



# WILDLIFE SHENANIGANS

Zane Pannell  
Michelle Hunt

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# History of the Great Smoky Mountains



1923

1936



# History of the Great Smoky Mountains



# Economic Benefits to the Region

- Great Smoky Mountains National Park creates **\$953 Million** in Economic Benefit
  - **11,421,203** visitors in 2018
  - Spending supported **13,737** jobs in the local area in 2018

# Partnerships

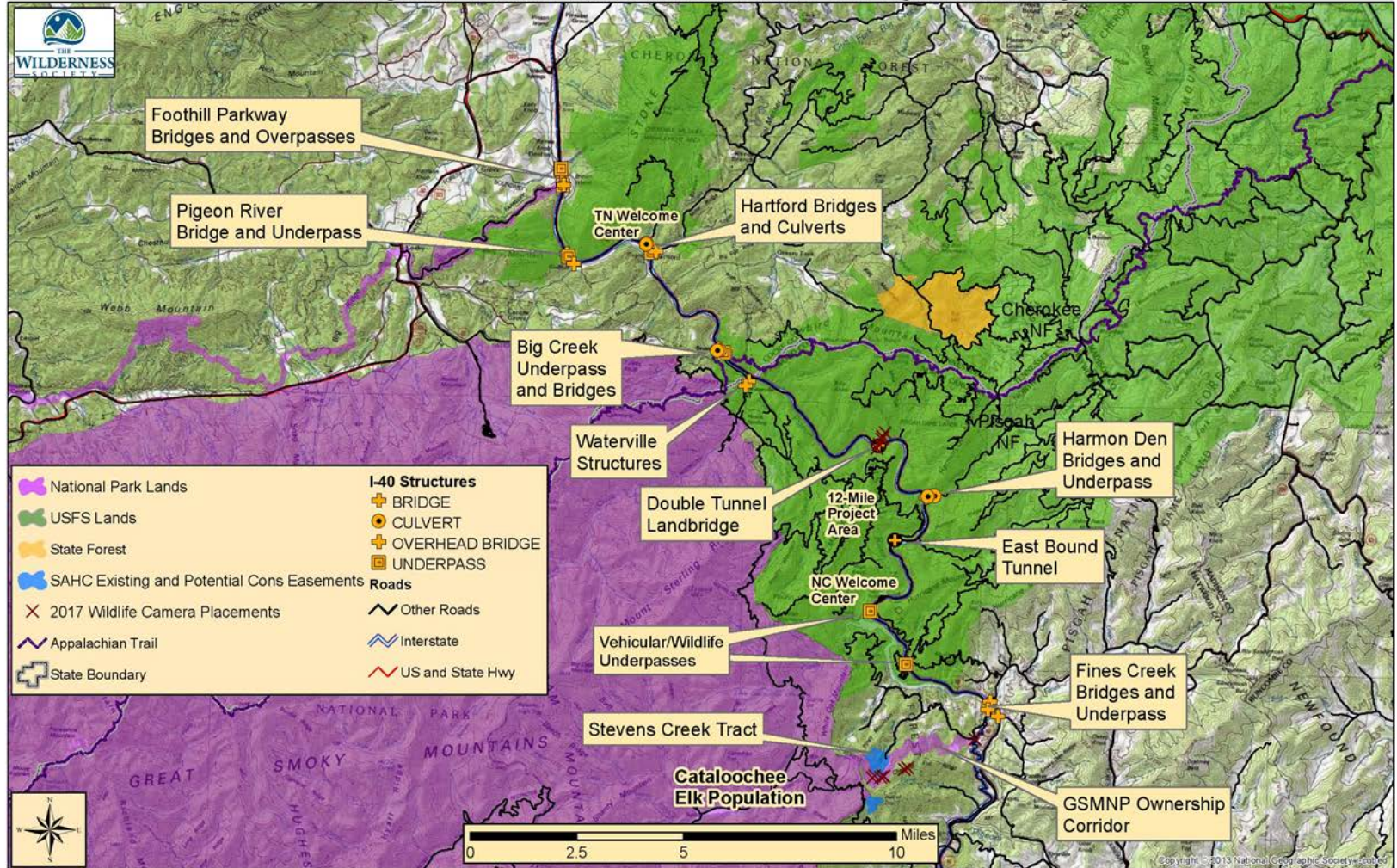


# Animal Mortality

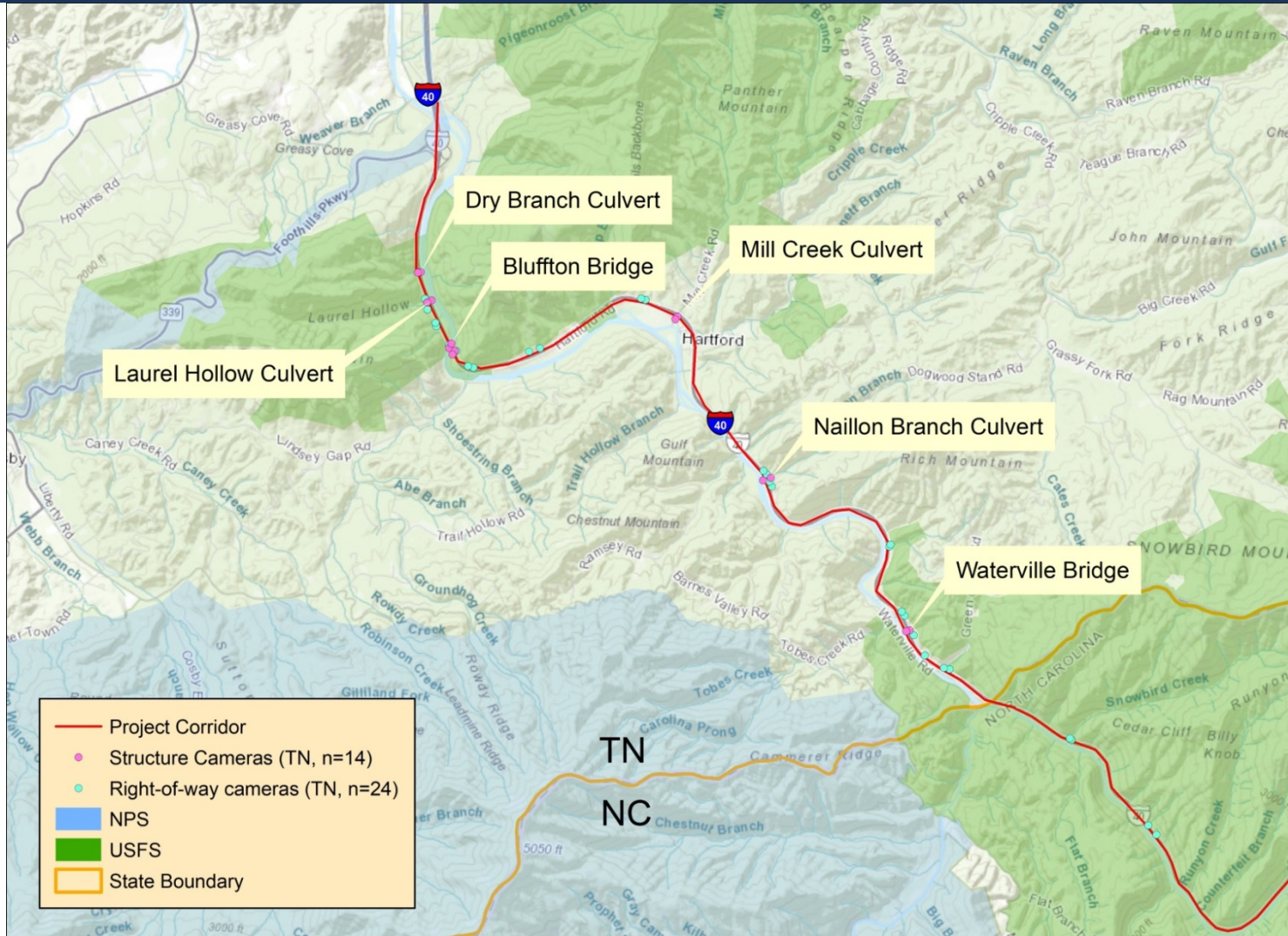
- I-40 From MM 440 (near Pigeon River) to the TN/NC State Line
- 16 recorded **deer** crashes (2014 to 2018)
- 1 recorded **coyote** crash (2014 to 2018)
- 19 recorded **bear** crashes (2014 to 2018)
  - All Property Damage Crashes
  - All occurred at **nighttime** between 7:30 PM and 4:00 AM
  - All but 4 bear crashes occurred in October, **November**, December
  - Area has the highest vehicle-bear collisions in the state
- Research states **2/3** of all vehicle-animal collisions are not recorded

