

Figure 14: Existing, NCDOT proposed, and City alternative design for Patton Avenue east of the French Broad River



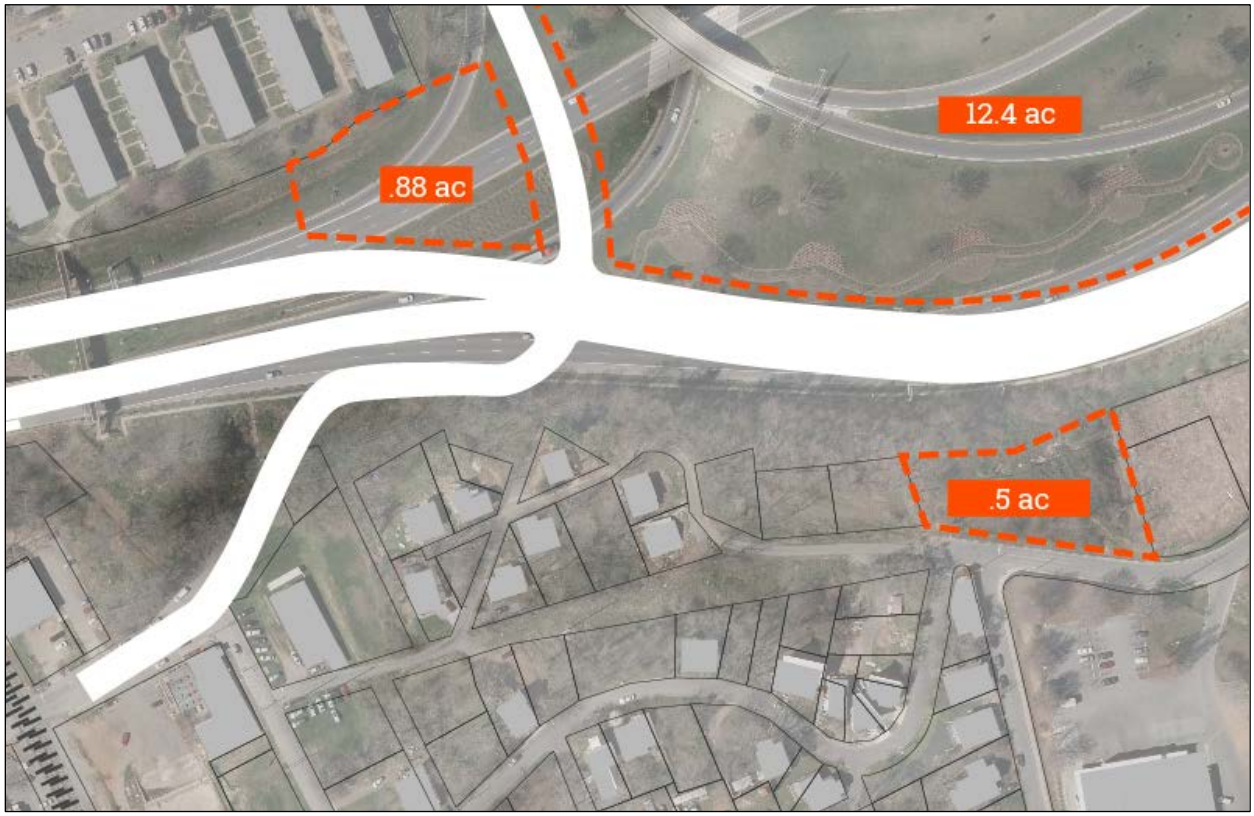
WECAN Connection

A connection from Patton Avenue down to WECAN and the river could be accomplished via a new roadway that extends south from the new Hillcrest Connector to West Haywood Street and the Craven Street Bridge (see Figure 15). This would help achieve the goal of connecting the River District with Downtown, relieving pressure on the traffic network and providing more convenient connections for those walking and biking through a more interconnected street grid.

City's Recommendation

The City recommends studying the possibility for this connection to WECAN and the Craven Street Bridge in more depth through the design process.

Figure 15: An example of a potential alignment of the WECAN Connector and adjacent development plots



Greenways

The I-26 Connector Project is critical to the creation of a network of interconnected, off-street multi-use paths in Asheville because key links within the network are affected by the project. At a minimum, this project should allow space for the greenways and not preclude the planned network. This principally includes the Patton Avenue greenway on the eastbound span of the Captain Jeff Bowen Bridges and the Haywood Road greenway connection to Patton Avenue, which have already been included in NCDOT's plans. Other planned greenways that require close coordination with the I-26 Connector Project include the Smith Mill Creek and Emma Road greenways.

As currently planned, the culvert system near the Montford Complex will not be altered, limiting any greenway incorporation/pedestrian barrel within that system. The desire to leave the culvert

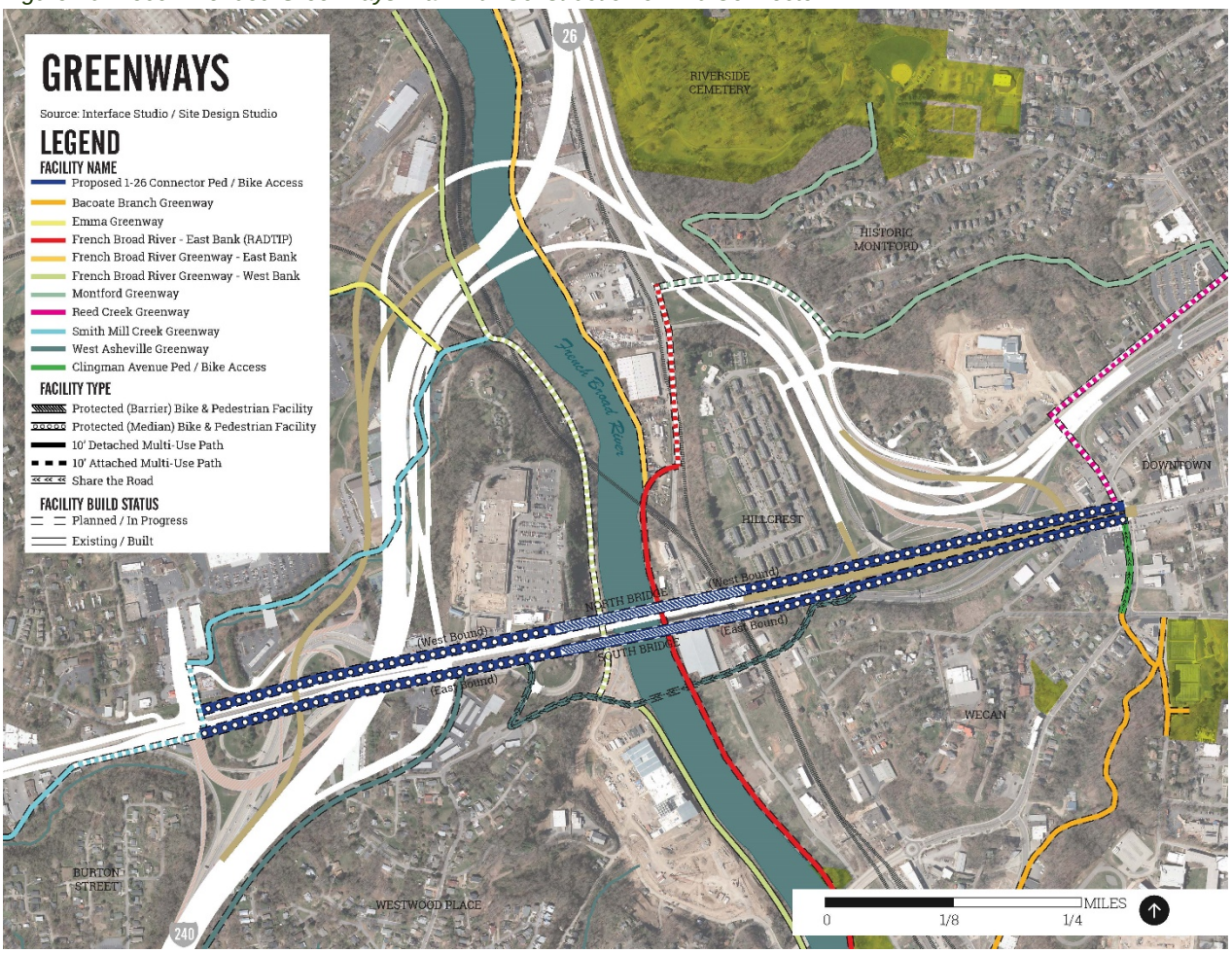
system as-is stems from the discovery that the existing culvert system serves as a roosting location for the federally-endangered gray bat. An inspection of the culvert by NCDOT in February also indicated the culvert is structurally sound and will not need to be replaced as part of this project.

The Burton Street neighborhood has requested, through their in-progress neighborhood plan, a connection to the Smith Mill Creek Greenway as part of this project.

City's Recommendation

The City recommends implementation of the greenway plan as shown in Figure 14: Recommended Greenways Plan with Construction of I-26 Connector, which has been developed to complement and not conflict with the I-26 Connector project. The I-26 Connector should build out those portions of the greenways can be economically designed and constructed as part of the interstate project; at minimum, it should not preclude future construction of these planned greenways.

Figure 16: Recommended Greenways Plan with Construction of I-26 Connector



Next Steps

This memo is intended to be included in the I-26 Connector Project FEIS as the official record of the City and State's collaboration and agreement to improve the 4-B plan as well as the City's preferences not reflected in the FEIS. This will help to guide the scope and/or Alternative Technical Concept (ATC) requests that could be included as part of the design-build project RFP (Request for Proposals).

Appendices

1. **Detailed Greenways Recommendations**
2. **City Council Resolution # 15-232**
3. **City Council Resolution # 16-163**
4. **Figg and Lochner I-26 Connector Final Report**

GREENWAYS

Source: Interface Studio / Site Design Studio

LEGEND

FACILITY NAME

- Proposed 1-26 Connector Ped / Bike Access
- Bacoate Branch Greenway
- Emma Greenway
- French Broad River - East Bank (RADTIP)
- French Broad River Greenway - East Bank
- French Broad River Greenway - West Bank
- Montford Greenway
- Reed Creek Greenway
- Smith Mill Creek Greenway
- West Asheville Greenway
- Clingman Avenue Ped / Bike Access

FACILITY TYPE

- Protected (Barrier) Bike & Pedestrian Facility
- Protected (Median) Bike & Pedestrian Facility
- 10' Detached Multi-Use Path
- 10' Attached Multi-Use Path
- Share the Road

FACILITY BUILD STATUS

- Planned / In Progress
- Existing / Built

RIVERSIDE CEMETERY

HISTORIC MONTFORD

DOWNTOWN

HILLCREST

WECAN

NORTH BRIDGE

SOUTH BRIDGE

(West Bound)

(East Bound)

(West Bound)

(East Bound)

French Broad River

BURTON STREET

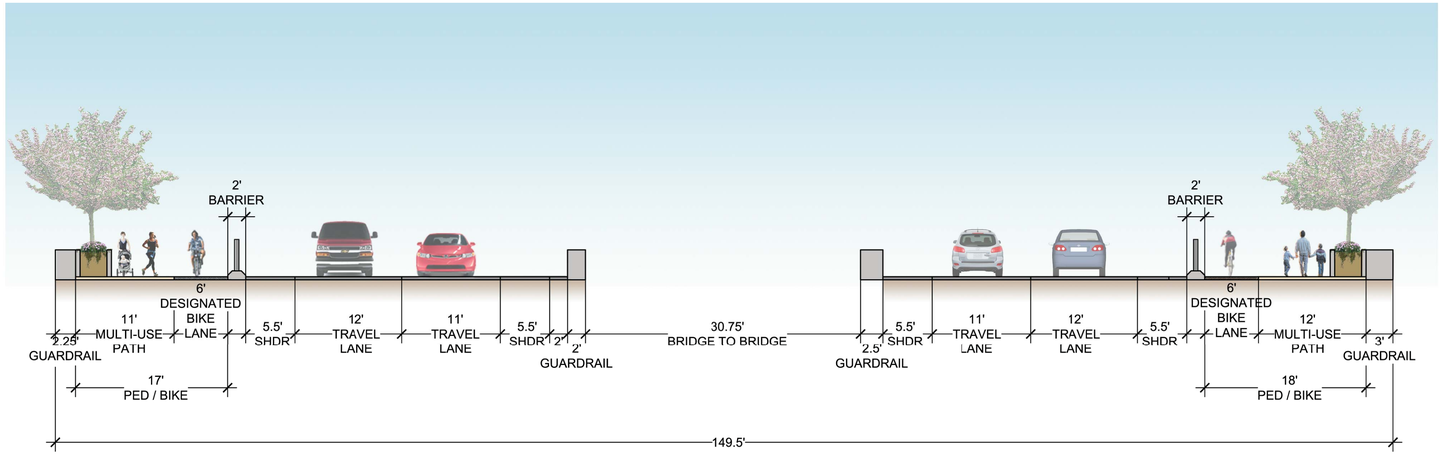
WESTWOOD PLACE

26

240

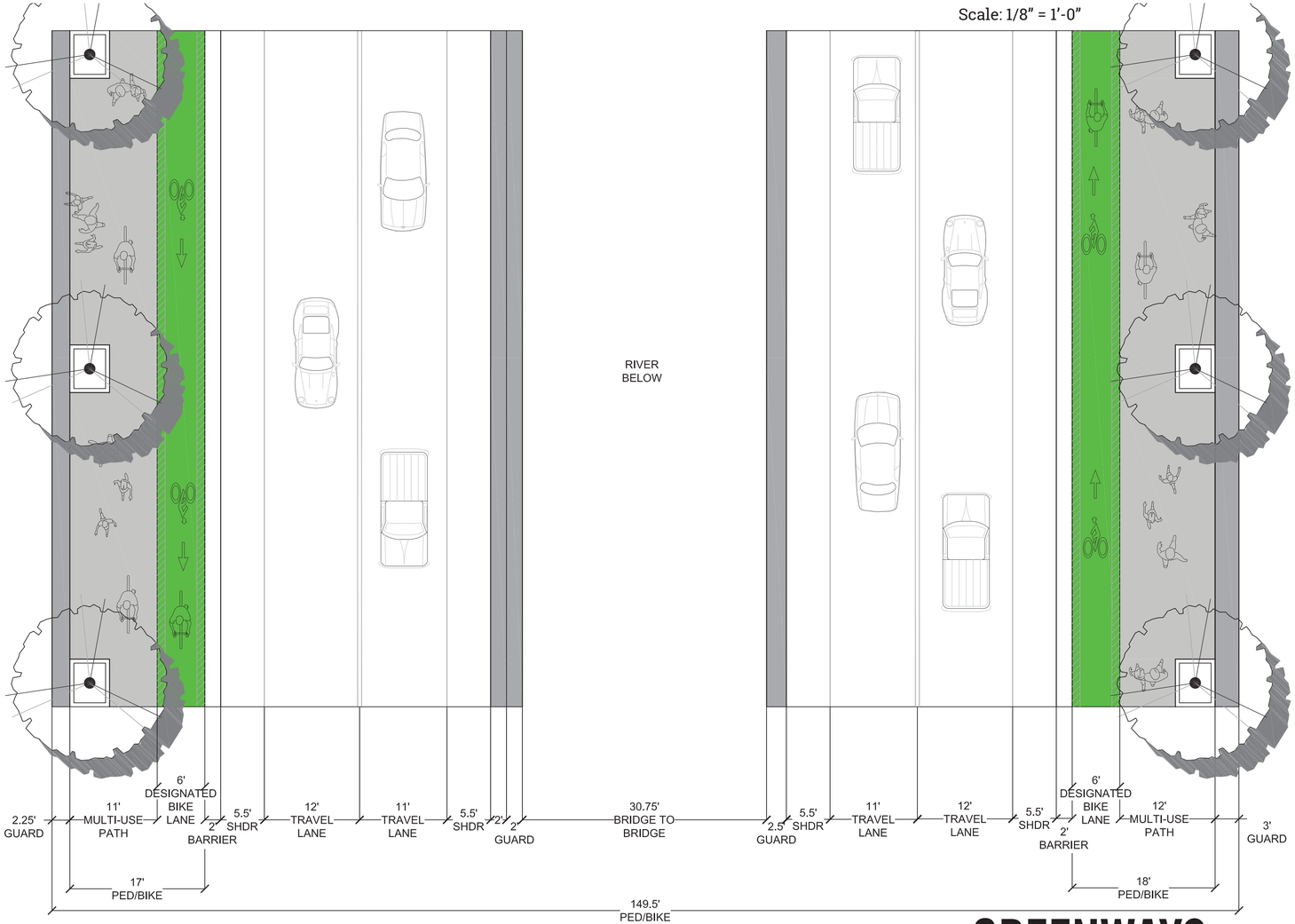
2

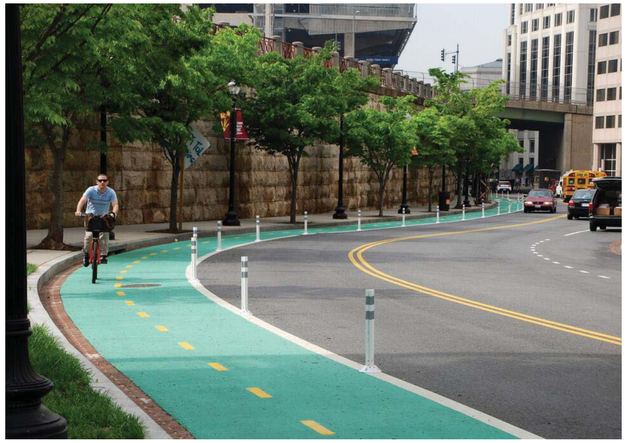
0 1/8 1/4 MILES



Section 1 - Protected Bike & Pedestrian Facility (Bowen Bridge)

