MEETING NOTES: ***CTB Innovation Subcommittee***

DATE: Tuesday, December 7, 2021

TIME: 8:30 a.m.

The meeting of the Commonwealth Transportation Board (CTB) Innovation Subcommittee was held at the Virginia Department of Transportation Central Office Old Highway Building Computer Lab, 1221 East Broad Street, Richmond, VA 23219. Director of Transportation Research and Innovation Cathy McGhee presided and called the meeting to order at 8:35 a.m.

Present: Mr. Yates, Ms. DeTuncq, Mr. Stant and Ms. McGhee.

Absent: Mr. Rucker.

Approval of October 2021 minutes – *It was determined that the notes from the October meeting had not been distributed for review so approval was deferred.*

Wildlife Crash Reduction Research and Resulting VDOT Safety Initiatives - Bridget Donaldson, Associate Principal Scientist, Virginia Transportation Research Council, provided an overview of recent work relating to wildlife crashes and efforts to mitigate them. Recent projects include the evaluation of effectiveness of DMS messages, active warning systems, and wildlife crossings (with and without fencing). Bridget also mentioned the addition of "Large Animal Crash Countermeasures" as a consideration during VDOT's project scoping process. The presentation is attached for reference.

Safety Data Analytics - Nathan O'Kane, Office of Strategic Innovations, briefed the committee on the project to integrate a number of both traditional and new datasets to enable a more comprehensive analysis of the contributor to serious and fatal crashes. Findings from the work include a link between pavement condition and speeding and more severe crashes, a need for more analysis of a potential link between curve radius and crash severities, and the identification of clusters the show patterns in crash attributes and locations. More work to ensure the quality of the data is needed followed by work to identify potential mitigation strategies. The presentation is attached for reference.

Public Comments – There were no public comments.

ADJOURNMENT: The meeting adjourned at 9:35 a.m. on December 7, 2021. The next CTB Innovation Subcommittee meeting will be held on Tuesday, January 11 2022, beginning at 8:30 a.m. in the Computer Lab of the Virginia Department of Transportation Central Office Old Highway Building located at 1221 East Broad Street, Richmond, Virginia 23219.

Wildlife Crash Reduction Research and Resulting VDOT Safety Initiatives

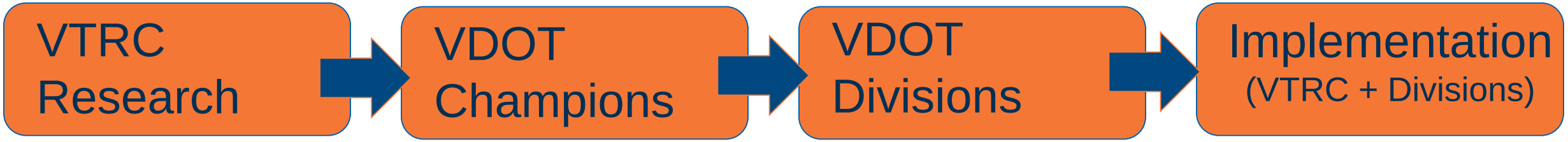
Bridget Donaldson

Associate Principal Research Scientist

Virginia Transportation Research Council

Virginia DOT

Research to Implementation



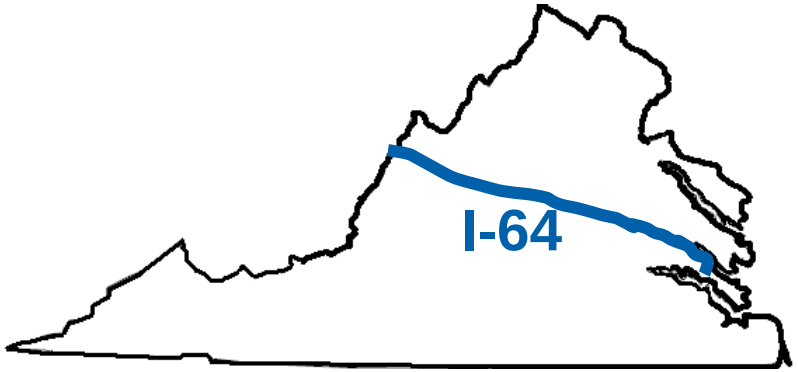
Wildlife Crash Research

Wildlife Crash Data

Police Report Data vs Carcass Removal Data

Police-reported deer crashes: ~6,000 per year

VA: 60,000 insurance claims for deer-related crashes per year



Top Police-reported Crash Types (section of I-64)

Donaldson, B.M., and Kweon, Y.J. *Improving Animal-Vehicle Collision Data for the Strategic Application of Mitigation*. VTRC 19-R8. Virginia Transportation Research Council, Charlottesville, 2017.