# Project Area

Existing and Potential Wildlife Corridors Across I-40 in Pigeon River Gorge



# Camera Locations in Tennessee





# Camera Locations

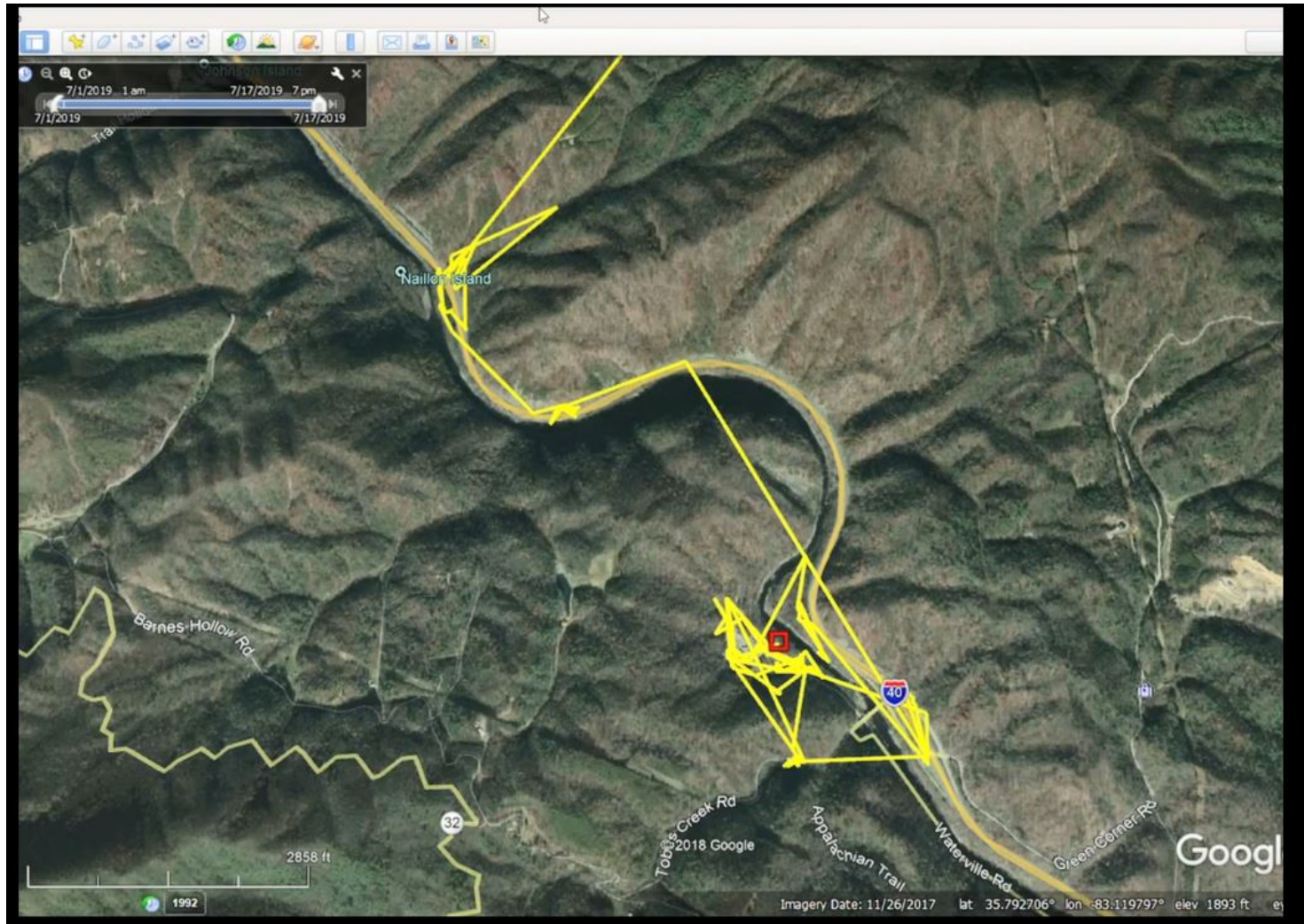
- Waterville Bridge



# Elk 216 and Calf at Waterville



# Elk 216 Collar Tracking



# Camera Locations

- Mill Creek Culvert



# Bear at Laurel Hollow



# Bear at Groundhog Creek



# Two Part Mitigation Strategy



+



# Species Specific Design



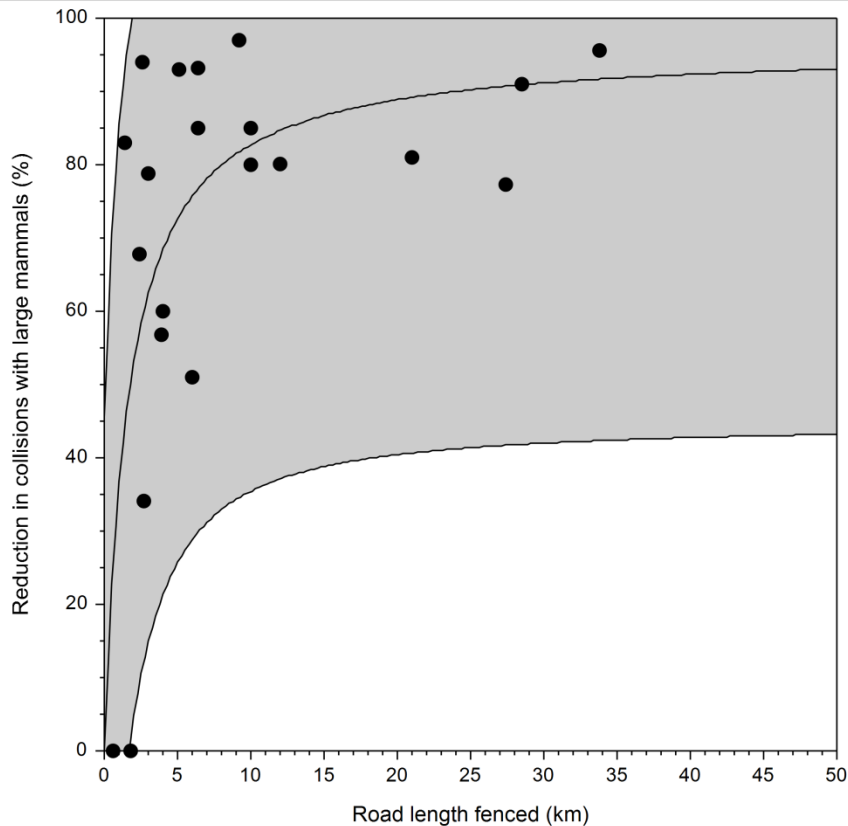
	Wildlife overpass	Open-span bridge	Large-mammal underpass	Medium-mammal underpass	Small- to medium-mammal pipe
Ungulates					
Deer sp.	●	●	●	⊗	⊗
Elk	●	●	●	⊗	⊗
Moose	●	●	●	⊗	⊗
Mountain goat	●	●	○	⊗	⊗
Bighorn sheep	●	●	○	⊗	⊗
Pronghorn	●	○	○	⊗	⊗
Carnivores					
Weasel	●	●	○	●	●
Pine marten	●	○	○	●	●
Fisher	●	●	○	⊗	⊗
Striped skunk	●	●	●	●	●
Badger	●	●	●	?	?
Wolverine	●	●	?	?	⊗
Bobcat	●	●	●	●	●
Canada lynx	●	●	?	?	⊗
Cougar	●	●	●	⊗	⊗
Fox1 ( <i>V. vulpes</i> , <i>Urocyon</i> )	●	●	●	●	●
Fox2 ( <i>V. macrotis</i> , <i>V. velox</i> )	●	●	○	?	?
Coyote	●	●	●	●	●
Wolf	●	●	○	⊗	⊗
Black bear	●	●	●	⊗	⊗
Grizzly bear	●	●	○	⊗	⊗

- Recommended/Optimum solution
- Possible if adapted to local conditions
- ⊗ Not recommended
- ? Unknown, more data are required



# Collision Reduction

## • Marcel Huijser



### Effectiveness of short sections of wildlife fencing and crossing structures along highways in reducing wildlife–vehicle collisions and providing safe crossing opportunities for large mammals

Marcel P. Huijser <sup>a,\*</sup>, Elizabeth R. Fairbank <sup>a</sup>, Whisper Camel-Means <sup>b</sup>, Jonathan Graham <sup>c</sup>, Vicki Watson <sup>d</sup>, Pat Basting <sup>e,1</sup>, Dale Becker <sup>b</sup>

<sup>a</sup> Western Transportation Institute, Montana State University, PO Box 174250, Bozeman, MT 59717-4250, USA

<sup>b</sup> Confederated Salish & Kootenai Tribes, PO Box 278, Puka, MT 59855, USA

<sup>c</sup> Department of Mathematical Sciences, The University of Montana, Missoula, MT 59812-0864, USA

<sup>d</sup> Environmental Studies Program, The University of Montana, Jeanette Rankin Hall 106A, Missoula, MT 59812-4320, USA

<sup>e</sup> Montana Department of Transportation, PO Box 20 0001, Helena, MT 59620-0001, USA

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#### ABSTRACT

Wildlife fencing in combination with crossing structures is commonly regarded as the most effective and robust strategy to reduce large mammal–vehicle collisions while also maintaining wildlife connectivity across roads. However, fencing and associated measures may affect landscape aesthetics and are sometimes considered costly and unpopular. Therefore fence length is often minimized. We investigated 1) whether short fenced road sections were similarly effective in reducing large mammal–vehicle collisions as long fenced road sections (literature review), and 2) whether fence length influenced large mammal use of underpasses (two field studies). We found that: 1) short fences (<5 km road length) had lower (52.7%) and more variable (0–94%) effectiveness in reducing collisions than long fences (>5 km) (typically >80% reduction); 2) wildlife use of underpasses was highly variable, regardless of fence length (first field study); 3) most highway crossings occurred through isolated underpasses (82%) rather than at grade at fence ends (18%) (second field study); and 4) the proportional use of isolated underpasses (compared to crossings at fence ends) did not increase with longer fence lengths (up to 256 m from underpasses) (second field study). If the primary success parameter is to improve highway safety for humans by reducing collisions with large ungulates, the data suggest fence lengths of at least 5 km. While longer fence lengths do not necessarily guarantee higher wildlife use of underpasses as use varies greatly between locations, wildlife fencing can still improve wildlife use of an individual underpass.