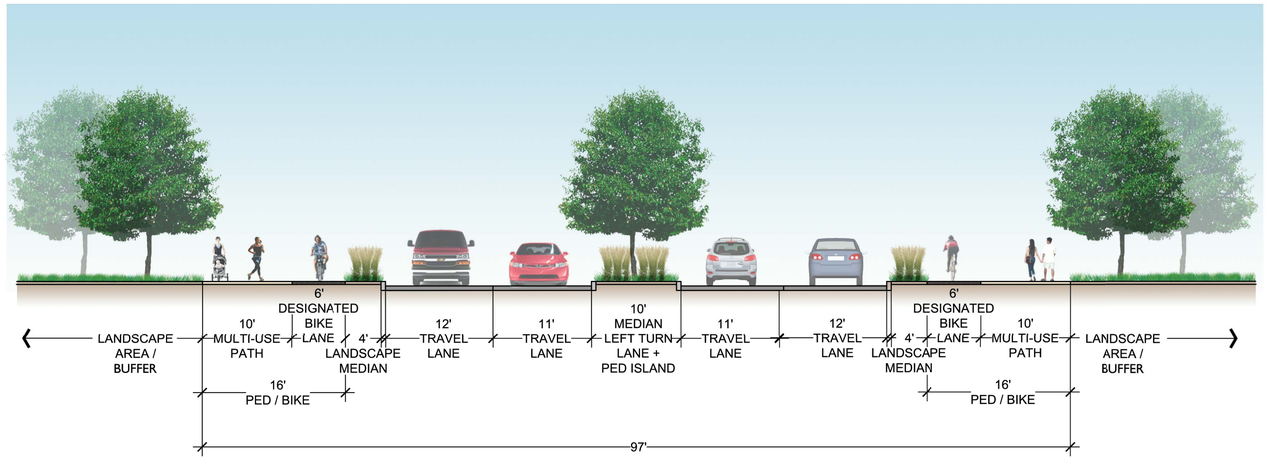
Scale: 1/8" = 1'-0"





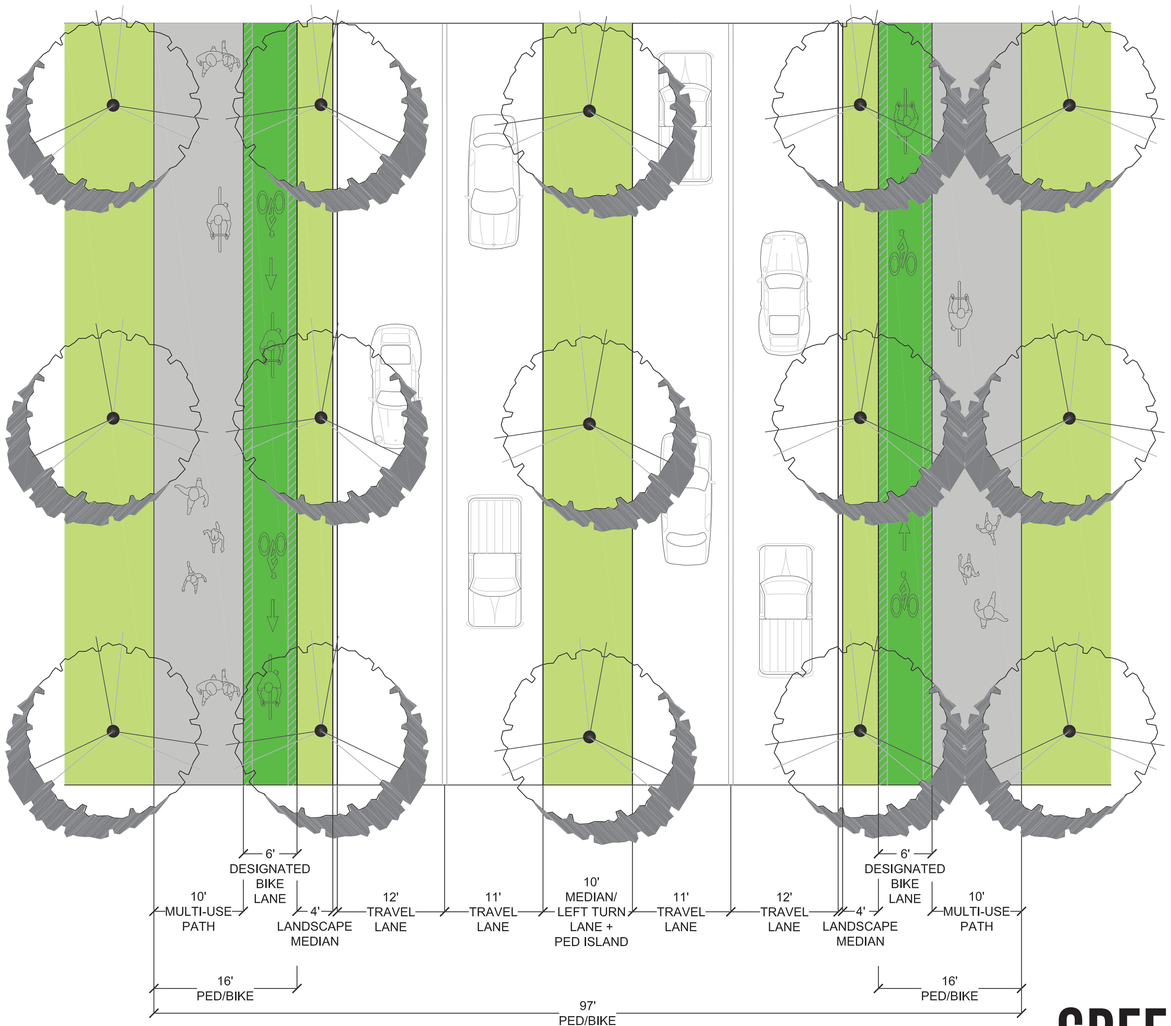
GREENWAYS

Typical Sections



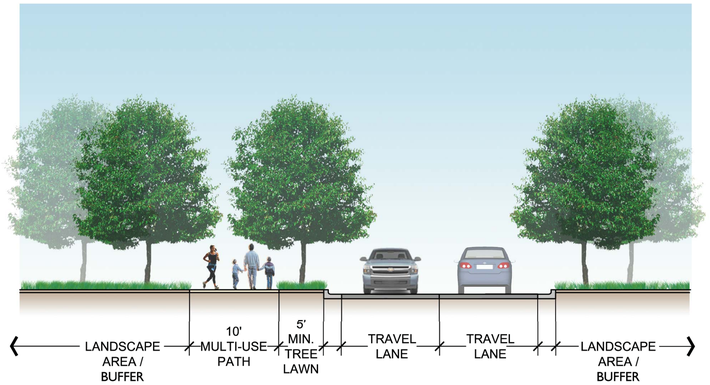
Section 2 - Protected Bike & Pedestrian Facility (Patton Avenue)

Scale: 1/8" = 1'-0"



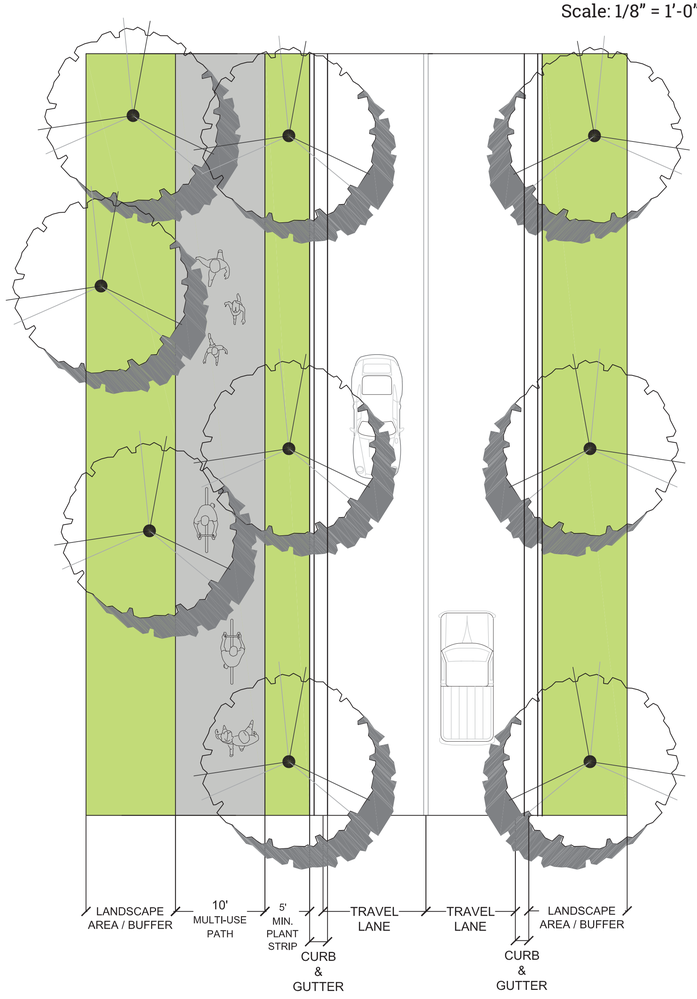
GREENWAYS

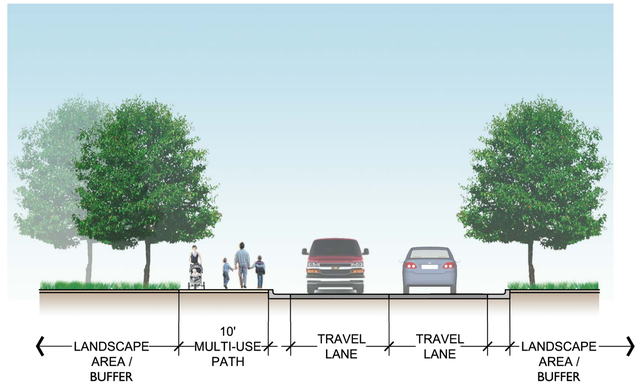
Typical Sections



Section 3 - 10’ Detached Multi-Use Path

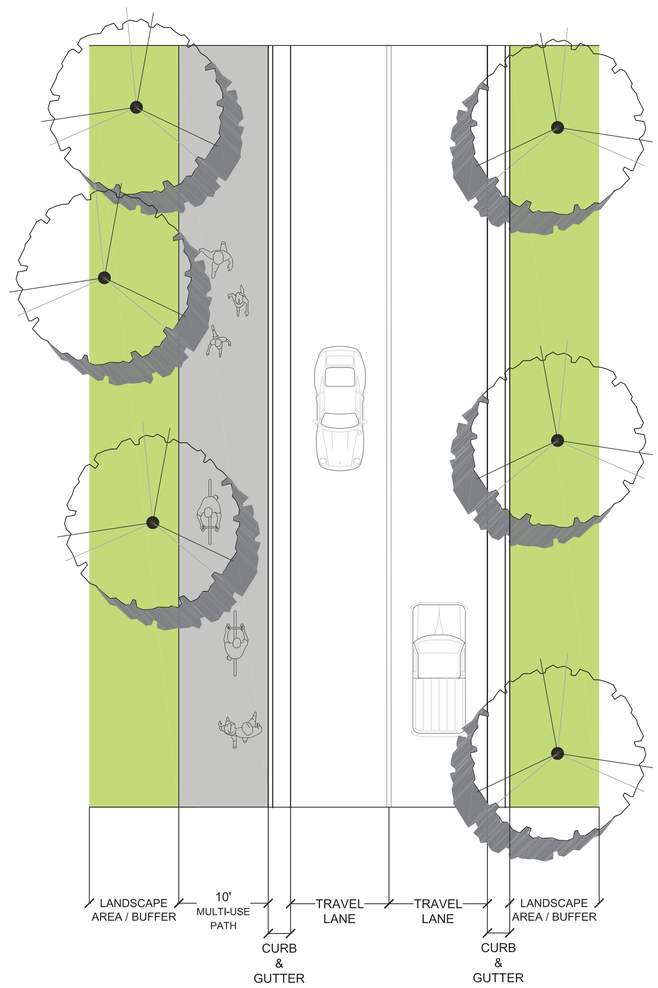
Scale: 1/8” = 1’-0”





Section 4 - 10’ Attached Multi-Use Path

Scale: 1/8” = 1’-0”



GREENWAYS

Typical Sections

RESOLUTION NO. 15-232

RESOLUTION REGARDING THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION I-26 CONNECTOR TIP PROJECT-2513

WHEREAS, the North Carolina Department of Transportation ("NC DOT") has issued a Draft Environmental Impact Statement ("DEIS") for the I-26 Connector Project, TIP Project I-2513 ("the project"); and

WHEREAS, NCDOT is seeking public input on the DEIS and held a public information session and hearing on November 16, 2015; and

WHEREAS, the City of Asheville is providing comments to NCDOT on the DEIS through a letter and this resolution; and

WHEREAS, the I-26 and I-240 corridors are critical to local and regional residents, visitors, interstate travelers, and regional commerce; and

WHEREAS, traffic congestion and safety are continuing challenges along I-240 and I-26 through Asheville; and

WHEREAS, improvements to the I-240 and I-26 corridors should be minimally impactful to the local community and should enhance the quality of life for residents and the quality of experience for visitors wherever possible; and

WHEREAS, NC DOT has been responsive to input from the City of Asheville and Buncombe County by including new bicycle and pedestrian facilities in the DEIS; and

WHEREAS, the NC DOT has committed to run the new, local travel demand model and undertake a capacity analysis that considers a six-lane alternative for Section A and has stated that fewer lanes would be built if these analyses demonstrate fewer lanes would be sufficient; and

WHEREAS, members of the community have expressed at the November 16 public hearing and through letters their strong preference for a project that addresses current congestion and safety problems but also one that is smaller overall, better reflects the character of Asheville, incorporates additional bicycle and pedestrian facilities, and minimizes harm to the affected neighborhoods of West Asheville, Burton Street, Emma, and Montford; and

WHEREAS, the City of Asheville seeks a closer working relationship with NC DOT on the ongoing design of this project to ensure its impacts are minimized;

NOW THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF ASHEVILLE THAT:

1. The City of Asheville calls on NC DOT to use any and all tools at its disposal to reduce the overall size and impact of the project on Asheville's neighborhoods and businesses and to improve community connectivity through inclusion of additional bicycle and pedestrian elements required by NC DOT's Complete Streets policy, reflected in adopted City plans and policies, and referenced in the December 9, 2015, cover letter and December 8, 2015, Memorandum from the City of Asheville, both of which are specifically incorporated herein by reference.