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#### 1. Introduction

Large mammal–vehicle collisions are abundant in many parts of the world (e.g. Groot Bruinderink and Hazebroek, 1996; Conover et al., 1995). Collisions with large ungulates typically result in the injury or death of the animals involved, substantial vehicle damage, and – in some cases – human injuries and fatalities (Allen and McCullough, 1976; Bissonette et al., 2008; Conover et al., 1995). Wildlife fencing in combination with wildlife crossing structures is commonly regarded as the most effective and robust strategy to reduce these types of collisions while also maintaining connectivity across highways for wildlife (review in Huijser et al., 2009). If wildlife fencing and crossing structures are designed based on the requirements of the target species,

and if they are implemented and maintained correctly, the measures can reduce large mammal–vehicle collisions by 80–97% (Clevenger et al., 2001; Gagnon et al., 2015; Sawyer et al., 2012). In addition, the number of animal movements across overpasses or through underpasses, as well as the percentage of animals out of a local population that use the structures, can be substantial (Clevenger and Waltho, 2000; Sawaya et al., 2013; Sawyer et al., 2012).

Despite the benefits described above, wildlife fences, wildlife crossing structures and associated measures can be a contentious issue. Wildlife fences for large ungulates are typically 2.4 m high and can affect landscape aesthetics (Evans and Wood, 1980). In addition, some landowners may also object to associated measures such as gates, wildlife guards, or similar measures at access roads as they may be time consuming or unpleasant to drive across. Furthermore, despite the wildlife crossing structures that may be present, fences are sometimes a problem for wide ranging large mammal species such as mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana*) (Coe et al., 2015; Poor et al., 2012; Seidner et al., 2015). They can even be a

\* Corresponding author.

E-mail address: [mhuijser@montana.edu](mailto:mhuijser@montana.edu) (M.P. Huijser).

<sup>1</sup> Current affiliation: JACOBS Engineering Group Inc., 707 17th Street, Suite 2400, Denver, CO 80202, USA.

# Design Standards

**GENERAL NOTES**

1. AT EACH LOCATION WHERE AN ELECTRIC TRANSMISSION, DISTRIBUTION OR SECONDARY LINE CROSSES A BARRIER FENCE, THE CONTRACTOR SHALL FURNISH AND INSTALL A GROUND CONFORMING TO ARTICLE 250 OF THE NATIONAL ELECTRICAL CODE. THE GROUND ROD SHALL BE A MINIMUM DIAMETER OF 1/2 IN. AND 8 FT. IN LENGTH AND DRIVEN AT LEAST 7 1/2 FT. INTO THE GROUND. THE ROD SHALL BE CONNECTED TO EACH WIRE WITH A MINIMUM AWG NCL 8 STRANDED COPPER WIRE. GROUNDING WILL NOT BE PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
2. END POST, CORNER POST, AND LINE BRACE POST SHALL BE ASSEMBLED BY THE UNIT AND PAID FOR AS SUCH. ALL WORK AND MATERIAL ASSOCIATED WITH EACH ASSEMBLY, SHALL BE INCLUDED IN THE UNIT PRICE FOR THAT ASSEMBLY.
3. LINE BRACE POSTS SHALL BE SPACED AT 400 FT. INTERVALS, WHERE FENCING IS CONTINUOUS AND WHERE END, CORNER & LINE BRACE POSTS ARE NOT SPECIFIED.
4. ALL LINE POSTS SHALL BE 5 IN. MIN. DIAMETER AND 12 FT. LONG. ALL END, CORNER AND LINE BRACE POSTS SHALL BE 6 IN. MIN. DIAMETER AND 12 FT. LONG. ALL POSTS AND BRACES SHALL BE TREATED IN ACCORDANCE WITH SUBSECTION 710.07.
5. FENCE WIRE MAY BE PLACED ON EITHER THE ROAD SIDE OR THE FIELD SIDE OF POSTS, DEPENDING ON LOCAL CONDITIONS; I.e., ON CURVES, THE WIRE SHOULD BE PLACED ON THE SIDE WHICH WOULD RESULT IN THE LEAST AMOUNT OF TENSION ON THE STAPLES. THIS ALSO APPLIES WHERE WIND DRIFT OR OTHER CONDITIONS WOULD EXERT UNUSUAL PRESSURE AGAINST THE WIRE.
6. WHERE CONCRETE STRUCTURES ARE USED AS A DEER PASS, THE FENCE SHALL END AT EYEBOLTS IN WINGS OF THE STRUCTURE. EYEBOLTS IN FRESH CONCRETE SHALL BE MADE OF 1/2 IN. ROUND BARS AND EMBEDDED A MINIMUM OF 6 IN. WITH A HOOKED OR BENT END. IN EXISTING CONCRETE, THE 1/2 IN. ROUND BARS SHALL BE DEFORMED AND GROUTED INTO DRILLED HOLES. EYEBOLTS SHALL HAVE A MINIMUM OF 1 IN. INSIDE EYE DIAMETER AND SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR. COST OF EYEBOLTS SHALL BE INCLUDED IN THE CONTRACT PRICE FOR FENCING.
7. WOVEN WIRE FENCE FABRIC SHALL CONFORM TO AASHTO M 279 (ASTM A 80). DESIGN NO. 2096-6-12 1/2, GRADE 60, COATING TYPE ZA, COATING CLASS 80.
8. ALL FENCE WIRE TIES, BRACE WIRES, STAPLES AND OTHER WIRE APPURTENANCES SHALL BE GALVANIZED IN CONFORMANCE WITH SUBSECTION 625.08.
9. THE CONTRACTOR SHALL RE-ESTABLISH DISTURBED OR DESTROYED SURVEY MONUMENTS TO THE APPROPRIATE ACCURACY IN ACCORDANCE WITH SUBSECTION 625.08 OF THE STANDARD SPECIFICATIONS.
10. CONTINUOUS LINE WIRE SHALL BE HIGH TENSILE (175 K MIN.). CONTINUOUS STAY WIRE SHALL BE MID-TENSILE (125 K MIN.). FIXED KNOT 13 GAUGE WIRE (60K MIN.) SHALL CONNECT LINE WIRE WITH THE VERTICAL STAY WIRE.
11. DEER GATE AND TOP BRACES SHALL BE PAINTED WITH GREEN PAINT ACCORDING TO SUBSECTION 708.03 AND COLOR NO. 14109 OF FEDERAL STANDARD 595B.

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Last Modification Date: 04/30/15	Initials: LTA
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04/30/15	Created new W Standards M-607-4 - Deer Fence, Gates, and Game Ramps

Colorado Department of Transportation  
 4201 East Arkansas Avenue  
 CDOT HQ, 4th Floor  
 Denver, CO 80222  
 Phone: 303-757-9021 FAX: 303-757-9868  
 Division of Project Support DLM/LTA

**DEER FENCE, GATES, AND GAME RAMPS**

STANDARD PLAN NO.  
 M-607-4  
 Sheet No. 1 of 5

Issued By: Project Development Branch March 4, 2015

# Design Standards



# Unique Approaches



# Unique Approaches



Cattle (Texas) Gates

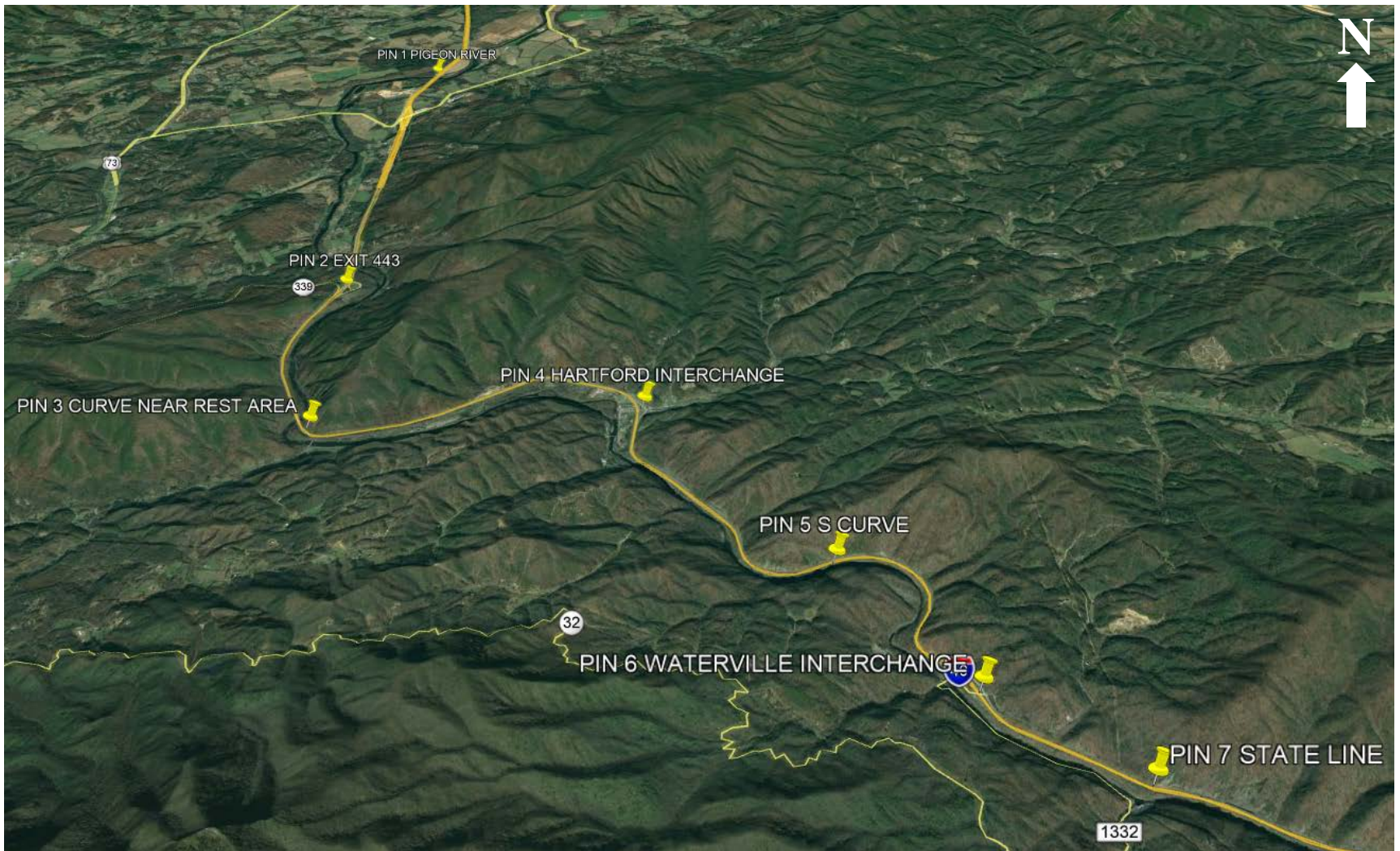


Electrified Cattle Guard

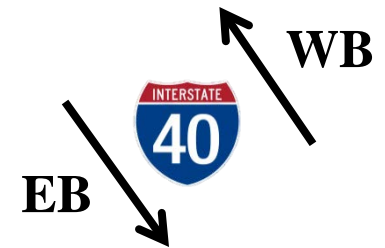
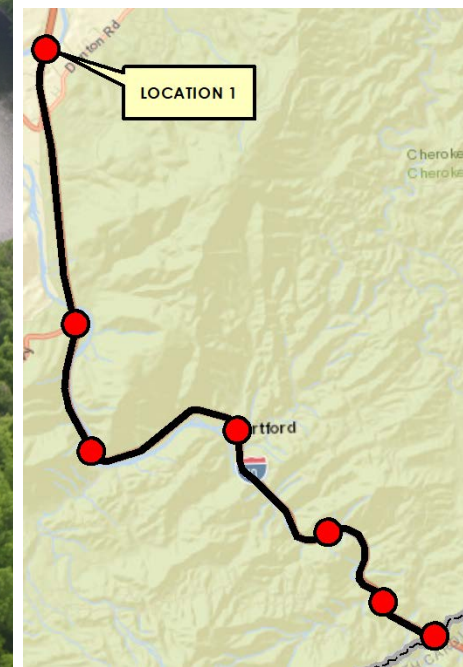


Electo-Mat

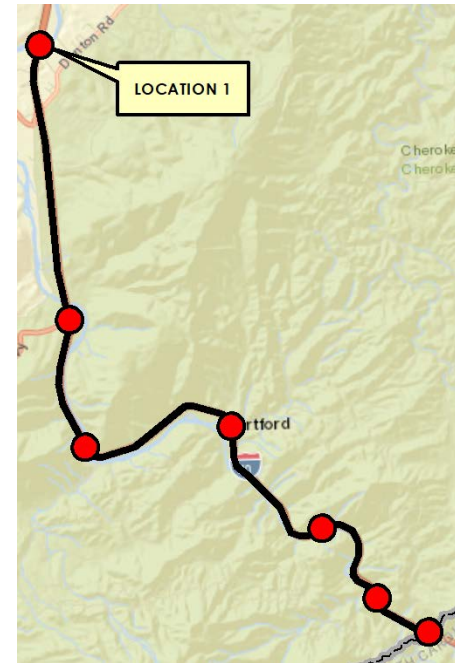
# Cocke Co. I-40 Study Area



# I-40 over Pigeon River

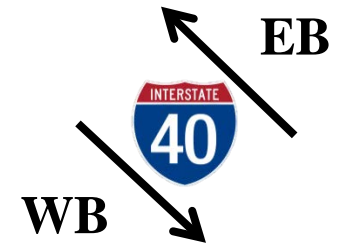
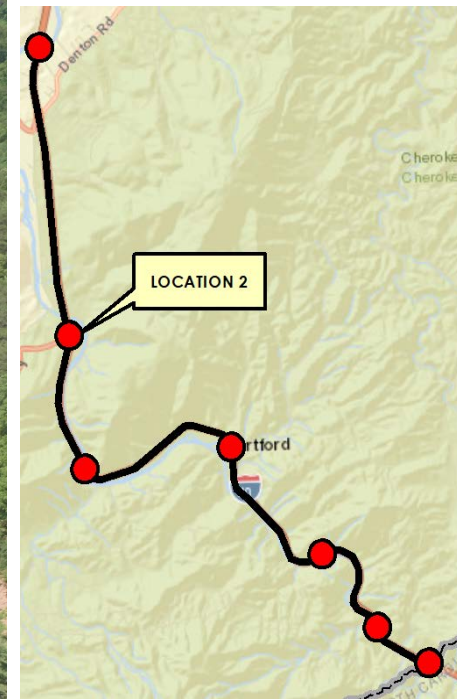


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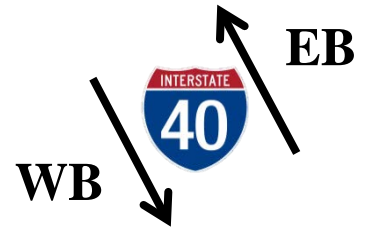
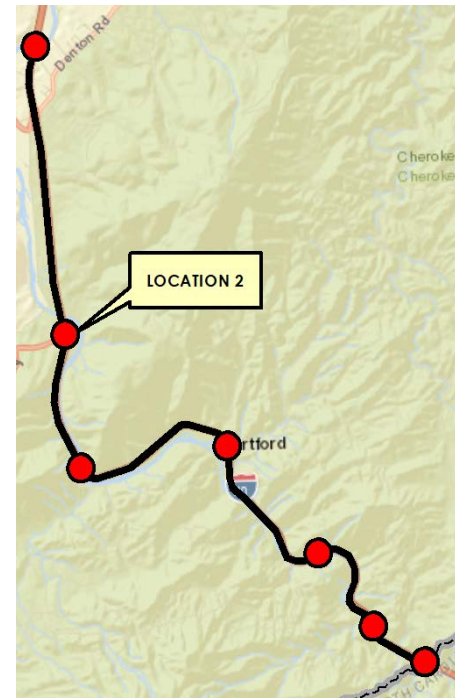