2. The City of Asheville further calls on NC DOT to analyze in both the travel demand model and the capacity analysis a six-lane alternative in Section A (the West Asheville section) coupled with four lanes for I-26 in Section B (the bridge section) and to construct as few lanes as possible to address safety and congestion.

3. The City of Asheville further calls on NC DOT to partner with the City in creating a collaborative working group of City appointees and NC DOT design professionals that will meet regularly starting in early 2016 and throughout the design phase to:

    a. minimize the project's size and impact, which will provide community benefits and reduce cost
    b. ensure adequate consideration of the concerns listed in the City's comment letter
    c. analyze the travel demand model, capacity analysis, and the methodology of calculating Level of Service in an effort to gain consensus on these foundational elements of the project
    d. identify opportunities to return land around the project to productive, tax-generating use and to ensure land on the east side of the river under any new bridges is put to use in a way that enhances the riverfront
    e. identify opportunities to repair or redress impacts of previous transportation projects on neighborhoods and businesses.

4. In order to provide the most benefit to the Asheville community while also accommodating through traffic, and for all the reasons stated in the City of Asheville's comment letter, the City of Asheville endorses Alternatives 4 and 4B for Section B and calls on NC DOT to further minimize the size and scale of these alternatives, particularly the impacts on the Burton Street Community, the impacts of Alt. 4 on the Emma Community, and the impacts of Alt. 4B on the Montford Community. Following completion of the new travel demand model and capacity analysis and focused exploration with NC DOT of options to reduce the overall size and impact of the project, the City of Asheville anticipates being able to endorse a single alternative but, in the absence of additional information, is not able to do so at this time.

5. The City of Asheville endorses Alternative F1 for Section C (I-40/I-26/I-240 interchange) in order to minimize the footprint and cost, while achieving the primary objective of creating full movement between interstate highways. For the reasons cited in the City's comment letter, the City of Asheville does not endorse the increased expense associated with the proposed collector roads and widening of I-40 east of Brevard Road.

Read, approved and adopted this the 8th day of December, 2015.

Magdalen Burleson
City Clerk

Mayor

Approved as to form:

City Attorney

RESOLUTION NO. 16-163

RESOLUTION REGARDING THE I-26 CONNECTOR

WHEREAS, the I-26 and I-240 corridors are critical to local and regional residents, visitors, interstate travelers, and regional commerce; and

WHEREAS, Alternatives 4 and 4B were the alternatives most strongly supported by the residents of Asheville and endorsed by City Council;

WHEREAS, the selection of Alternate 4B selection will put the interstate on a new location from the Patton Avenue interchange across the French Broad River, just north of the Captain Jeff Bowen bridges, and connect with U.S. 19/23/70; and

WHEREAS, the selection of Alternate 4B will return Patton Ave to a surface street, allowing the opportunity to create a new gateway into downtown and a truly urban, multi-modal boulevard with new, infill development – all of which will help Asheville grow sustainably and create opportunities for economic investment and development; and

WHEREAS, this alternative has the least amount of impact on the Burton Street community and would provide the opportunity for a new connection from Hillcrest directly to Patton Ave; and

WHEREAS, this decision will help ensure the project provides benefits to the residents of Asheville in addition to those travelling through our city; and

WHEREAS, there are still improvements needed to make this project context and neighborhood sensitive and to ensure it aligns with the City of Asheville's strategic vision and goals, including making the footprint as small as possible, minimizing the noise and visual impacts on all Asheville neighborhoods and historic resources, designing new bridges that will contribute to Asheville's scenic beauty, including more bike/pedestrian facilities, and maintaining accessibility to and the scenic nature of the French Broad River as an amenity for residents and visitors; and

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF ASHEVILLE THAT:

The City of Asheville is grateful to the North Carolina Department of Transportation and other state and federal agencies for responding to public input and selecting the Alternate 4B option in section B of the I-26 Connector project; and the City of Asheville looks forward to continuing the positive working relationship between the city's working group and NCDOT to address the remaining issues, and looks forward to positive decisions emerging from those discussions that will continue to improve the project for the residents of Asheville.

Read and approved and adopted this 5th day of July, 2016.

Magdalen Burleson
CITY CLERK

Esther G. Manheimer
MAYOR

Approved as to form:

CITY ATTORNEY

Study of the Asheville Design Center's

I-26 CONNECTOR

Proposal

for City of Asheville

Buncombe County

Asheville Design Center

by

FIGG

In Association with LOCHNER

VOLUME I
Report

March 26, 2009

Table of Contents

VOLUME I

VOLUME II

List of Figures and Tables

OBJECTIVES

On September, 2007 the City of Asheville and Buncombe County (CA/BC) in conjunction with the Asheville Design Center (ADC) requested qualifications from engineering consultants interested in providing professional services for the analysis and review of the Asheville Design Center's proposed alternate plan for the I-26 Connector in Asheville, North Carolina. The intent of the study was to determine the feasibility of the proposal as a viable alternative for inclusion in the North Carolina Department of Transportation's (NCDOT) Environmental Impact Statement (EIS) for the project. On November 2, 2007 Figg Bridge Engineers, Inc (FIGG), in association with Lochner as a principal subconsultant, was given notice to proceed with the study.

PROJECT DESCRIPTION

This portion of the NCDOT project being considered is approximately a two-mile connection between two completed segments of I-26 that extend through Asheville adjacent to the French Broad River and downtown. NCDOT currently has three remaining proposed alternative connections, but the CA/BC and ADC were concerned that these alternatives are not context sensitive solutions that satisfy their stated sustainable community goals. A non-profit organization, the Asheville Design Center, created a new alternative within the same study area (Figure 1) that was considered by the community as a viable alternative that offers a more context sensitive solution.

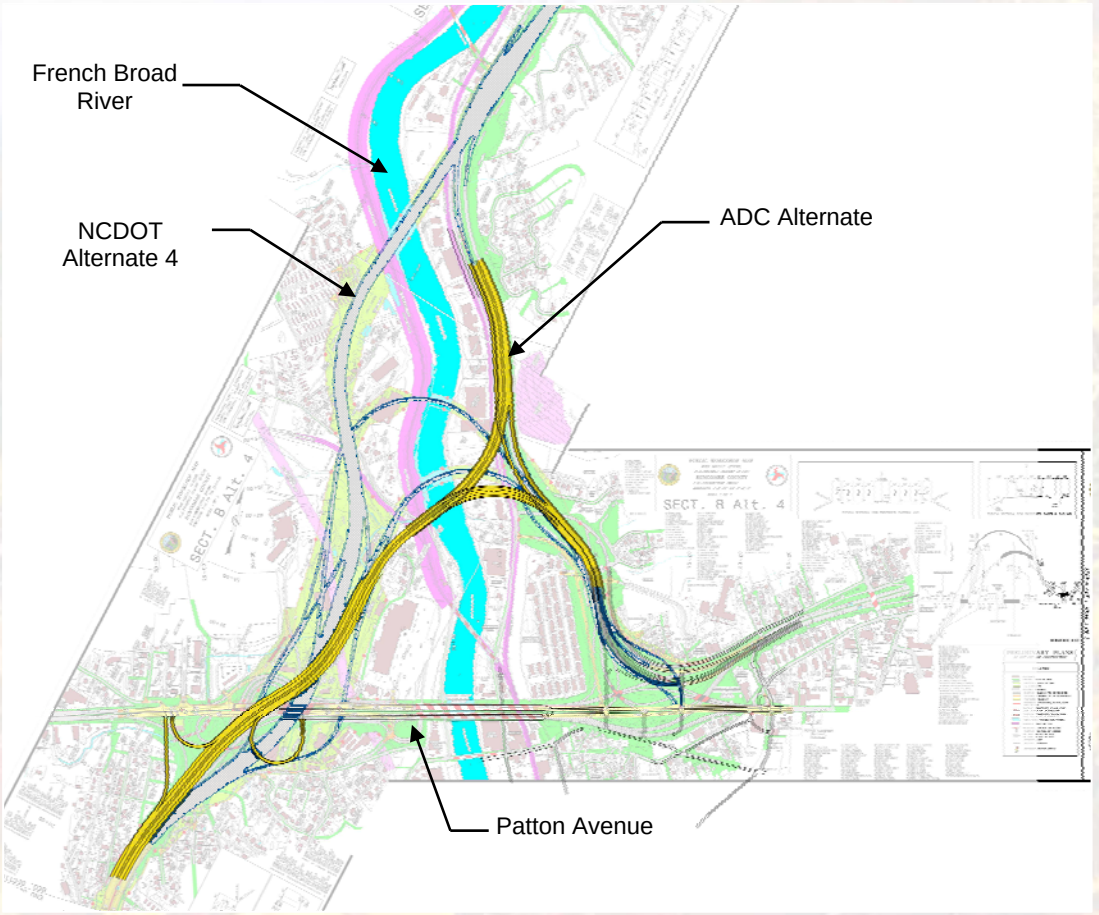


Figure 1 – ADC Alternative

In the summer of 2007, at the request of the Asheville City Council and local state legislators, the NCDOT consultants currently working on the project provided a partial analysis of the ADC proposal. Although the ADC proposal was not determined infeasible in the NCDOT report, results of the study identified several concerns. In an effort to address these concerns, community leaders sought an objective, independent analysis and review to determine the viability of the proposed ADC alternative.

BACKGROUND

The I-26 connector project has been under discussion and review for almost 20 years. In June 2006, the AIA Asheville Section was awarded a grant from the American Institute of Architects (AIA) for a "Bridging the French Broad: Creating Connected Livable Communities" Legacy project. The goal of this project was to engage the community in finding a more context sensitive design solution to the I-26 connector alternatives proposed by NCDOT. The ADC adopted a set of specific guidelines for the project by incorporating existing, established design goals from the following documents:

- The AIA "Ten Principles for Livable Communities"
- The Community Coordinating Committee's (CCC) Report
- Wilma Dykeman River-way Plan
- The Asheville City Development Plan for 2025

After studying four connector designs proposed by NCDOT, ADC developed a modified plan. This alternative met community goals and honored and satisfied the design guidelines listed above. It also offered opportunities for sustainable growth with increased "livability" along the riverfront and in neighborhoods west of downtown Asheville. The project also presented the opportunity for a new "signature" bridge over the French Broad River. Key to the success of this plan was the separation of existing I-240 and I-26 traffic from local traffic on Patton Avenue. (These are currently mixed on the same roadways.) The ADC plan proposes a co-location of a new I-26 "signature" bridge over the French Broad, with a new interchange between I-240 and I-26 just north of existing Patton Avenue/I-240 "Smoky Park" Bridge within sight of downtown. A double deck bridge with compact lane movements on each end was proposed as a solution that addressed the mountainous terrain, limited roadway widths, and nearby historic properties found in the project area.

SCOPE OF WORK

The CA/BC supported by the ADC requested that the study/analysis identify and address the following key engineering elements including:

1. Address NCDOT design concerns with the ADC proposal as described in their report to the Asheville City Council. Concerns identified in the NCDOT report include:
    a. Line and grade of bridge approaches
    b. Super-elevation of ramps
    c. Weaving distance between traffic movements on I- 240
    d. Bridge design and dimensions (heights proposed by NCDOT design require longer steeper ramps than the ADC proposal)
    e. Horizontal clearance along River Road and the Cemetery
    f. Vertical clearance over the railroad

2. Incorporate ADC primary design objectives in the design solution, as follows:
    a. Context sensitive design – provide a compact road alignment and bridge structure utilizing the double deck scheme proposed by the ADC or other appropriate design for the location that addresses these issues
    b. Separation of local and interstate traffic - achieve city planning goals, featuring Patton Avenue/Smoky Park Bridge must be a local urban street connecting downtown Asheville to West Asheville and Emma across the French Broad.
    c. Traffic movement– design speeds and lane capacities should be appropriate for the urban locations planned growth and meet with applicable State and federal guidelines.
    d. Constructibility – a smaller highway footprint should require less land acquisition and less physical construction. This should translate into project savings in time and construction cost, leaving more land along the river available for future development.
    e. Time – a major concern of the community has been the continual delay of this project. Solutions considered should simplify the project and reduce the overall completion schedule
    f. Aesthetics – retain the possibility of a "signature bridge" integrated into the urban fabric

3. Propose schematic solutions that address the NCDOT concerns and ADC objectives in accordance with standard professional engineering practice that satisfies FHWA requirements and standards.

4. Develop a conceptual statement of probable construction quantities for the two-mile segment in the scope of this proposal.

5. Develop an initial construction schedule for the two-mile segment in the scope of this proposal.

APPROACH TO PROJECT

A. General

The I-26 Connector project has a long history and over time numerous studies and alternates have been considered. There has also been a considerable public involvement effort that includes many meetings with community leaders, local interest groups, business groups and the affected business owners and neighborhood groups since 1989. Due to the voluminous amount of available information and project data, it was imperative to develop a project approach that would systematically study, analyze and ultimately develop any necessary proposed improvements to the alternate for consideration by the CA/BC and ADC. This approach would also consider other major project stakeholders such as the FHWA and NCDOT.

The following major tasks were identified for evaluating the feasibility of the proposed ADC alternate:

1. **Develop Approved Design Criteria & Comprehensive List of NCDOT Concerns**. This was the starting point of the review process. For the study/analysis to be successful, it was imperative to have a clear understanding

of the stakeholders' objectives, concerns and constraints. After engaging in partnering meetings with the FHWA and NCDOT, it is understood that their key objectives can be summarized as follows:

a. Provide a safe and functional system
b. Meet local and federal design standards
c. Consider environmental impact
d. Meet operation requirements

2. **ADC Alternative 4b Analysis**. Once the design criteria were established and a comprehensive list of concerns had been prepared, the FIGG Team analyzed alternative 4B. This was an iterative process in which all the stakeholders were involved in the decision making process jointly developing solutions to any and all challenges. The constant communication was very important for the quick resolution of concerns.

3. **Final Plan Development (Schematic Solutions)**. This is the last step in the process where the alternative has evolved into a schematic solution that the NCDOT indicated was acceptable for inclusion into the EIS and subsequent advancement into the preliminary design phase. The final plan development phase consists of evolving the ADC alternative into a complete functional highway design that is compliant with FHWA and NCDOT design guidelines and achieves the ADC's objectives.

The following elaborates further on the results realized from performing this study that focuses on these three major tasks.

B. Develop Approved Design Criteria & Comprehensive List of NCDOT Concerns

On October 22, 2007 a project Kick-Off meeting was held at City Hall, Asheville, North Carolina. The intent of the meeting was to meet all the stakeholders, discuss in detail the intent of the City's study, schedule, NCDOT design criteria and concerns. A copy of the meeting minutes and list of attendees can be found in Appendix H. From this meeting, the following list of NCDOT concerns and items to accommodate were developed:

1. Address items in these areas:
    a. clearances (shoulders, over and under streets and railroads)
    b. alignment (horizontal and vertical) and
    c. traffic volume capacities (operational).
2. Address non-standard shoulder offsets, clearance between lanes and gradients.
3. Accommodate "physical constraints" on the west side relative to footing placement where the bridge over the French Broad River will cross the Smith Mill Creek floodplain, a railroad and a golf course.
4. End all alternates at Broadway in order to compare alternatives equitably. This is necessary for the EIS document even if construction is done in phases.
5. On the east side, there is a landfill running along the French Broad River, the Montfort Area Historic District and a railroad spur (runs along landfill). These three constraints pose horizontal clearance challenges (this condition is illustrated as Section F in the NCDOT PowerPoint presentation to Asheville City Council). North of Section F available horizontal clearance increases.