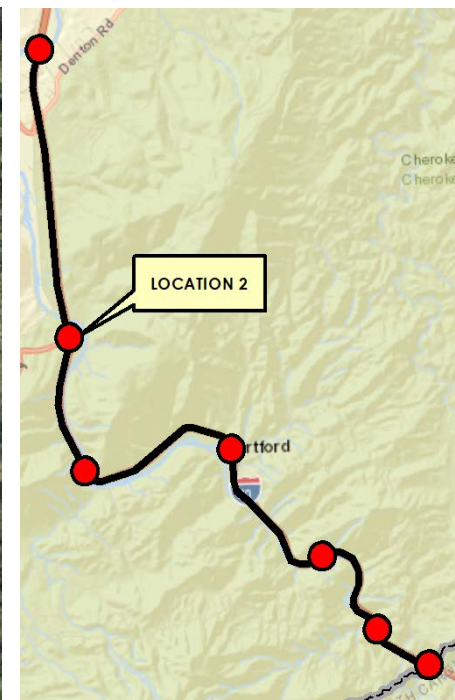
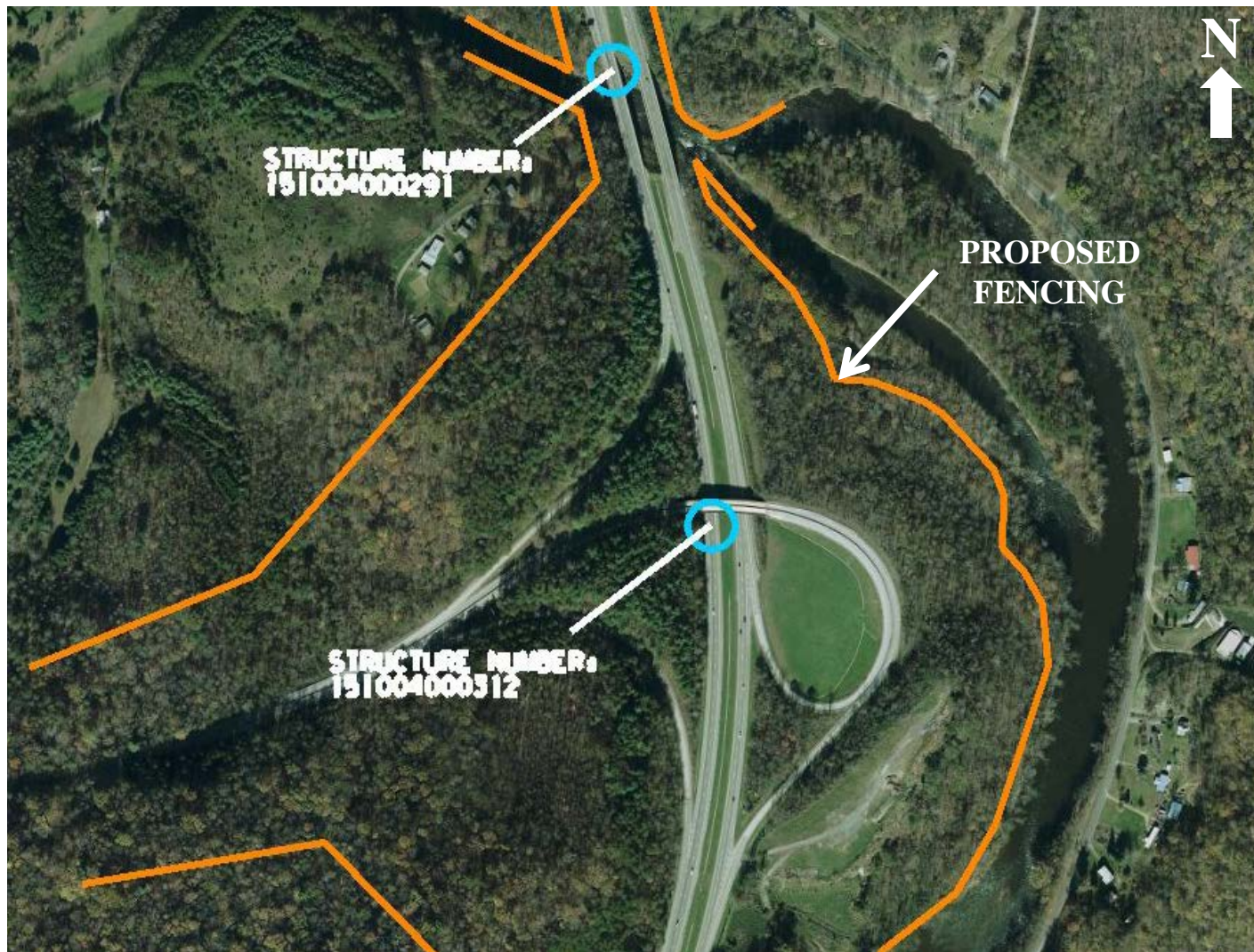
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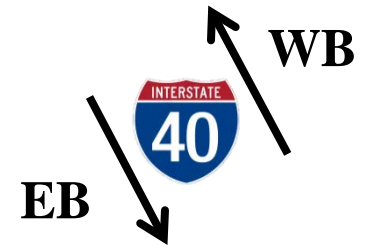
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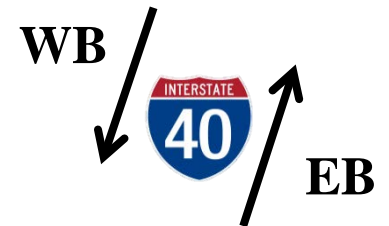
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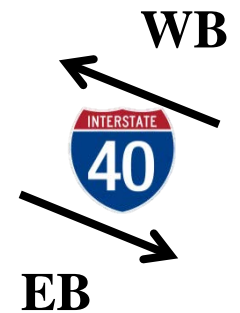
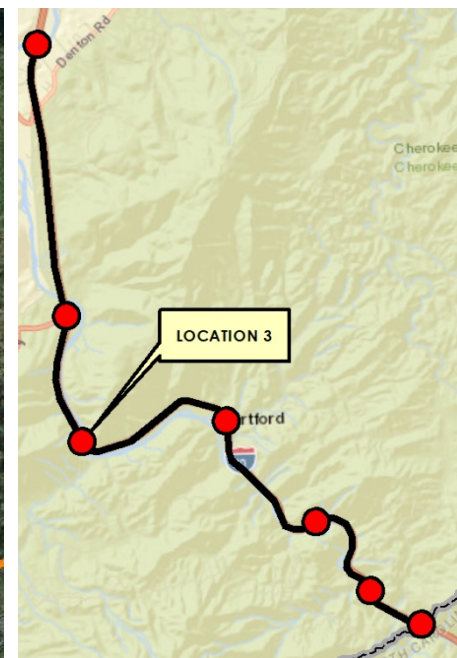
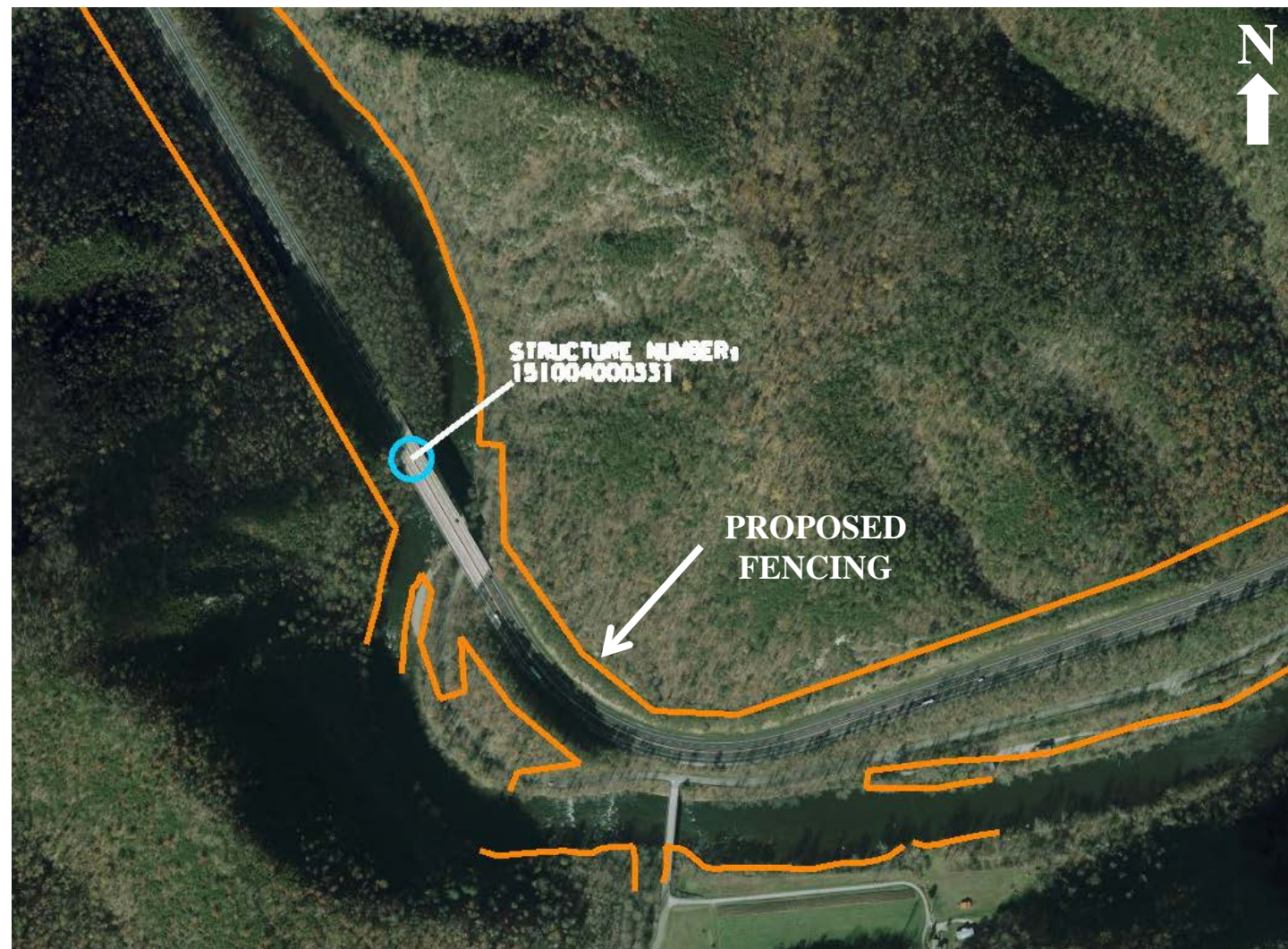
# I-40 Curve near Rest Area



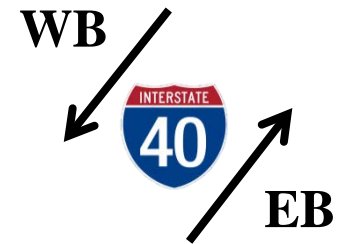
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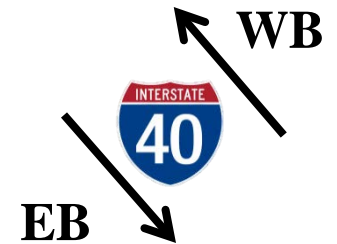
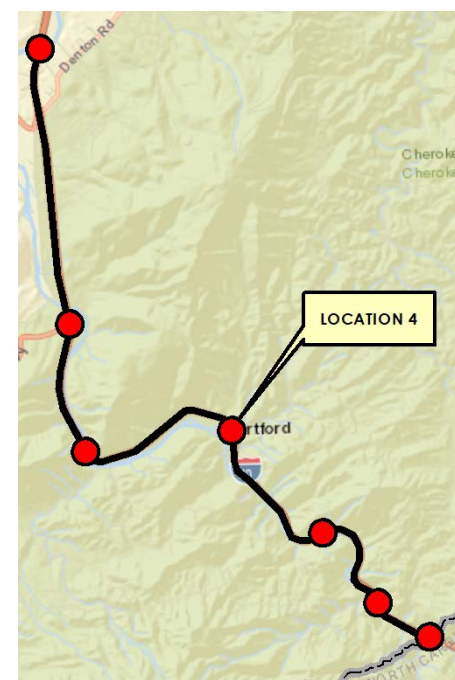
# I-40 Curve near Rest Area



# I-40 Exit 447 (Hartford) Interchange

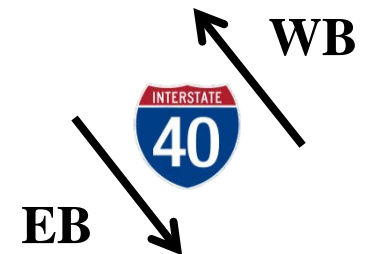
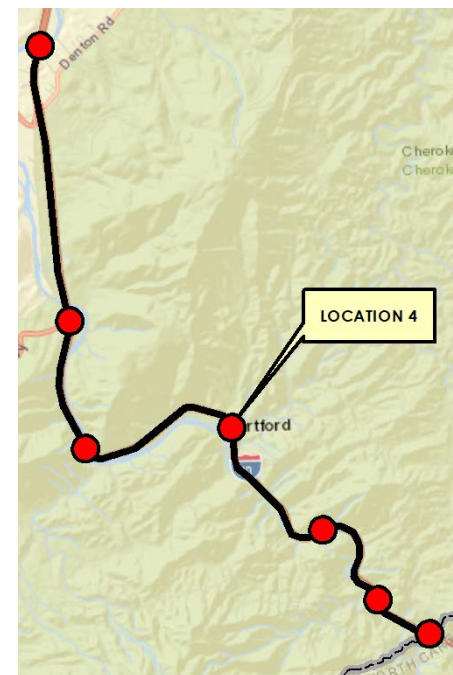
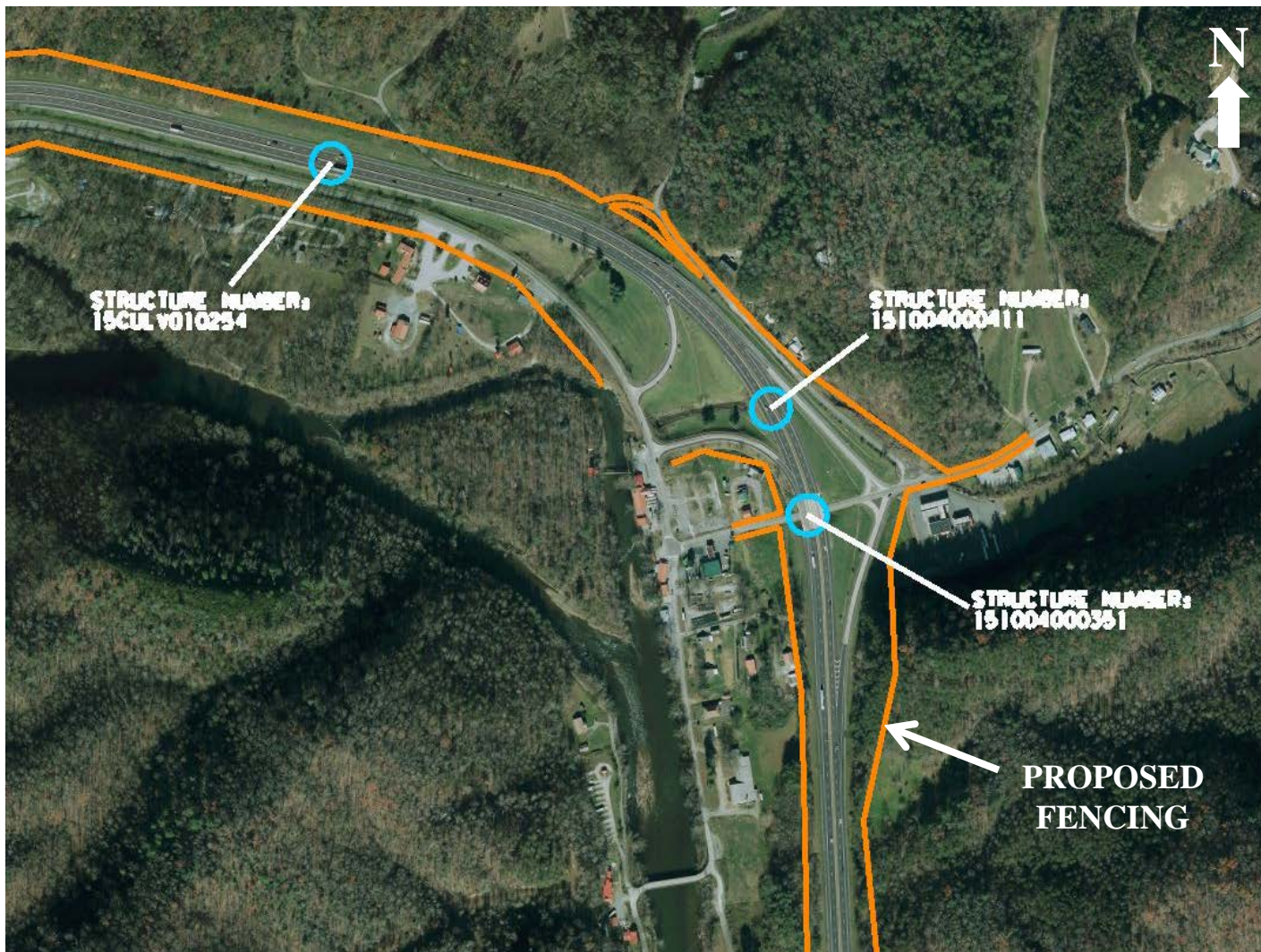


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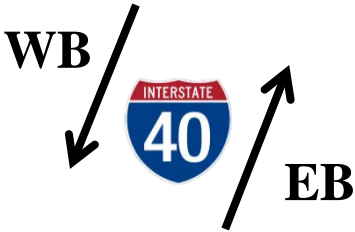
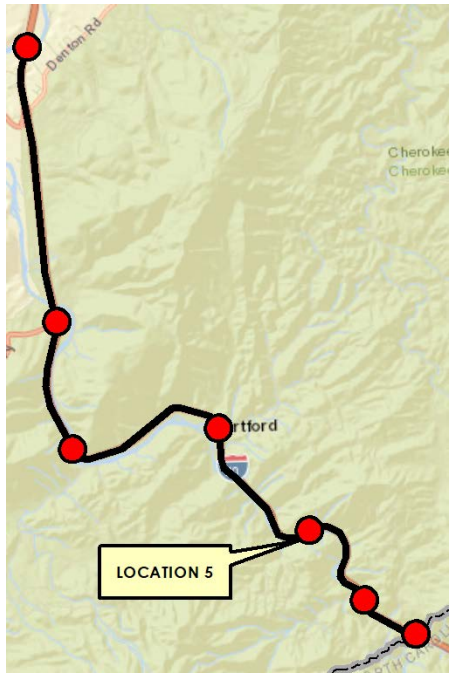