6. The grade on I-240 EB ramp (west side of river) required to provide the necessary vertical clearance over I-26 (at the double deck bridge) is acceptable. However, the profile on I-240 WB ramp (west side of river) required to provide the necessary vertical clearance over I-26 (at the double deck bridge) is not acceptable. Unlike the I-240 EB lanes, the I-240 WB lanes are at the low point of the 6% super-elevation prior to passing over I-26. This condition requires a steep grade approaching the double deck structure. There is also a low point on the structure which is unacceptable to the NCDOT. NCDOT does not allow sag profile low points on structures.
7. If the I-240 ramp profile (west of river) is lowered, the ramp length can be reduced.
8. Maintain a bridge cross-section approaching double-deck structure is 216 ft. out-to-out including 10 lanes plus shoulders to interstate criteria.
9. Operational issues (queue storage and weave distances) were identified as questionable at the following locations:
    a. I-240 EB Exit Ramp to Patton
    b. I-240 EB Entrance loop from Patton
    c. I-240 WB Exit Loop to Patton
    d. I-240 WB Exit to Hill Street
    e. I-240 WB Entrance from Hill Street
    f. Hill Street Connector
10. Develop cost estimates strictly as construction costs. Detour costs have not been included yet on the other NCDOT alternates.
11. TGS Engineers, working for NCDOT, did not review the Hill Street Interchange for possible improvements. Their scope of work consisted of evaluating Alternate 4b as presented to them.
12. The bridge cross-section approaching the double-deck structure has a 6% super-elevation. Vertical separation of the I-240 ramps will be a constraint.
13. Freeman and C.G. Worley Historic Properties are constraints on the other NCDOT alternates.
14. Traffic storage on the southwest loop that is approximately 500 feet long needs to be improved.
15. Fiber Optics near Patton is a concern due to the high cost of relocation. This is also a constraint for NCDOT alternates 3, 4 & 5. Overhead Power is a constraint for all alternates.
16. The Railroad on the east side of the river runs about 3 trains per week. Each train has between 3 to 6 cars each which corresponds to 13 to 26 tractor trailers.

The following figures illustrate the major design, environmental and operational concerns raised by the NCDOT.

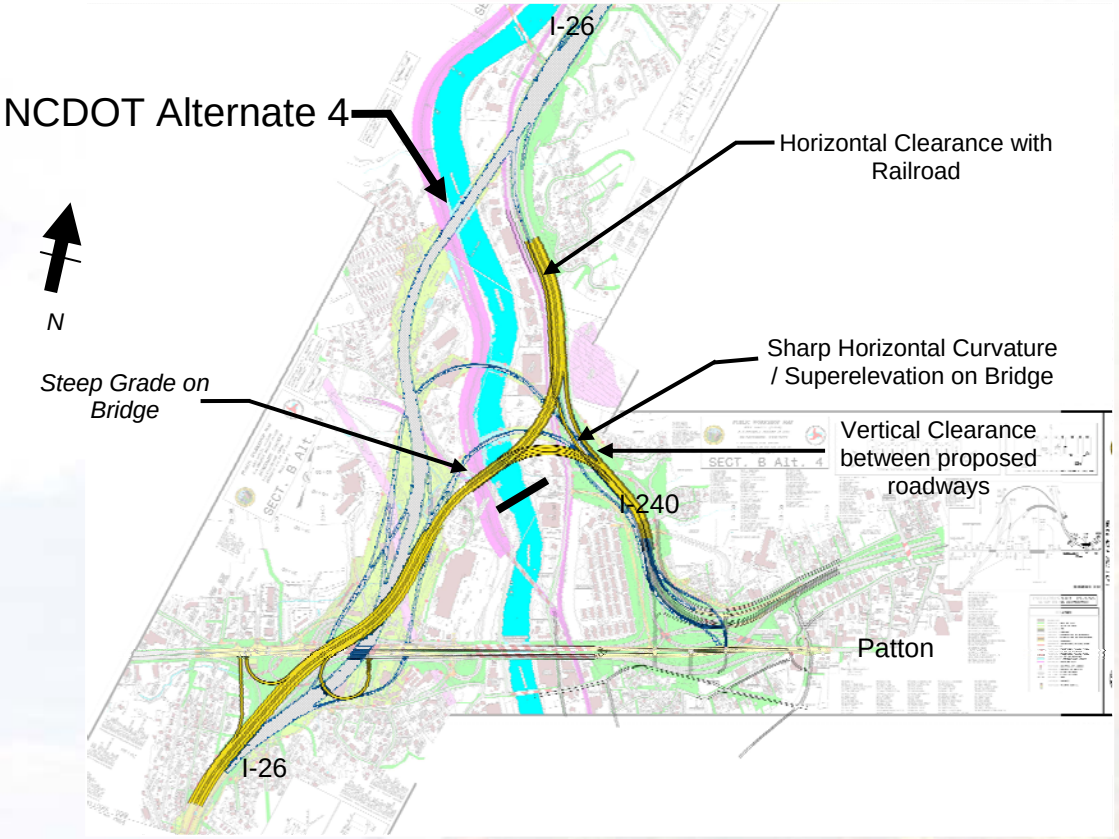


Figure 2 – NCDOT Design Concerns

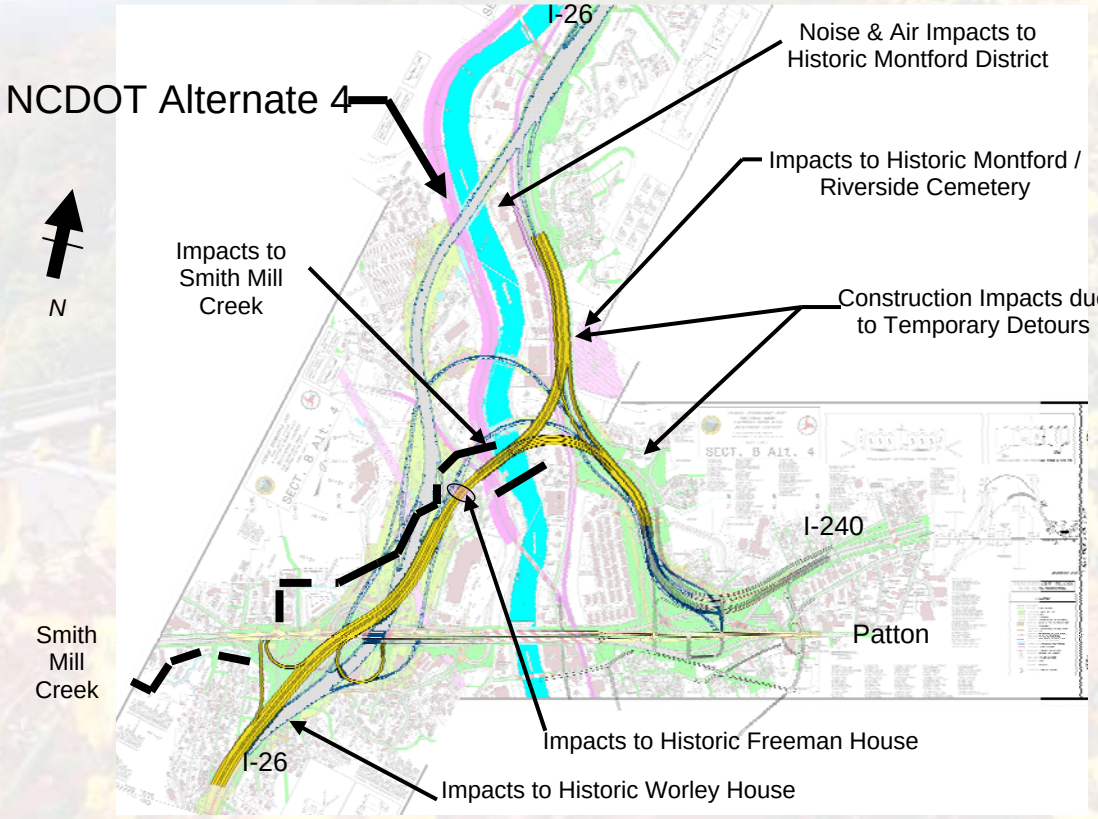


Figure 3 – NCDOT Environmental Concerns

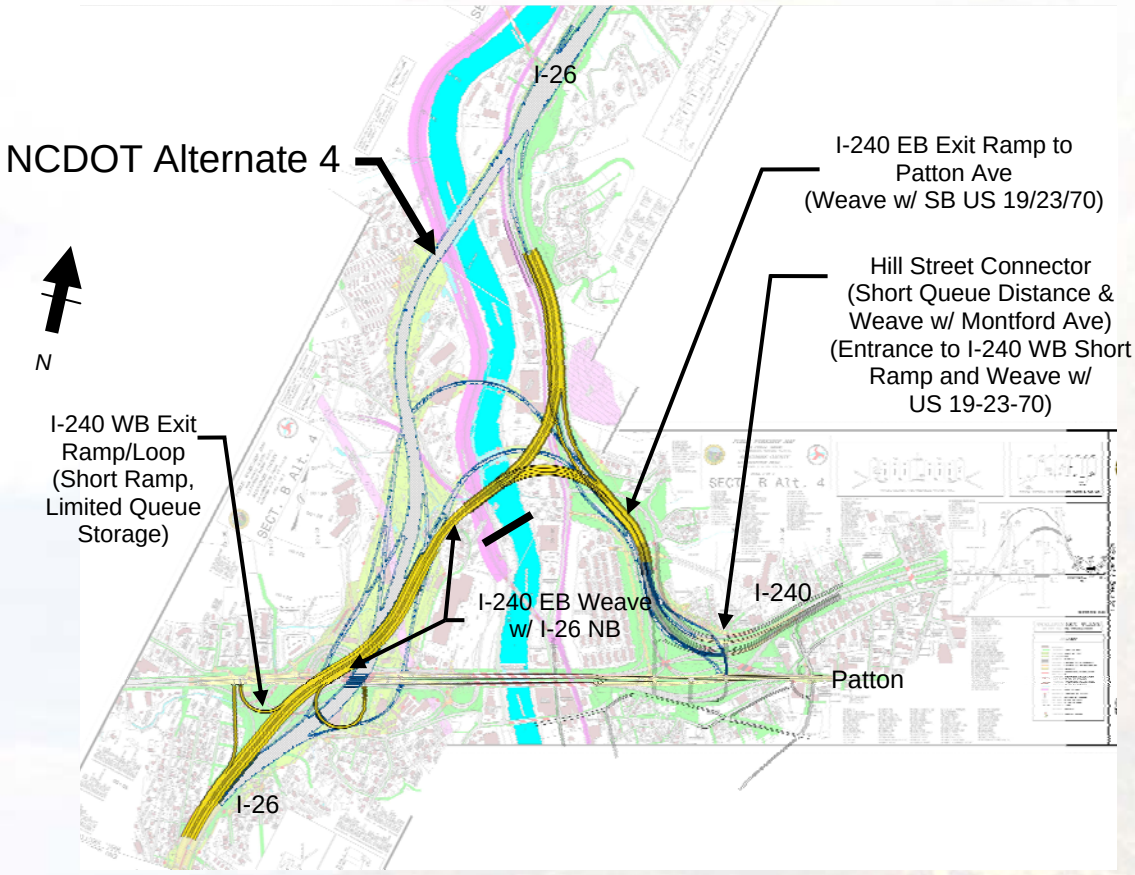


Figure 4 – NCDOT Operational Concerns

With regards to the design criteria, NCDOT noted the following:

- Design criteria for alternate 4B are the same as for all other alternates
- FHWA requires no design exceptions
- A copy of the design criteria will be provided via e-mail

The list of approved design criteria for this project is provided in Appendix A.

C. ADC Alternative 4B Analysis

During this phase the review was focused on coordinating with all the stakeholders and performing the appropriate level of engineering analysis to assist in determining the feasibility of the proposed alternative. The basis for this analysis was the design criteria and list of NCDOT concerns established above and the study corridor mapping developed by NCDOT for the other alternatives. Factors included in the study corridor mapping include jurisdictional wetlands (as identified by field delineations), floodplains, parks and recreational areas, recorded hazardous waste generators and underground storage tank sites, cultural resources, businesses, communities and community facilities (such as cemeteries, schools, and churches). The analysis of Alternative 4B included performing the following principal technical tasks by the review team:

Bridge Geometry Alternatives – Performed conceptual level engineering analysis using resources from previous projects to establish bridge typical sections and pier

layouts. This included a focus on reducing the grade of bridge approaches along with increasing vertical clearances over existing railroads and roads. This was provided while maintaining consistency with the ADC objective for using compact roadway alignments. The analysis also assumed preserving the possibility of a "signature bridge" that can be integrated into the urban fabric.

Traffic and Operational Analysis – Conducted a traffic analysis (capacity analysis) on the ADC Alternative. It included a weaving analysis, ramp merge analysis, ramp diverge analysis, freeway analysis, multi-lane analysis, signalized intersections and traffic network solutions. This analysis was performed utilizing traffic counts provided by NCDOT.

Horizontal and Vertical Curve Alignment Evaluation – Reviewed the ADC alternative for conformance with NCDOT and FHWA design criteria. This review included lane widths, shoulder widths, cross slope, horizontal curvature, super-elevation, tangent grade, vertical curvature, vertical clearance, stopping sight distance, bridge width, horizontal clearance and design speed.

During the initial review of Alternative 4B, the focus was on five areas that were considered fundamental because they could impact the intent of the concept developed by the CA/BC and ADC. The FIGG Team provided the results from our analysis of these key areas and the associated recommendations for consideration by CA/BC and ADC.

The following timeline of communications outlines the evolution of addressing the results from our review with adjustments to the original ADC alternative alignment.

November 30, 2007 Meeting

The FIGG Team's original recommendations were shared during the first progress meeting with the CA/BC and ADC at City Hall in Asheville, North Carolina.

The five key areas of recommendations that were prepared for discussion at this meeting were:

1. **Developing a conceptual bridge superstructure clearance envelope that is reasonable and does not preclude any structure types from consideration**. This envelope shown in Figure 5 was developed to check all vertical clearances and allow the City, County, ADC and NCDOT flexibility in selecting various superstructure types in the future. To develop the superstructure clearance envelope, it was important to consider structure types that are feasible for this project. Bridge superstructure types considered for this study as shown in Figure 6 and 7, include concrete box girder, steel plate girder and precast Bulb-T configurations.