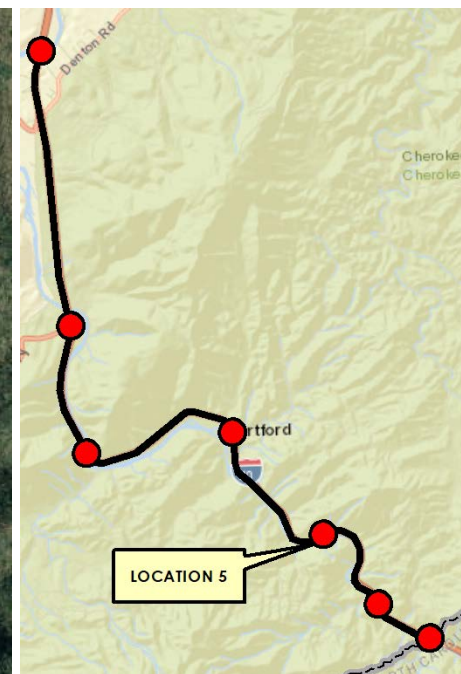
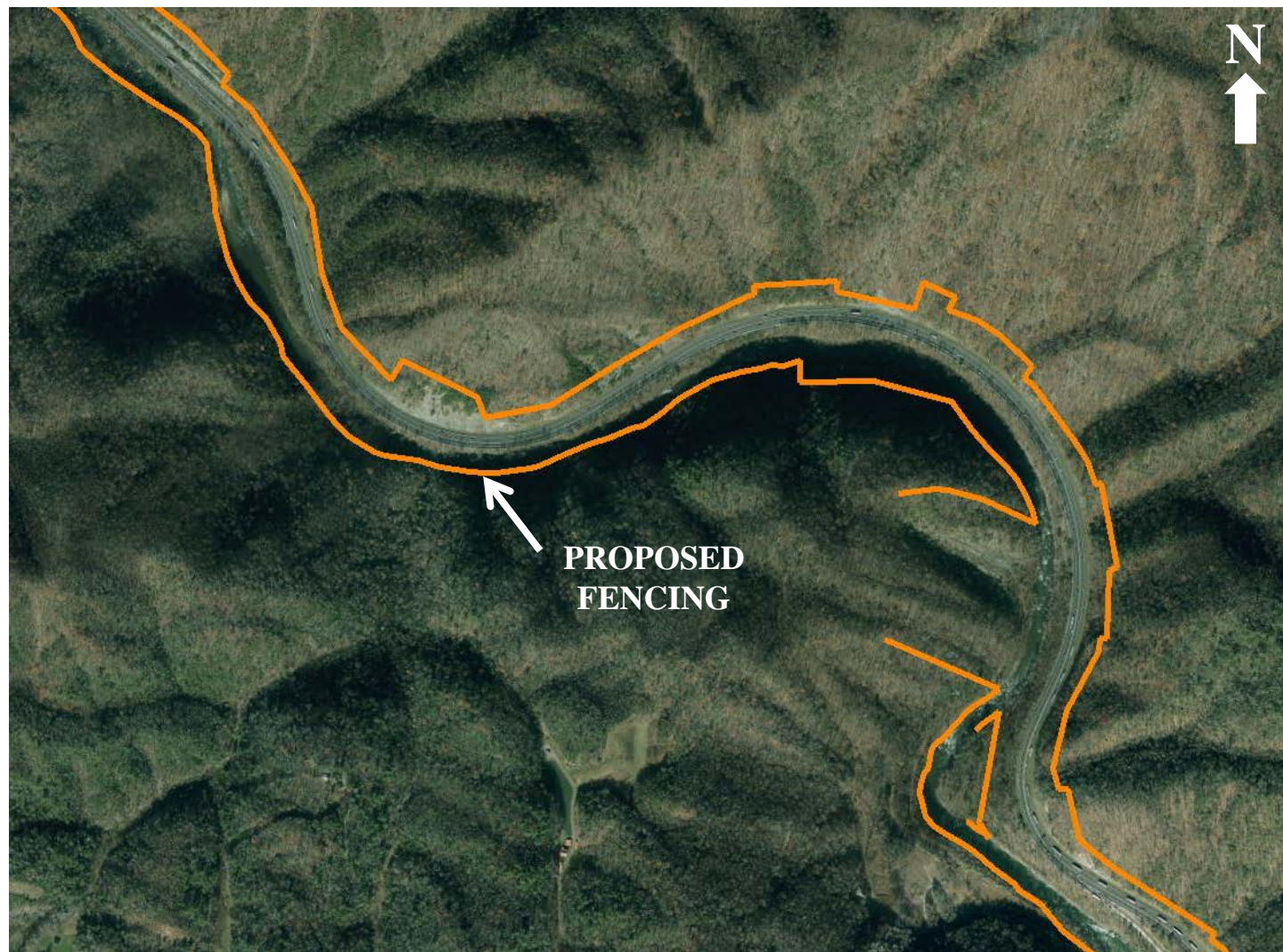
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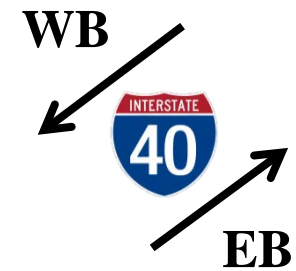
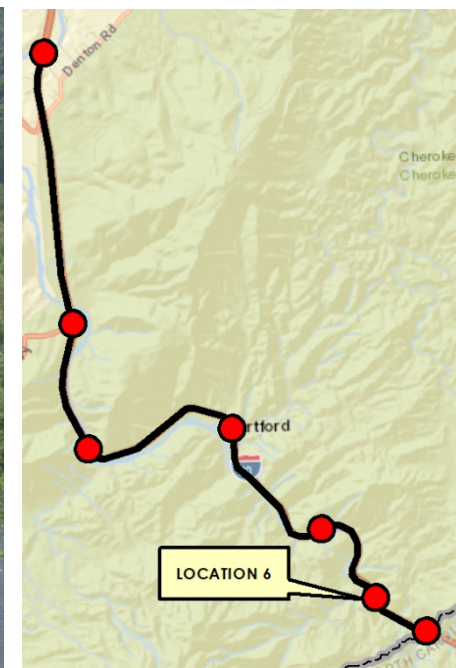
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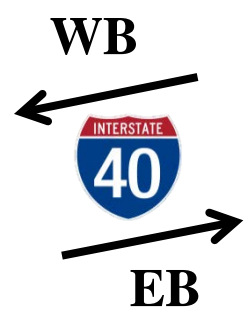
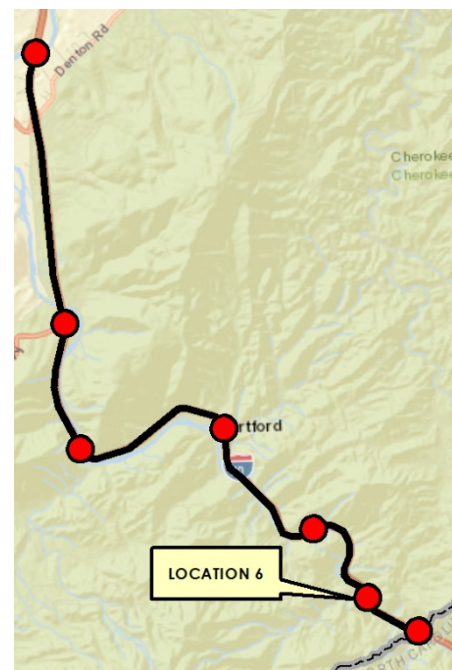
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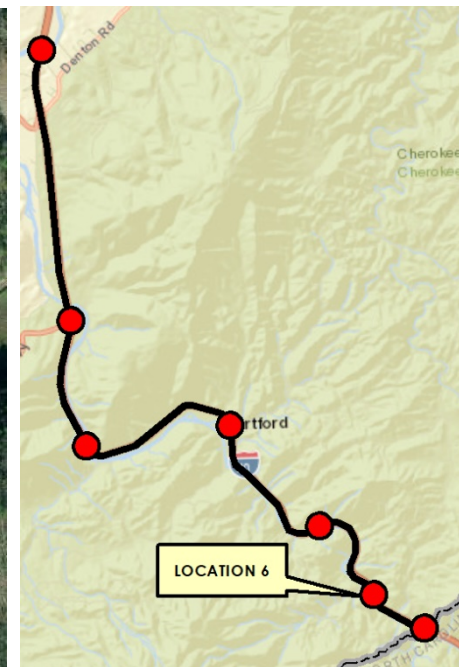
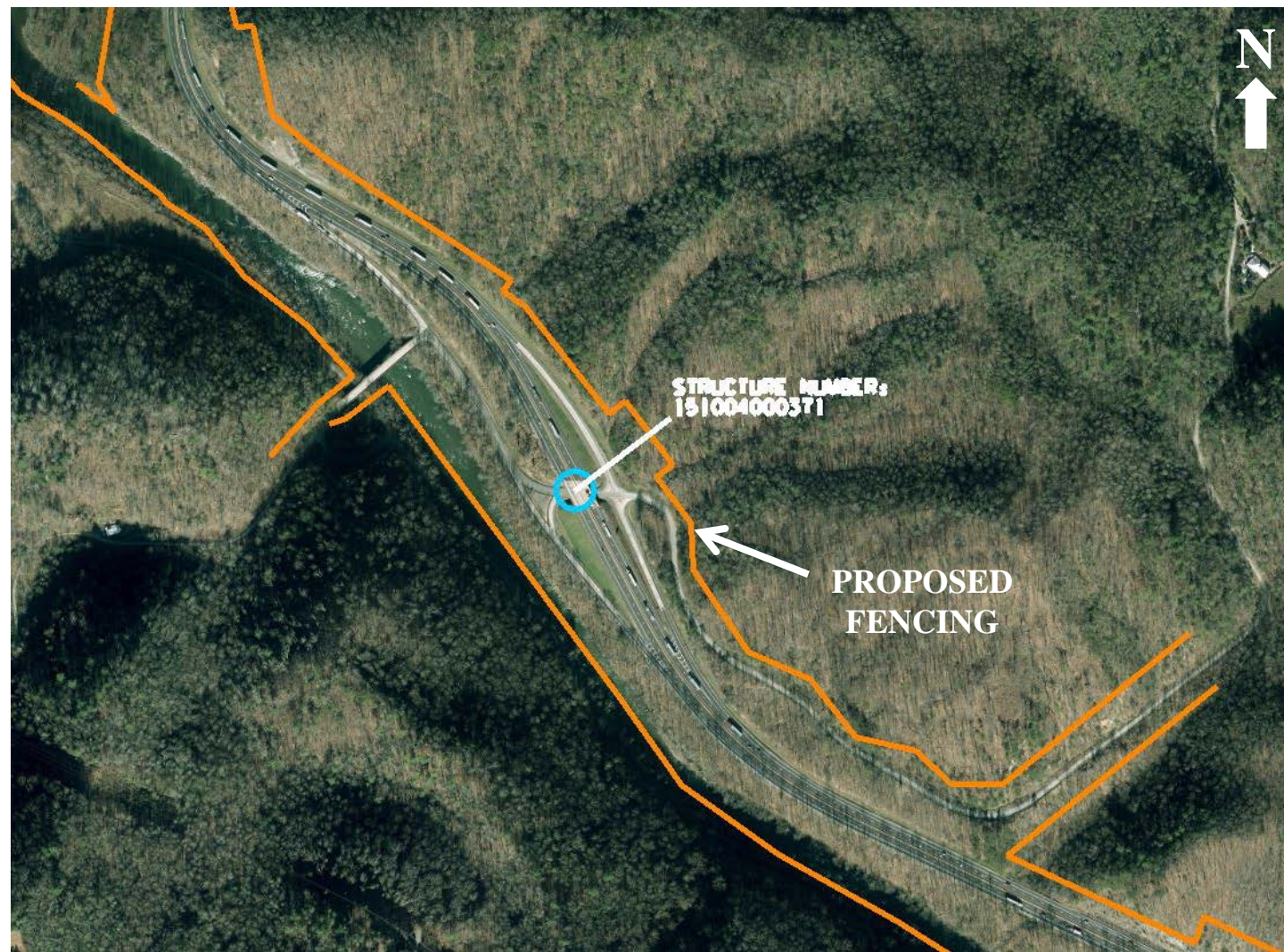
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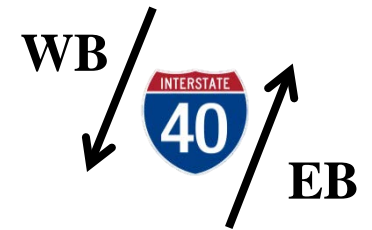
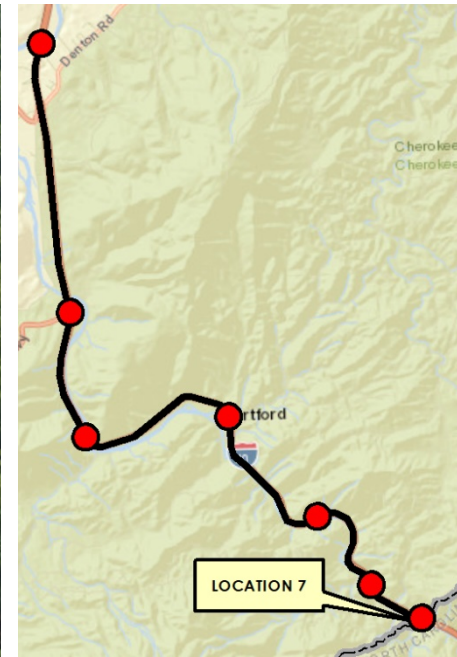
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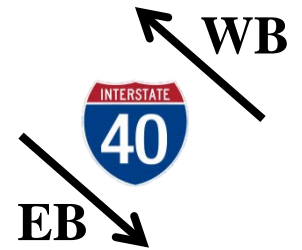
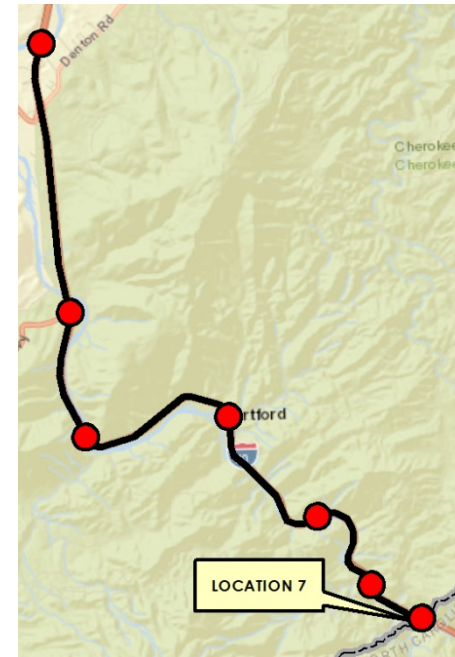
# I-40 Exit 451 (Waterville) Interchange