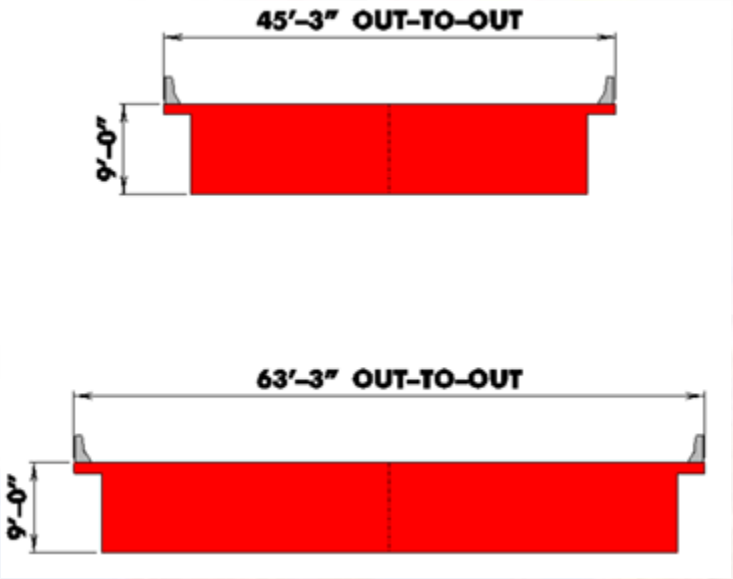


Figure 5 – Conceptual Superstructure Clearance Envelope

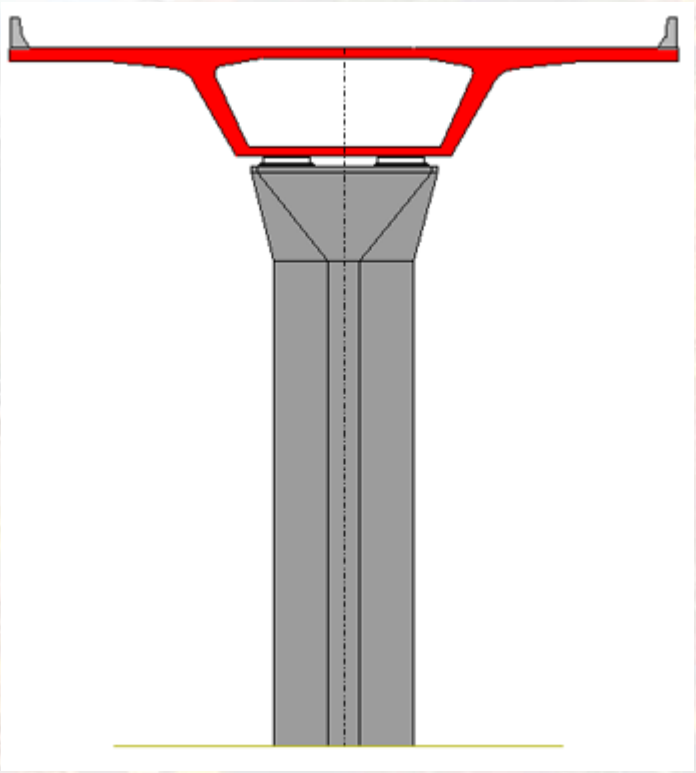


Figure 6 – Possible Box Girder Bridge Superstructure Concept

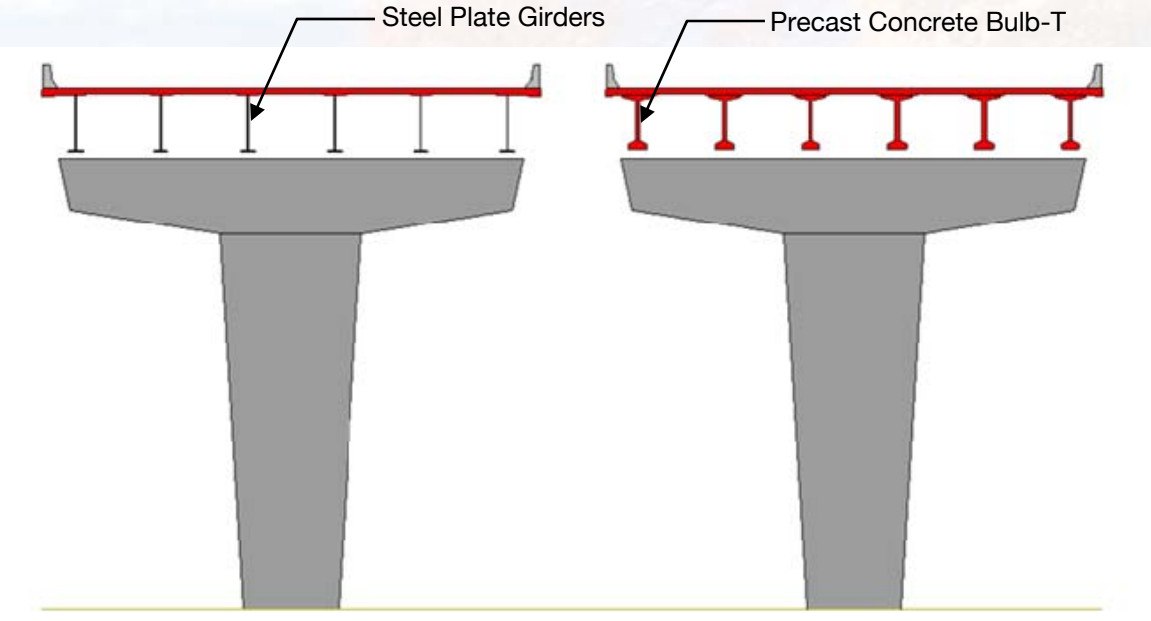


Figure 7 – Possible Beam Bridge Superstructure Concepts

2. **I-240 ramps super-elevation and required radius**. This challenge was selected for review based on the potential to impact a double deck bridge concept. The preliminary horizontal alignment developed by the NCDOT had an 8% super-elevation on the I-240 ramps. The I-240 ramps super-elevation and required radius were reviewed with a focus on meeting the most current NCDOT design criteria of 50 mph with a 6% super-elevation. Given the increased radii required to satisfy the 6% super-elevation, it was not feasible to tie I-240 back to I-26 in the vicinity of the river crossing. A concept revision as shown in Figure 8 was developed to preserve the ADC objective for minimizing the structural footprint, while satisfying the NCDOT design criteria and preserving the possibility of a signature structure. This concept locates I-240 EB on a structure that crosses over I-26, with I-26 / I-240 WB crossing the French Broad River on a separate lower level structure. The benefits of this concept as shown in Figure 8 are that it:
    a. satisfies AASHTO minimum required radii (uses identical radius to those in the NCDOT alternate),
    b. preserves the intent of the double deck structure by minimizing the structural footprint, and
    c. enhances the ability to explore structural forms (structure depth, span length and pier shapes) that are less visually intrusive.

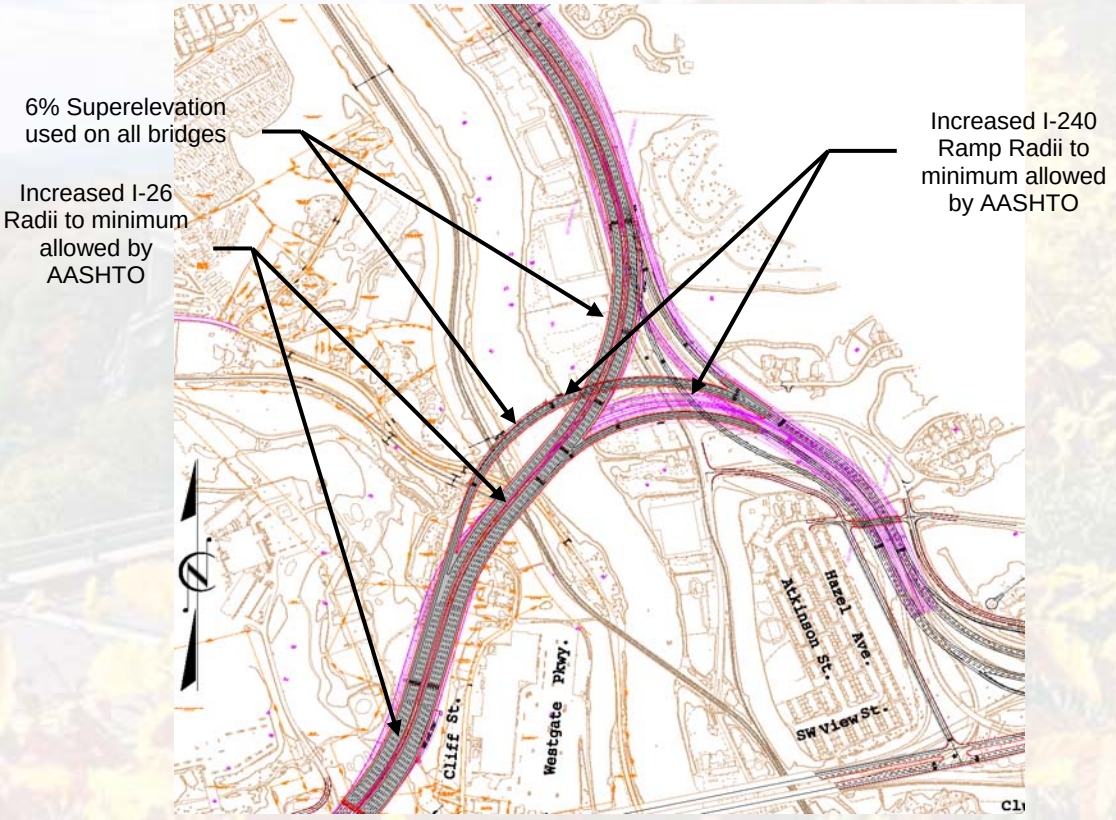


Figure 8 – Alternative 4B Revised French Broad River Crossing Concept

3. **Merger of I-26 with US 19-23**. The initial review of merging I-26 with US 19-23 focused on developing a concept that satisfies the super-elevation design criteria for structures (6% maximum) and is within the environmental and horizontal clearance constraints identified by NCDOT. The concept as presented in Figure 9 extends the I-26 structure through the horizontally constrained areas until the available right-of-away allows the structure to transition back down to grade. In this concept, the I-26 NB structure is elevated along the existing US 19-23 median; and the I-26 SB structure is elevated along the area between US 19-23 SB and Riverside Drive. The benefits of this concept are that it:
    a. Reduces and possibly eliminates the need for additional right-of-way.
    b. Eliminates impacts to the historic cemetery and railroad right-of-way.
    c. Provides the opportunity to minimize retaining walls.
    d. Preserves possible use of existing shoulders as temporary traffic lanes for maintenance of traffic during construction.
    e. Prevents the need to relocate Riverside Drive and the railroad spur.
    f. Serves as an attractive horizontal buffer to noise from vehicles on the US 19-23 roadways below the new elevated deck with the wide wings of the box girder structure.

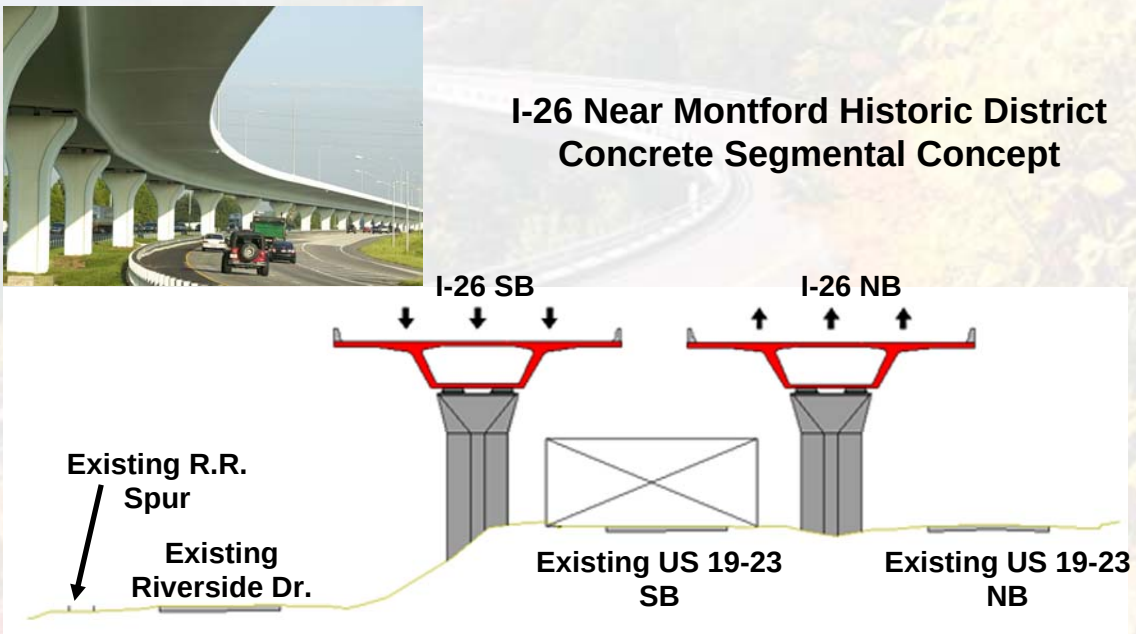


Figure 9 – Alternative 4B I-26 Merger with US 19-23 Concept

4. **Patton Avenue / I-26 Interchange**. The I-26 and Patton Avenue interchange review focused on developing a concept that satisfies several operational concerns identified by NCDOT. The concept shown in Figure 10 was developed to provide an additional connection for Regent Park and Holiday Inn Drive. This also accommodates a triple left turn on the I-240 EB exit loop to Patton as a means of addressing the queue storage needs identified by NCDOT. A triple left turn as shown in this concept is not an uncommon design element to NCDOT and is currently being considered by NCDOT for other projects in the state.

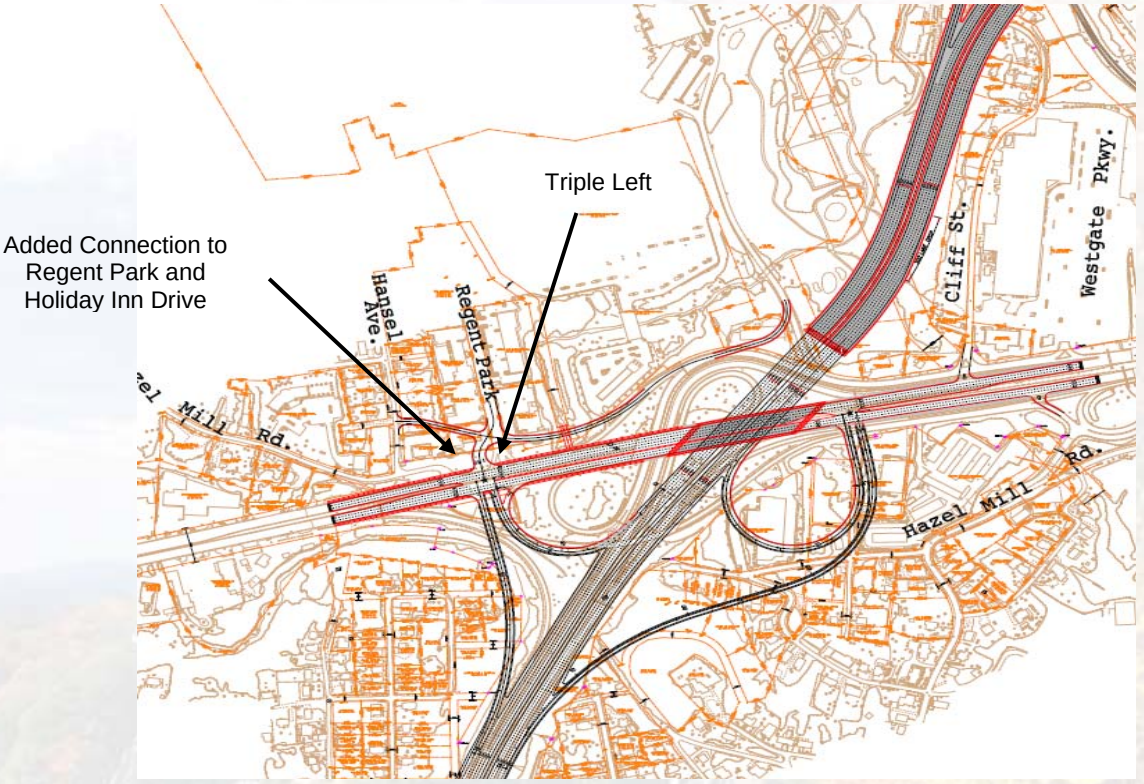


Figure 10 – Alternative 4B Patton Avenue Interchange

5. **Patton Avenue / Hill Street / I-240 Interchange**. The Patton Avenue / Hill Street / I-240 interchange was reviewed to address several NCDOT operational concerns associated primarily with traffic storage at the Hill Street. Our analysis indicated it is difficult to add an interchange with Hill Street due to the close proximity of the Montford Avenue Interchange. A possible improvement was proposed by adding a service road to connect Hill Street with Patton Avenue and Riverside Drive as shown in Figure 11. Another option was presented which added a connection between Hillard Street and Patton Avenue along with connecting Patton Avenue and I-240 EB as shown in Figure 12. The City, County and ADC advised that the first option was more consistent with the objectives of converting Patton Avenue into a future boulevard.

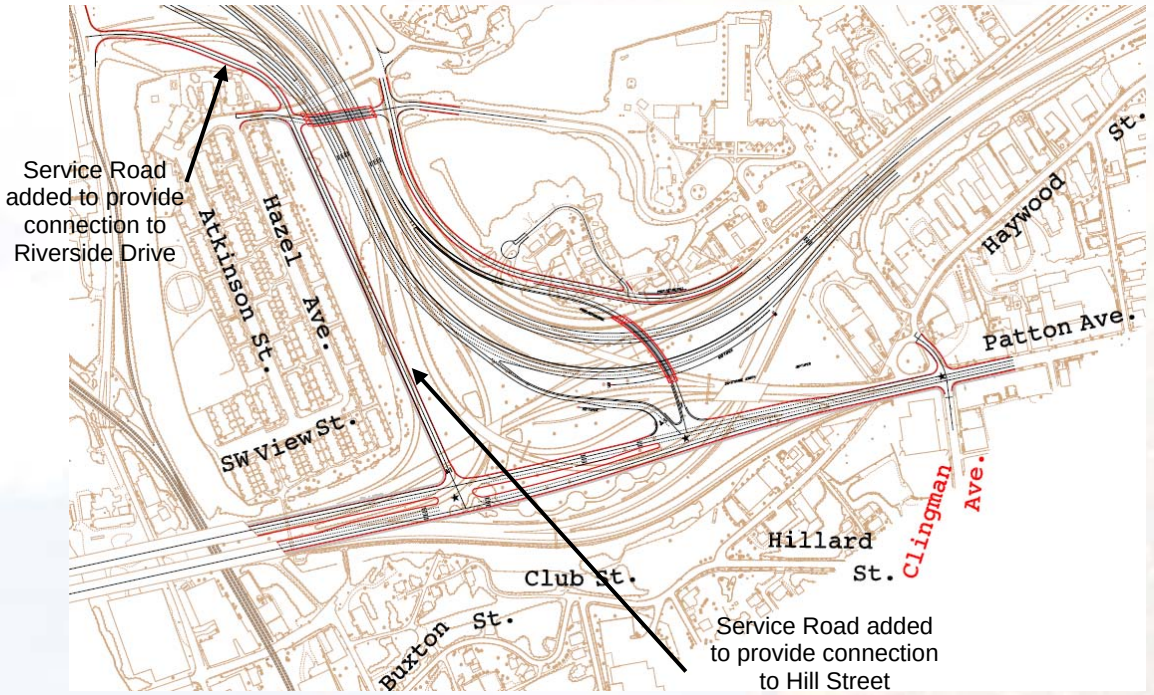


Figure 11 – Alternative 4B Patton Avenue I-240 Access

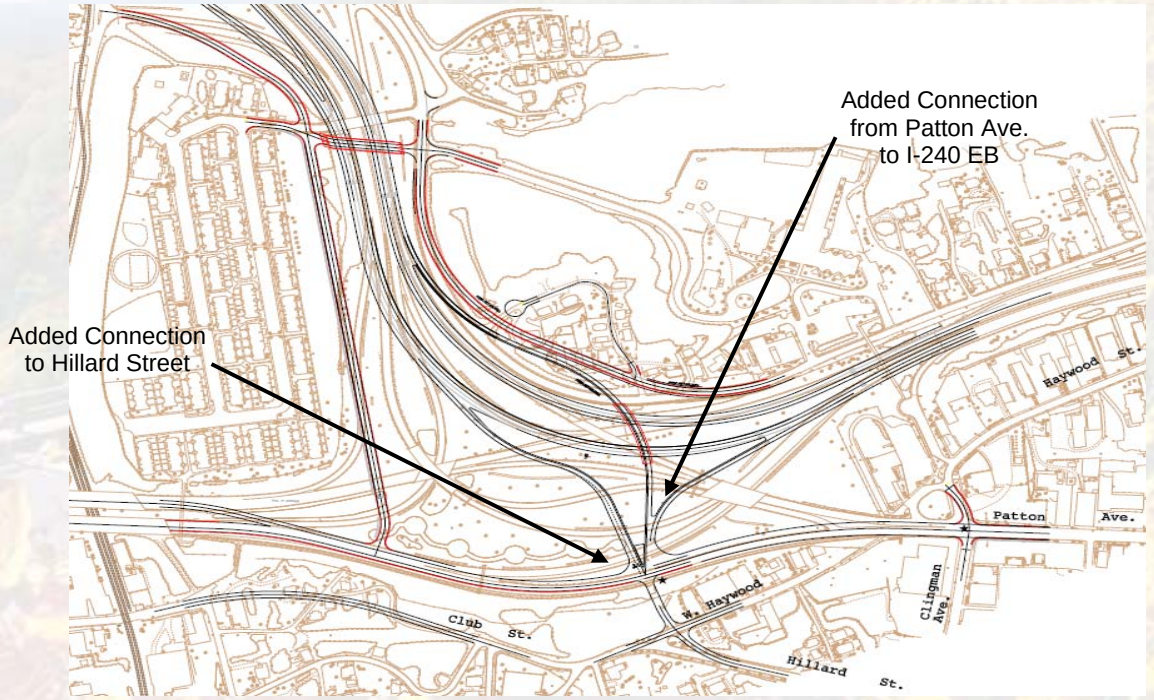


Figure 12 – Alternative 4B Patton Avenue I-240 Access Option

The impact of all these proposed revisions to the original ADC alternative are illustrated by superimposing the revised alignment over the initial 4B alternate, as shown in Figure 13. This illustrates that the proposed revisions will achieve the ADC goals for maintaining a small footprint and preserving the ability to integrate a signature bridge into the final configuration.

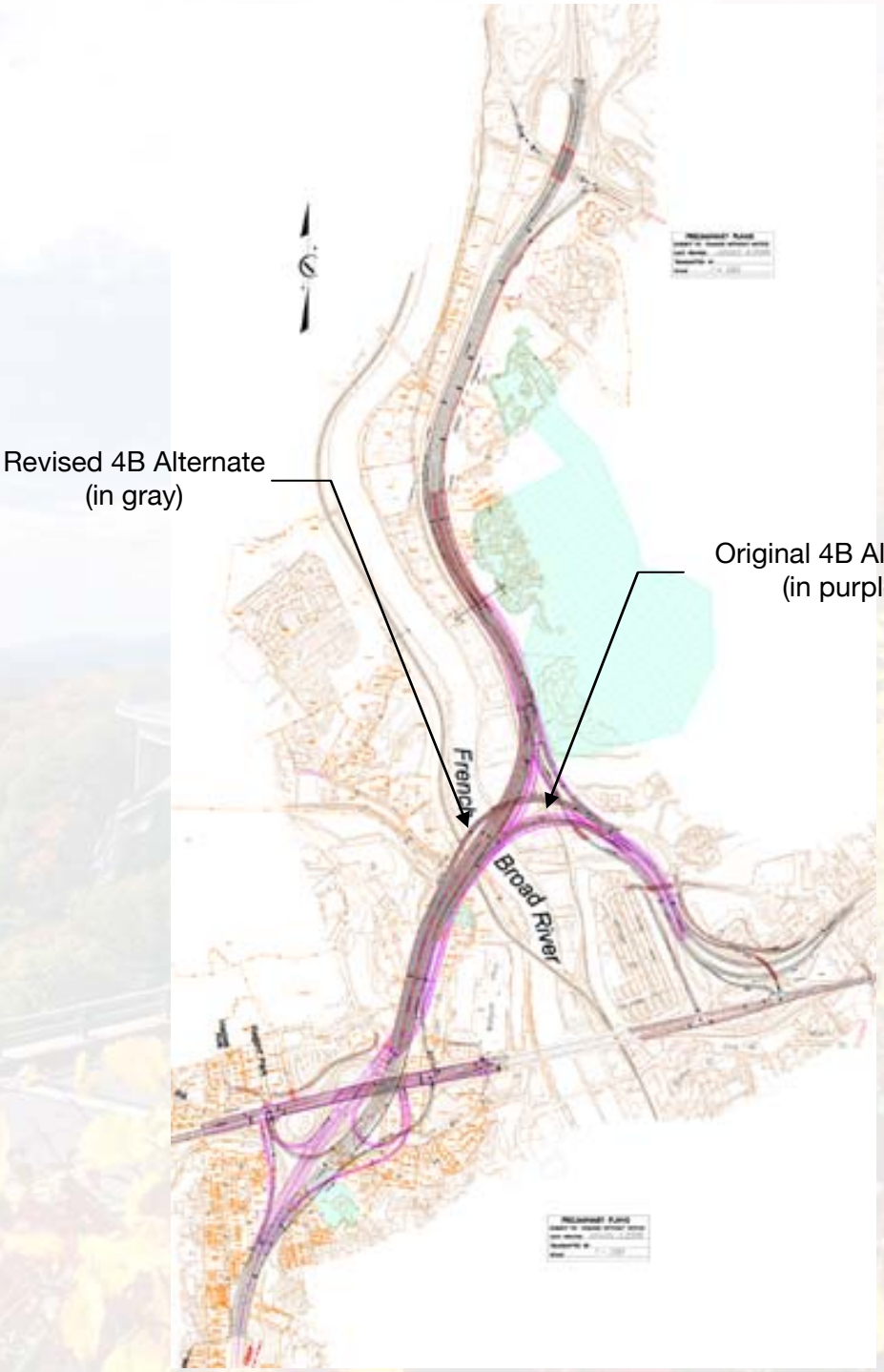


Figure 13 – Superimposition of Original and Revised 4B Alternates
(see appendix for 11" X 17" print)

The efforts following the initial recommendations and feedback from the CA/BC and ADC were directed towards completing the Alternative 4B traffic capacity analysis for the I-26 / Patton Avenue interchange and developing vertical profiles for the horizontal alignment concepts that were presented at the meeting.

After the initial proposed improvements were discussed with the CA/BC and ADC and as the review continued, a progress meeting was scheduled with the NCDOT. This allowed our team to maintain constant coordination and communication with all the stakeholders during the review process. This also marks the beginning of an iterative process of sharing concepts between the CA/BC/ADC, NCDOT and FHWA to determine an acceptable Alternative 4B alignment for all the parties involved with this process.

December 11, 2007 Meeting

The subsequent meeting on Tuesday morning, December 11, 2007 was performed at the North Carolina Department of Transportation (NCDOT) Century Building in Raleigh. The NCDOT was updated on the status of the ADC Alternate 4B review along with a discussion regarding possible improvements that have been identified and discussed with the City of Asheville, Buncombe County, and the Asheville Design Center.

Appendix H contains a copy of the minutes and attendees sign-in sheet associated with the communications at this meeting.

Discussions focused on five key areas that the review team had shared with the CA/BC and ADC:

1. I-240 WB Exit Loop to Patton Avenue
2. I-240 EB Exit Ramp to Patton Avenue
3. Double Deck Structure Concept over the French Broad River
4. I-26 Merger with US 19-23 (Montford Historic District)
5. Hill Street / Patton Avenue / I-240 interchange

The FIGG Team presented in detail the proposed improvements and received the following summary of primary responses from NCDOT:

1. **I-240 WB Exit Loop to Patton Avenue**. NCDOT noted that all movements need to be at a minimum level of service “D”.

2. **I-240 EB Exit Ramp to Patton Avenue**. The FIGG Team was evaluating the possibility of revising the I-240 EB Entrance Loop to shift the I-240 EB Exit Ramp further west and minimize or eliminate impacts on the C.G. Worley House Historic Property.

3. **Double Deck Structure Concept over the French Broad River**. NCDOT noted that if the concept to replace the double deck structure concept is advanced and a gore area is located over the French Broad River, then pier placement and orientation will need to consider any skew with respect to the river hydraulics.

   NCDOT raised concerns about the gore area for I-26 NB and I-240 EB being located on a bridge. The concern was with excessive rollover between the two

alignments since I-26 curves to the left with a 6% super and I-240 EB curves to the right with a 6% super. NCDOT was also concerned about having the super elevation reach 0% on the bridge.

4. **I-26 Merger with US 19-23 (Montford Historic District)**. NCDOT noted that they prefer a 0.5% minimum longitudinal grade on structures and that design termini for alternate 4B should remain consistent with NCDOT's other alternatives.

   FIGG/LOCHNER stated that the bridge limits along US 19-23 were estimates only to show conceptual location, and recommend that a detailed study during final design be completed to determine the actual bridge limits.

5. **Hill Street / Patton Avenue / I-240 interchange**. NCDOT suggested that it may be beneficial to extend the I-240 bridges past Hill Street. In this manner, Hill Street will go under the bridges and prevent an excessive steep grade on the relocated Hill Street connection, as currently proposed.

In addition, the FIGG Team also discussed with NCDOT the following two optional horizontal alignments that were under consideration to address the footprint over the Freeman House and horizontal curvature design criteria requirements.

1. The first optional alignment as shown in Figure 14 is primarily a tangent section on the west side of the river with horizontal curves used to cross the French Broad River and merge into the elevated structure on the east side of the river. It was developed subsequent to the meeting with the CA/BC/ADC on November 30, 2007 and prior to this meeting with the NCDOT. The radii for this alignment were selected on the basis of using the 8% super-elevation charts, a minimum radius of 2,320 ft., which provides for a 6% super-elevation at 60 mph.

2. The second optional alternative as shown in Figure 15 is a variation of the first option. This option is characterized primarily as a series of horizontal curves intended to minimize impacts to the Smith Mill Creek and Freeman House historic properties west of the river and merge into the elevated structure on the east side of the river. The radii on this alignment were selected on the basis of those used on other NCDOT alternatives, which appear to be based on the 6% super-elevation chart. This is the same alignment that was presented to the CA/BC/ADC during the November, 30, 2007 progress meeting.

   While meeting with NCDOT, the FIGG Team requested clarification on the use of the 6% and 8% super-elevation charts for the I-26 mainline. NCDOT stated that the 6% super-elevation charts (tighter radius) would be allowed for sections of I-26 that are located on a bridge.