# I-40 at TN/NC State Line

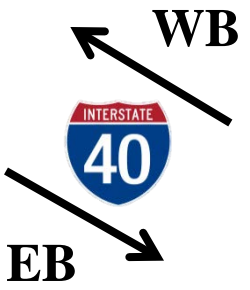
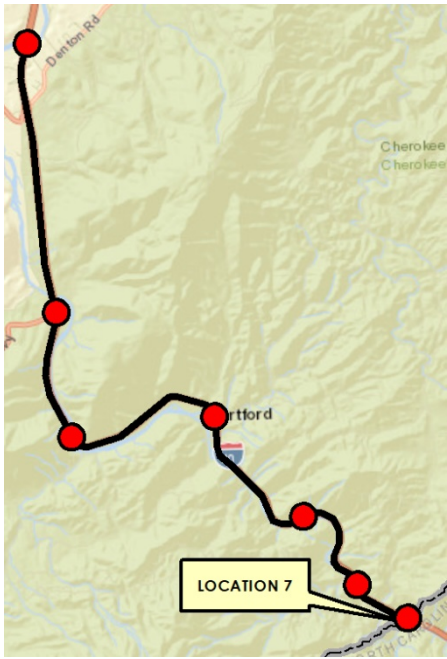
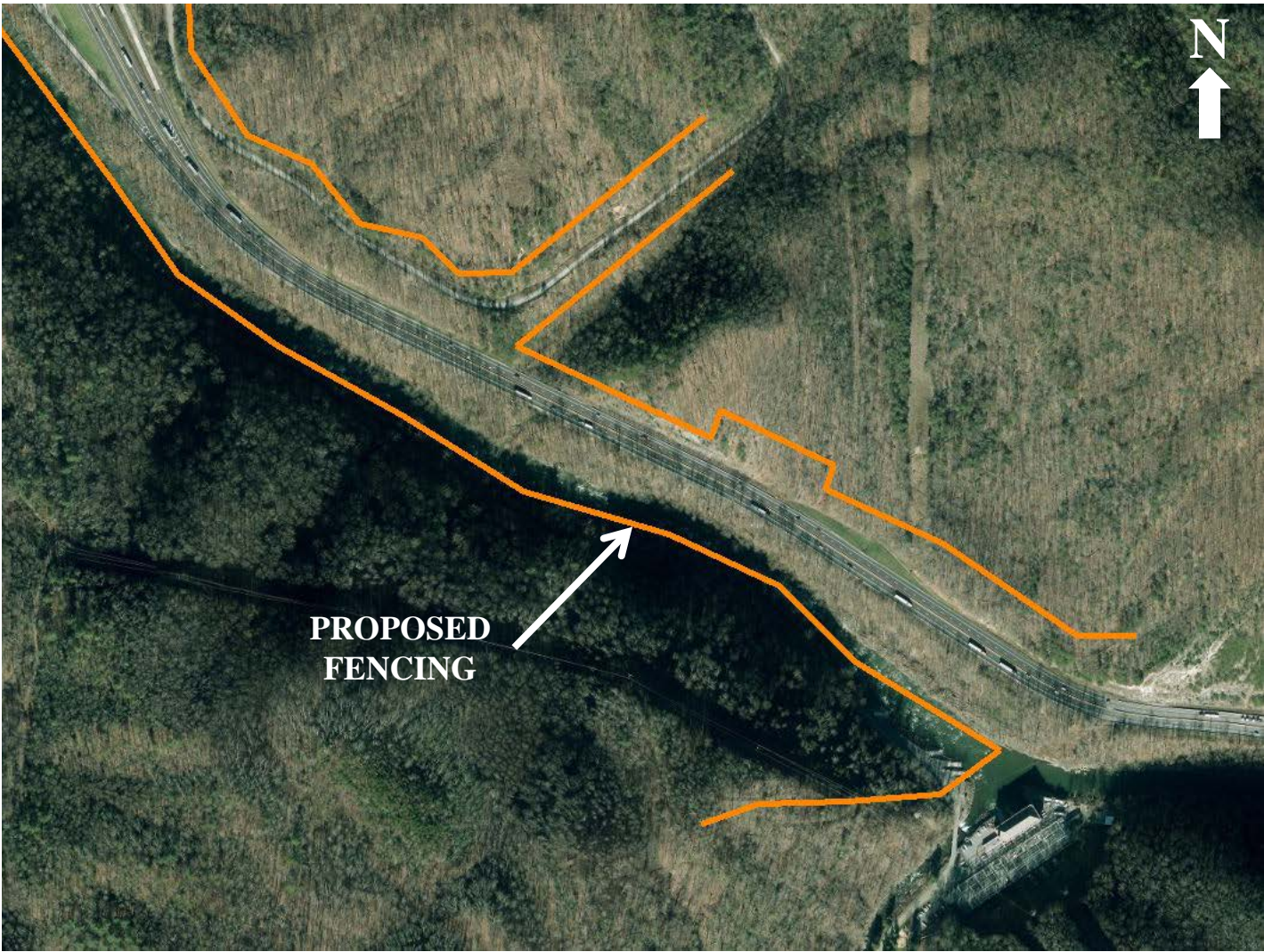


# I-40 at TN/NC State Line





# I-40 at TN/NC State Line



# Partnerships



# Questions