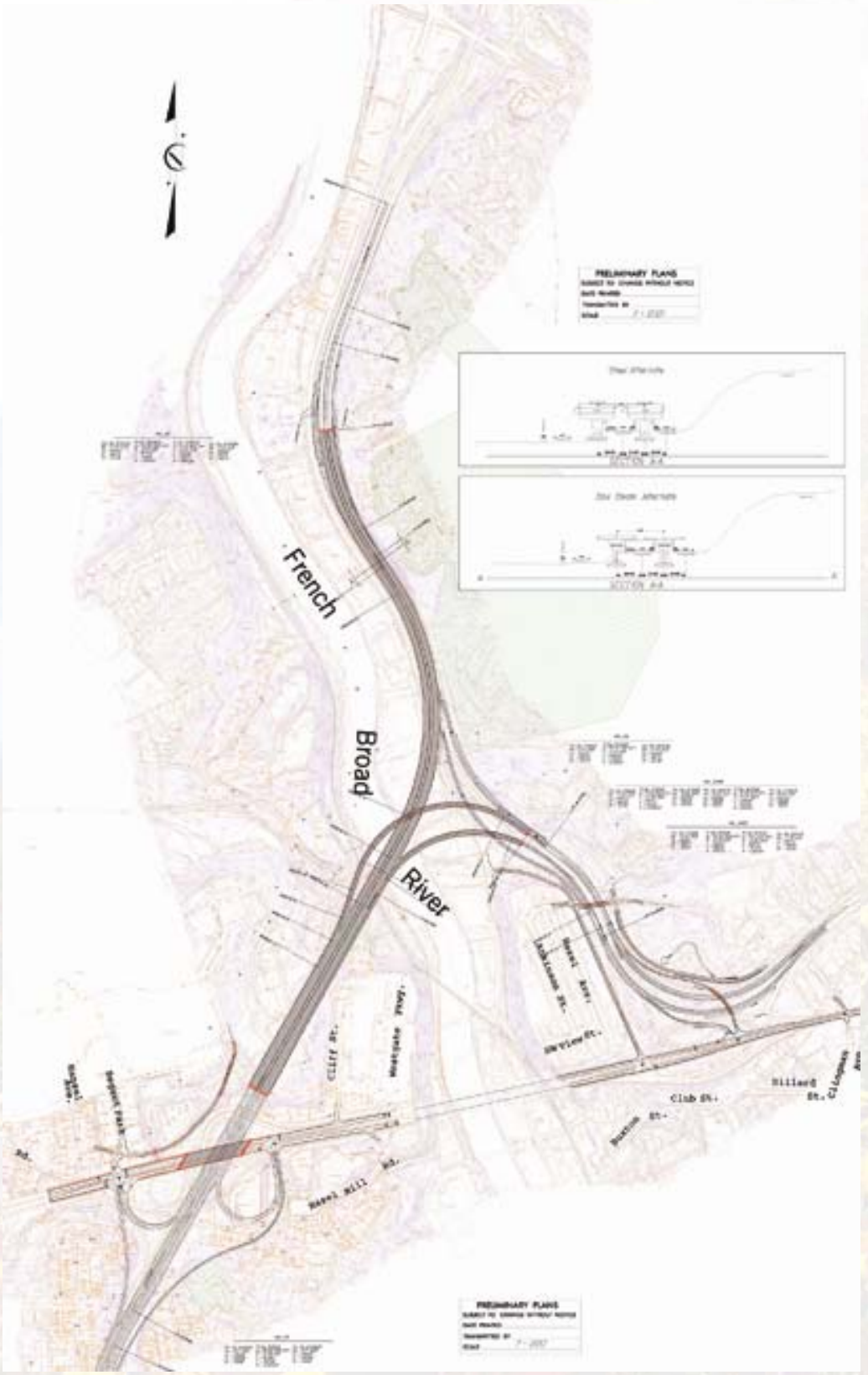


Figure 14 – Alternative 4B Alignment Option 1
(see appendix for 11” X 17” print)

Figure 15 – Alternative 4B Alignment Option 2
(see appendix for 11” X 17” print)

NCDOT also offered the following comments regarding their constructibility considerations with these options:

- maintain traffic on the existing Patton Avenue and I-240 Interchange during construction.
- address the significant cut on the I-240 EB Exit Ramp to Patton Avenue.
- contact and discuss with Norfolk Southern about the elevated alignments over the Norfolk Southern Bridge spanning the Smith Mill Creek Bridge.
- address traffic control during construction of the elevated structure over US 19-23.

NCDOT indicated that these construction sequence comments are important; however, they will only need to be addressed later during the functional plan development phase.

December 19, 2007 Teleconference Meeting

The CA/BC and ADC were updated during this teleconference regarding the outcome of the December 11, 2007 progress meeting with NCDOT. A copy of the minutes from this meeting can be found in Appendix H.

After summarizing the December 11, 2007 meeting with the NCDOT, the following discussions proceeded with the CA/BC and ADC.

It was noted that Option 2, as previously shown in Figure 15, provided a larger footprint over the Freeman House historic property than Option 1 and both Options 1 and 2 have a larger footprint over the Freeman House Historic Property than NCDOT Alternate 4.

Based on the outcome of discussions during the December 11, 2007 meeting with NCDOT regarding the two options presented to address horizontal curvature and impacts to the Freeman House historic property, the FIGG Team developed a third conceptual alignment for consideration of the CA/BC and ADC. This third adjusted alignment as shown in Figure 16 is similar to Option 1 with a tangent section west of the river and a horizontal curve used to cross the French Broad River and tie into US 19-23. However, this Option 3 alignment is shifted west to avoid the Freeman House property completely. This concept was developed to achieve two distinct advantages over the NCDOT alternates. First, it eliminates all impacts to the Freeman House historic property. Secondly, the horizontal curvature is in accordance with the most stringent interpretation of AASHTO (8% super-elevation charts). The footprint of Option 3 does extend over the commercial properties on the east side of the river and is significantly larger than Option 1 and Option 2.

Figure 16 – Alternative 4B Alignment Option 3
(see appendix for 11” X 17” print)

After reviewing these three options, the CA/BC and ADC offered the following comments:

1. **Option 1**. The CA/BC and ADC had previously looked at a similar tangent alignment west of the river and NCDOT had advised them that it may not satisfy constructibility. This option also has a larger footprint over the Freeman House Historic Property.
2. **Option 2 (preferred alternate)**. It is consistent with their objectives by minimizing the footprint on the waterfront properties and is anticipated to have the most public support.
3. **Option 3**. This alignment does provide technical and environmental advantages over NCDOT alternates; however, most of the commercial business properties on the east side of the river are affected. Minimal public support for this alternate is expected.

The FIGG Team also noted that they had received the Norfolk Southern contact information from NCDOT, and FIGG initiated communications with the Norfolk Southern Railroad. A request was made for any policies and criteria regarding construction of highway bridges directly over their railroad structures in North Carolina.

During this teleconference, the CA/BC requested that the FIGG Team provide a progress update for the Asheville City Council and representatives from Buncombe County in January 2008. It was agreed that another progress meeting with the NCDOT should be scheduled prior to the briefing meetings with the City of Asheville and Buncombe County.

January 4, 2008 Meeting

On the afternoon of Friday, January 4, 2008 a progress meeting was held at the City of Asheville 6th Floor Conference Room with the CA/BC, ADC and NCDOT. A copy of the minutes and attendees sign-in sheet is provided in Appendix H.

The City of Asheville noted that they had scheduled an I-26 Alternate 4B Study progress update to be delivered at the next Asheville City Council meeting on the evening of January 15, 2008. The City of Asheville also agreed to submit the study of the Asheville Design Center (ADC) I-26 Alternate 4B to NCDOT on January 18, 2008. NCDOT requested that the following material be included in the January 18, 2008 submittal for them to determine the feasibility of including Alternate 4B in their Environmental Study Documents:

1. **Functionality** – include slope limits, grades, capacity analysis and a staging plan for the project. Construction staging needs to specifically address construction of the Patton Avenue interchange and I-26 elevated portion over US 19-23.

2. **Standards and Movements** – demonstrate that the alternate satisfies the project design standards and movements.

The NCDOT indicated that they will need 2 months from the time the study is submitted to complete their review and determine if the ADC revised alternate is feasible to include as one of the Environmental Study feasible alternatives. NCDOT is currently

working on the other alternates and suggested reviewing Alternate 4B concurrently. They suggested accommodating the schedule by including Alternate 4B as a supplement to the Draft Environmental document. However, NCDOT needed consent from FHWA to pursue a supplement to the Environmental Study process. The NCDOT also indicated that they did not need cost estimates to commence their review. They would need a rough cost estimate later in the review process. Since Alternate 4B incorporates portions of Alternate 4, it was agreed that the NCDOT would provide the breakdown of those quantities common to both alternates. Selection of the preferred alternate is done by a large group of stakeholders that considers in aggregate the environmental impact of the overall project and not just the effect on historic properties. Community support is an important consideration when selecting the preferred alternate.

Based on the alternate versions they had seen to date, NCDOT provided the following advanced comments:

- The mainline grade at Patton Avenue is approximately 30' below the loop. The construction staging needs to address construction sequence in this area.

- During construction of the elevated portion of I-26 over US 19-23, the solution needs to maintain two lanes open in each direction with an allowance from 8 pm to 6 am for some traffic control.

- No major concerns with triple left turn on the Patton Avenue Loop, pending further review.

- Traffic analysis needs to consider existing traffic conditions outside of the project limits and prevent creating capacity concerns.

January 15, 2008 Meeting

A PowerPoint presentation was provided by FIGG to representatives from Buncombe County and at the Asheville City Council meeting on January 15, 2008. A copy of this presentation is provided in Appendix C.

D. Final Plan Development (Schematic Solutions)

This phase commenced after the January 18, 2008 Revised Alternate 4B submittal to the NCDOT. At this stage in the process, improvements to Alternate 4B had been identified and incorporated with approval from the CA/BC and ADC. Progress meetings were held with NCDOT to update them on the review and various improvements that were considered and adopted, including adjustments based on NCDOT input up to this date.

However, the NCDOT had noted that their formal review did not begin until the requested information was submitted on January 18, 2008. During this period of the formal review process, comments were received from the NCDOT and resolved with NCDOT input while also coordinating with the CA/BC and ADC. This led ultimately to a notification from NCDOT at a progress meeting in the Raleigh NCDOT headquarter offices on June 20, 2008 that they had not found any fatal flaws and the NCDOT would move forward with incorporating the revised Alternate 4B into their environmental process.

The following timeline of communications outlines the evolution of additional adjustments to the revised ADC Alternative 4B alignment as submitted on January 18, 2008 that were triggered by comments from the NCDOT through their formal review.

January 22, 2008 Meeting

To discuss the review process, review assignments, schedule and materials submitted by the FIGG Team, a meeting was held on January 22, 2008 at the NCDOT Highway Building in Raleigh. A copy of the minutes and attendees sign-in sheet is provided in Appendix H.

The NCDOT project team started their review of the ADC modified Alternative 4B concept with a focus on identifying any fatal flaws. The review assignments for the NCDOT project team members were as follows:

- Engineering Plan review – Roadway Design Unit, Structures Unit and TGS (primary), Division Office and URS (secondary)
- Capacity Analysis – URS
- Construction Staging – Work Zone Traffic Control Unit
- Environmental Impacts – TGS and URS

Issues discovered during the review process were brought directly to the attention of the FIGG Team through NCDOT staff. NCDOT agreed to complete the review by February 22, 2008.

The goal of this review was to determine if the ADC Alternate 4B was a feasible alternative. If it was identified as a viable alternative, then it would be adopted as a project alternative eligible for further detailed study by NCDOT prior to a LEDPA decision.

The concept alternative review package as provided by the FIGG Team in the January 18, 2008 submittal (see Appendix D) included:

- Plan, profiles and cross sections
- Construction staging plans (These represent the FIGG Team's proposed initial construction schedule for the modified Alternate 4B.)
- Compact disc containing the above and a capacity analysis

January 22 through March 13, 2008 Progress

As the NCDOT team proceeded with their review, both formal and informal meetings were held to discuss comments and possible solutions. Many informal communications occurred in the spirit of partnering between the FIGG Team and NCDOT staff to fine-tune the alignment characteristics during the course of the NCDOT review. This interaction with the NCDOT led to the March 13, 2008 comment resolution meeting.

March 13, 2008 Meeting

The first formal comment resolution meeting was held on March 13, 2008, at the NCDOT Highway Building in Raleigh. The purpose of the meeting was to discuss and resolve review comments related to the operational and design issues identified by the NCDOT Roadway Design Unit in their review of the FIGG Team functional designs of the ADC modified conceptual alternative.

The main review comments that were discussed are:

- The two lane collector/distributor for I-26 northbound to I-240 eastbound was considered a left hand exit
- Elimination of a movement at the interchange west of the French Broad River where eastbound Patton Avenue traffic would cross the river west (north) on I-26
- Concerns with the operation of braided ramps that they considered to conflict with driver expectation (i.e. exit right to go left)
- Concerns with route continuity

NCDOT noted that they had not checked the design in detail because they identified these primary issues for resolution before proceeding with a full review of the plans.

During the meeting, several options were discussed as possibilities for resolving these concerns:

- The simplest solution to the braided ramps concern is to include a loop in the southeast quadrant of the interchange, west of the river. TGS and NCDOT stated that it had been considered in the past and had proven difficult to resolve along with concerns about truck rollovers on the tight radius loop. Adding a loop would also significantly impact neighborhoods, businesses and a historic property. This would conflict with objectives of the City and ADC to minimize the project footprint.

- None of the NCDOT alternatives provide all movements at all interchanges, but the movement that would not be included from Patton Avenue eastbound to I-26 northbound with this Alternative 4B is considered a primary required movement by NCDOT and FHWA.

- NCDOT is concerned that their traffic forecast numbers are too low and a left turn movement on to I-26/I-240 from Patton Avenue will not accommodate the traffic.

- NCDOT was concerned with the length of the ramps before they split to I-26 and I-240 and stated that they felt a minimum of 1,000 feet was needed for decision making and to provide adequate signing.

- Discussion of traffic – Highway Capacity Software (HCS) used by the NCDOT representatives indicated that some weaving movements will work but HCS has anomalies in the analysis of complex traffic operations, so we should not rely on HCS alone. They may need to use micro simulation for evaluating traffic operations.

- The sag on the bridge for the braided ramp option is not acceptable.

- In addition to the initial review comments focused on operations, the NCDOT also felt that concerns over constructibility and cost were not yet satisfied.

- I-240 was identified as a Collector/Distributor (C/D) on the ADC alternative, but NCDOT considers it as the I-240 mainline. Thus NCDOT believes the I-26 northbound movement functions as a left hand exit.
- URS, as a consultant working for NCDOT, also mentioned that there were concerns with how the proposed triple lefts from Patton Avenue eastbound to I-26/I-240 west (south) bound would be accommodated relative to the location of the Haywood Street interchange. The weaving section and lane drops would be an important issue relative to maintaining access to Haywood Street.

To resolve these concerns, the following course of action was agreed to:

- The FIGG Team will further address three potential solutions:
    - Braided ramp (also removing the sag on the bridge)
    - Add a loop to the interchange west of the river in the southeast quadrant
    - Provide the Patton Avenue EB to I-26 NB movement east of the river.

- After the FIGG Team revised and resubmitted the alternative, NCDOT would conduct a full review of the alternative.

March 13 through April 16, 2008 Progress

After evaluating the three potential solutions discussed above during the comment resolution meeting of March 13, 2008, it was determined by the FIGG Team that the best solution was the braided ramp option. This solution consisted of:

- Adding a second lane to I-240 EB (2 lane C/D)
- Using a braided ramp to eliminate the left hand exit for driver on Ramp D intending to continue north on I-26.

This new revised Alignment 4B (see Figure 17) was submitted to the NCDOT on March, 28, 2008 for their continued review.

Concurrent with development of the braided ramp option, the FIGG Team also prepared responses to constructibility comments that were received on April 9, 2008 from the Traffic Control Project Engineer and Division 13 Construction Engineer. On April 9, 2008 the FIGG Team provided responses to the construction comments received. See Appendix E for a copy of the construction comments and associated responses.

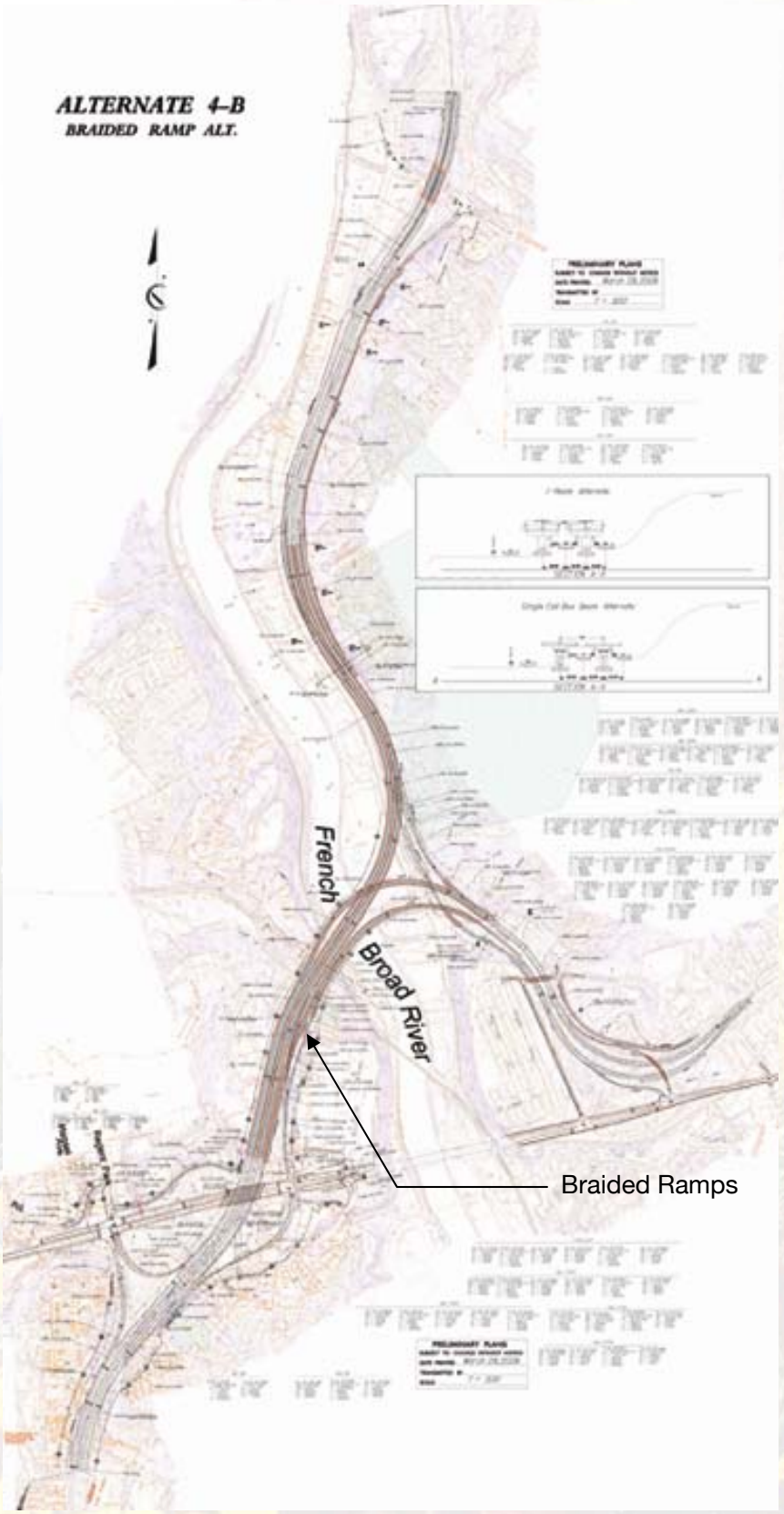


Figure 17 – Alternative 4B Braided Ramp Concept
(see appendix for 11" X 17" print)

April 16, 2008 Meeting

In order to discuss review comments on the revised horizontal alignment of the Alternate 4B (braided ramp option) that was submitted on March 28, 2008 and constructibility comments responses submitted on April 9, 2008, a second comment resolution meeting was held on the morning of April 16, 2008 at the NCDOT Century Center in Raleigh. A copy of the minutes and list of attendees from the meeting is provided in Appendix H. Review comments were provided by the following NCDOT representatives:

- NCDOT Roadway Section – Design Review
- TGS – Design Review
- URS – Capacity Analysis
- NCDOT Congestion Management Section – Traffic Operations Review
- NCDOT Eastern Work Zone Traffic Control Region and Highway Division 13 – Construction Phasing and Constructibility
- NCDOT Bridge Section – Structures Review (via handout)
- TGS – Environmental Impact Review

On the basis of the review comments presented during this meeting, the following course of action was agreed to by NCDOT and the FIGG Team:

- The FIGG Team would address and provide responses to major comments from NCDOT within two weeks. Major concerns included the following:
    1. Operation of the I-26 EB/I-240 WB weaving movement between Patton Avenue and Haywood Street and Patton Avenue westbound triple lefts to I-26 EB/I-240 WB.
    2. Remove the Hazel Mill intersection and terminate with a cul-de-sac. Then check if Patton Avenue/Loop B intersection will operate at an acceptable LOS. NCDOT also noted a concern with the cycle length used in the provided analysis, given that the adjacent signalized intersections may control.
    3. With the removal of Hazel Mill intersection, the FIGG Team will re-analyze the Patton Avenue and Regent Park Boulevard/Loop B intersection.
    4. Evaluate the gore width for the I-240/I-26 split.
    5. Investigate the rollover issue with the US 19-23-70 NB diverging traffic from I-240.
- Forward vertical clearance correspondence with Norfolk Southern Railroad to Vince Rhea and Lonnie Brooks (see Appendix G).
- Provide Mr. Brooks with a copy of the preliminary pier location plans.

The NCDOT indicated that, until their most recent comments were addressed, there would not be any further consideration of Alternate 4B as a feasible alternative. It was agreed that the remainder of comments that NCDOT had generated to date were less serious in nature and could be addressed in the preliminary design phase of Alternative 4B if these major comments could be resolved to the satisfaction of NCDOT.

April 16 through June 20, 2008 Progress

After evaluating and studying these additional review comments from NCDOT, and in an effort to determine a version of the alternative that would be acceptable to the

NCDOT, the FIGG Team revised the alternative to address the comments discussed during the April 16, 2008 meeting.

The primary revisions to the Alternative 4B (braided option) as presented during the April 16, 2008 meeting, consisted of locating the I-26 new alignment over Patton Avenue. The primary consideration for this modification was to use the existing I-240 WB and I-26 EB ramp (Ramp DB) as the means for providing free flowing traffic from west bound Patton Avenue onto I-26 SB without triple lefts at the Regent Park intersection traffic signal.

This resulted from a previous NCDOT position that west bound Patton Avenue traffic required a means for accessing I-26 SB at a location near the Regent Park intersection traffic signal rather than only using the I-240 WB to I-26 SB ramp connection. As a result of including this traffic connection for west bound Patton Avenue traffic at this intersection, the projected volume of traffic moving through this signal was larger than could be accommodated to achieve an acceptable Level of Service with only two lanes. The solution was to use triple left turn lanes from west bound Patton Avenue onto Ramp B for merging onto I-26 SB. This presented a difficult scenario for reducing the number of lanes on the ramp from three to one before the next interchange at Haywood Street, thus resulting in an unacceptable weaving condition on I-26 SB.

Locating the new I-26 alignment over Patton Avenue also avoids a complex on-site detour for Patton Ave. since the existing bridge on Patton Ave over the ramps to I-26/240 can remain in place during construction. This would eliminate the numerous and expensive construction staging phases that would otherwise be necessary to perform the earthwork cuts where I-26 would pass under Patton Avenue.

The following modifications were also incorporated into the I-26 over Patton Avenue revision to further address other NCDOT comments:

- Eliminate the triple left on Patton Avenue WB accessing I-26 SB by preserving the existing I-240 WB and I-26 EB ramp (Ramp DB).
- Add Ramp B for Patton Avenue EB traffic accessing I-26 SB.

This newest revised alignment as shown in Figure 18 that addressed the NCDOT comments from the April 16, 2008 meeting was discussed with the City of Asheville and the ADC and subsequently submitted to NCDOT for their continued review on May 27, 2008.

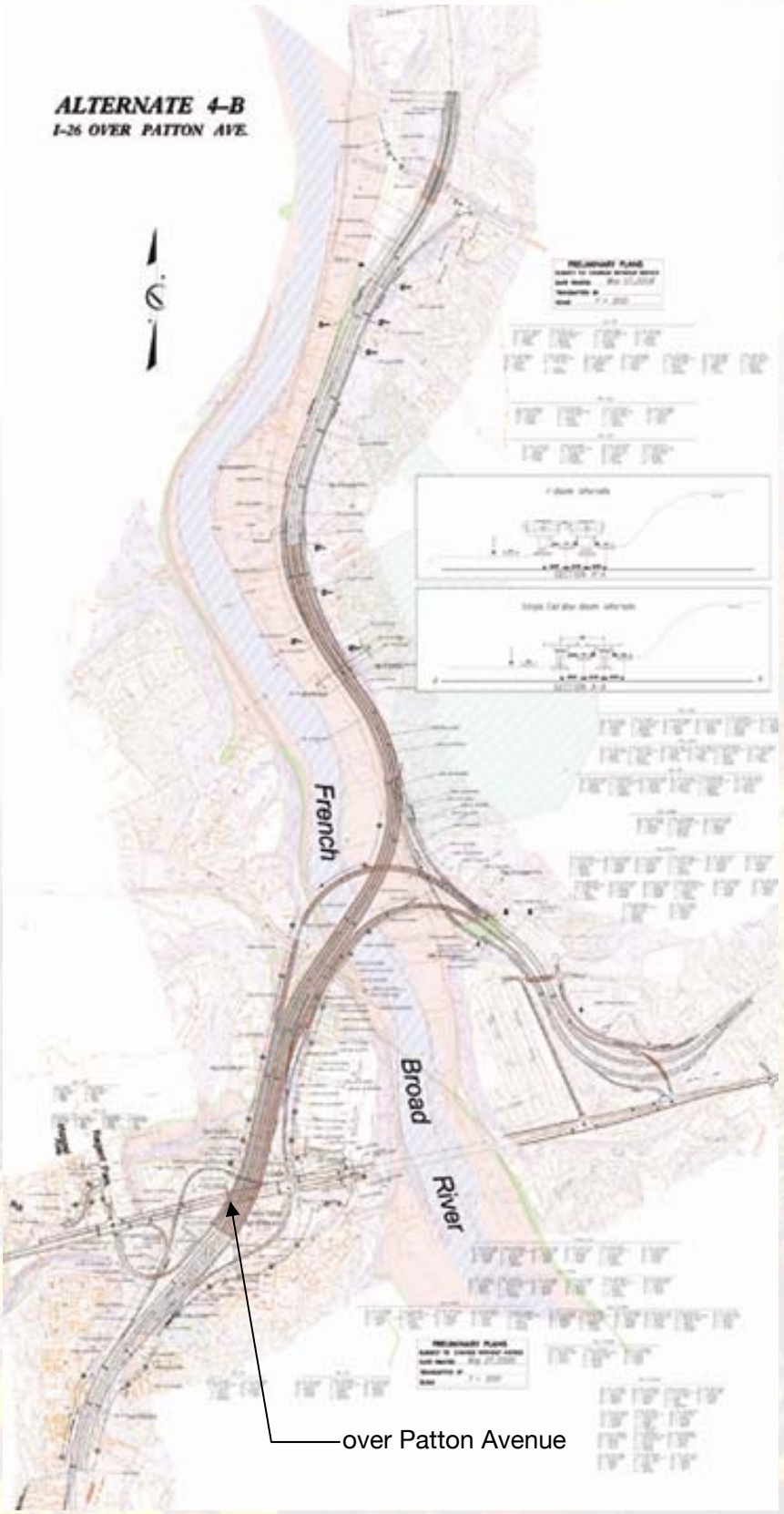


Figure 18 – Alternative 4B I-26 over Patton Avenue Concept (see appendix for 11" X 17" print)

June 20, 2008 Meeting

The review comments on the revised Alternative 4B were discussed during a resolution meeting on Friday, June 20, 2008 at the NCDOT Transportation Building in Raleigh. For a copy of the minutes and list of attendees refer to Appendix H.

Review comments that had been submitted from various NCDOT branches, TGS and URS were discussed at this meeting. The review comments were provided by:

- NCDOT Roadway Design Unit
- NCDOT Congestion Management
- NCDOT Structure Design Unit
- URS
- TGS
- NCDOT Work Zone Traffic Control and Division 13 Construction

After discussing the review comments, NCDOT noted that no fatal flaws had been identified with the concept as shown in Figure 18, and NCDOT would proceed with this alternative into preliminary design for inclusion in the NEPA process. NCDOT also noted that this alternative would be presented as a Corridor Hearing/Public Workshop map.

It was also agreed that the Quantity Estimates would be done by the FIGG Team and these quantities would be used by NCDOT to develop the Cost Estimates for this Alternative 4B.

August 15, 2008 Submittal

As agreed during the June 20, 2008 meeting, the FIGG Team prepared and submitted the requested quantities on August 15, 2008 to the NCDOT. A copy of the submitted quantities for the approved Alignment 4B is provided in Appendix F.

It is noted that the original recommended adjustments to the ADC Alternate 4B includes the possibility for using an elevated segmental box girder structure type. This bridge type has provided value to previously completed FIGG bridges with minimal on-site construction time, reduced on-site construction staging requirements, less inconvenience to the traveling public during construction and cost savings from the economies of segmental construction. Given the estimated quantities that were submitted for Alternate 4B in combination with using a segmental box girder structure type, the estimated cost for Alternate 4B should be competitive with the costs estimated for Alternate 4.

SUMMARY

On November 2, 2007 the City of Asheville and Buncombe County (CA/BC) in conjunction with the Asheville Design Center (ADC) provided the FIGG Team notice to proceed with a feasibility study of the ADC proposed Alternative Alignment for the I-26 Connector in Asheville, North Carolina. The FIGG Team performed an analysis and proposed modifications to obtain NCDOT acceptance of the ADC proposed Alignment Alternative 4B for including in the NEPA Environmental Study as a feasible alternative. The goal of the CA/BC and ADC is to receive preferred alternative status for the proposed Alternative 4B.

The FIGG Team engaged in numerous formal and informal meetings with the NCDOT while also coordinating with the technical team representing the CA/BC and ADC throughout the study period that extended from October 2007 through August 2008. A summary listing of the formal meetings is provided in Table 1.

Through this partnering process the NCDOT has agreed to accept the Alternative 4B functional plans that were submitted on May 27, 2008 for continuing through Preliminary Design in the NEPA environmental study process. The next major milestone for Alternative 4B is inclusion in the NCDOT Corridor Hearing and Public Workshop.

Date	Purpose of Meeting
October 22, 2007	Kick-off meeting with CA/BC & ADC (Asheville)
November 30, 2007	Progress meeting with CA/BC & ADC (Asheville)
December 11, 2007	Progress meeting with NCDOT (Raleigh)
December 19, 2007	Progress teleconference with CA/BC & ADC
January 4, 2008	Progress meeting with CA/BC, ADC & NCDOT (Asheville)
January 15, 2008	Progress meeting with CA/BC, ADC & NCDOT (Asheville)
January 22, 2008	Coordination meeting with NCDOT (Raleigh)
February 28, 2008	Progress meeting with CA/BC & ADC (Asheville)
March 13, 2008	Progress meeting with NCDOT & FHWA (Raleigh)
April 16, 2008	Progress meeting with NCDOT (Raleigh)
June 20, 2008	Progress meeting with NCDOT & FHWA (Raleigh)
July 7, 2008	Status meeting with CA/BC & ADC (Asheville)
August 19, 2008	Status meeting with CA/BC, ADC & NCDOT (Asheville)
August 24, 2008	Rendering review meeting with ADC (Asheville)

Table 1 – Project Meeting Summary