Seasonal Wildlife Advisories on Changeable Message Signs

Messages were posted seasonally (Oct-Nov) from 5pm to 9am, every other day

- Deer crash reduction of 51% when messages were posted
- Driver speed was 0.5 MPH to 2.8 MPH lower on average

Donaldson, B.M. and Kweon, Y.J. Deer Advisories on Changeable Message Signs as a Deer Crash Mitigation Tool. *Transportation Research Record*, Vol. 2673, No. 12, 2019, pp. 548-557.

Animal Detection/Driver Warning System

Buried cable animal detection systems were tested in 2 locations

- 99% reliability in detecting large animals
- 80% of drivers either braked or reduced speed in response to the sign activation
- 75% reduction in deer crashes after the first year of deployment

Druta, C. and Alden, A.S. *Preventing Animal-Vehicle Crashes using a Smart Detection Technology and Warning System*. *Transportation Research Record*, Vol. 2674, Issue 10, 2020, pp. 680-689.

Druta, C. and Alden, A.S. *Evaluation of a Buried Cable Roadside Animal Detection System*. Report 15-R25. Virginia Transportation Research Council, Charlottesville, VA, 2015.

Wildlife Crossings

Invest in America Act:
$350 million for wildlife crossings

Wildlife Crossings in Virginia

Near City of Chesapeake – U.S. 17

Bordering Great Dismal Swamp National Wildlife Refuge

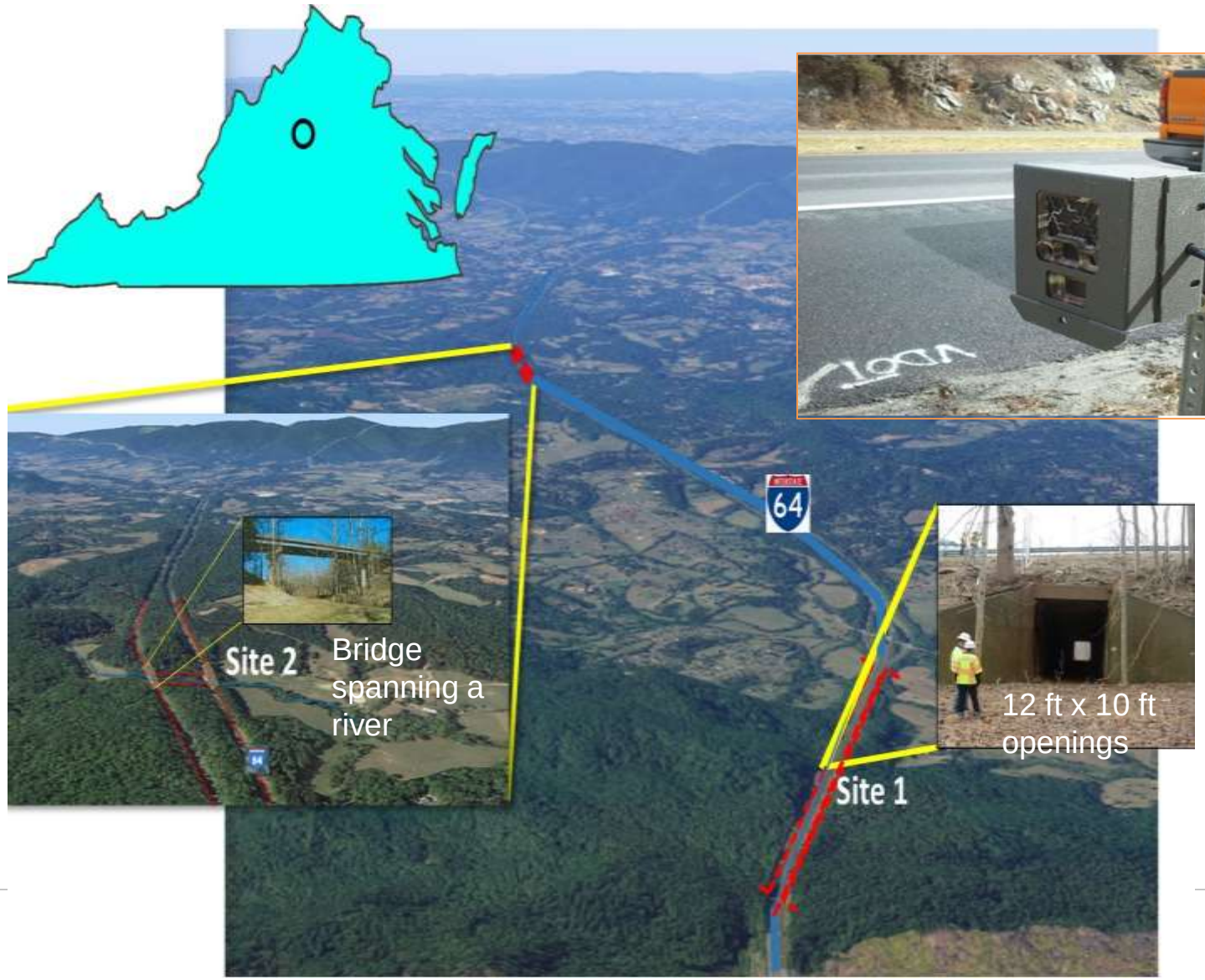
Fairfax Co Parkway

near Ft. Belvoir

Enhancing Existing Underpasses with Wildlife Fencing

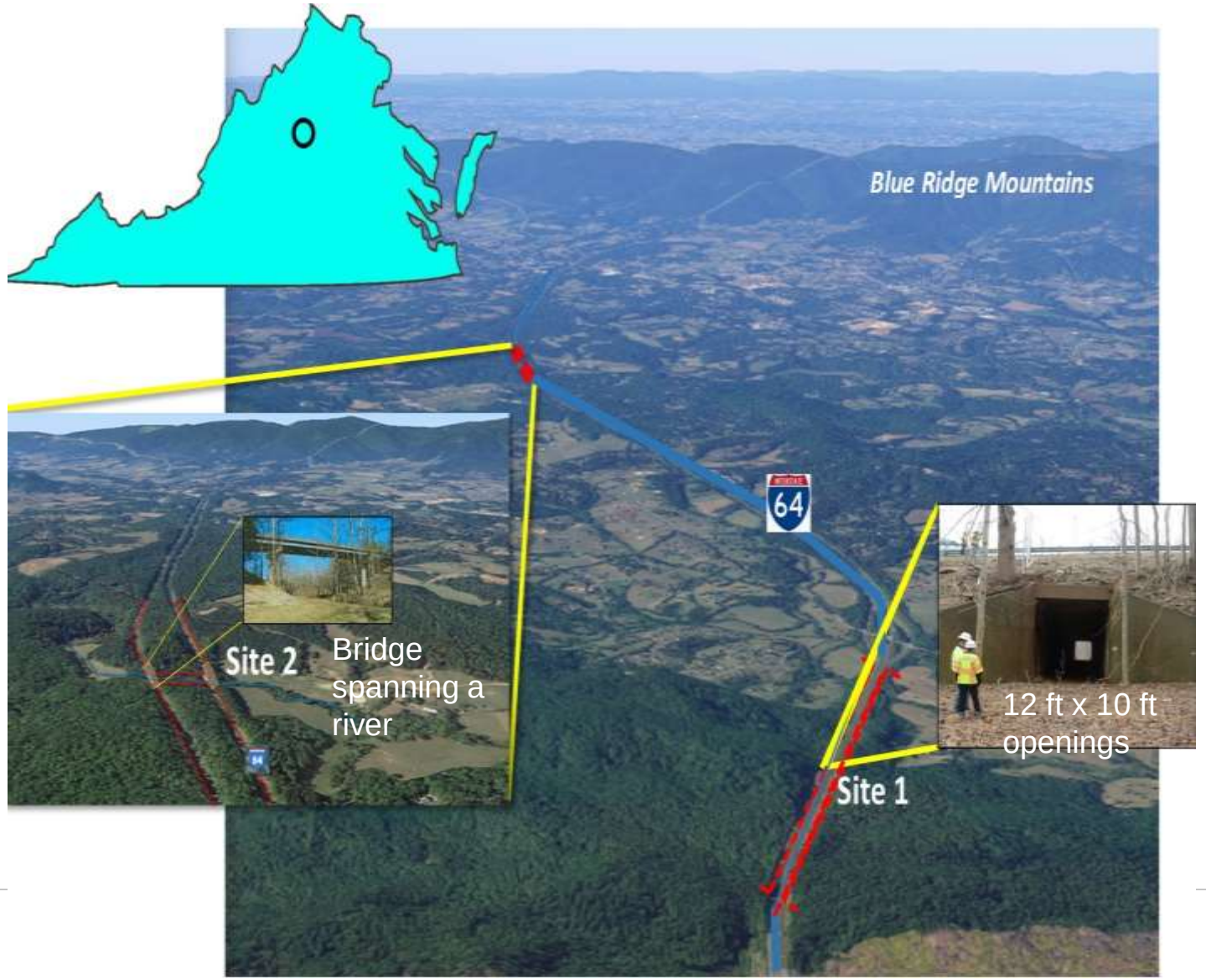
While there is limited new road construction in Virginia, there are many existing underpasses that are suitable for wildlife use

Enhancing Existing Underpasses with Wildlife Fencing



2-yr pre-fencing monitoring study

Enhancing Existing Underpasses with Wildlife Fencing



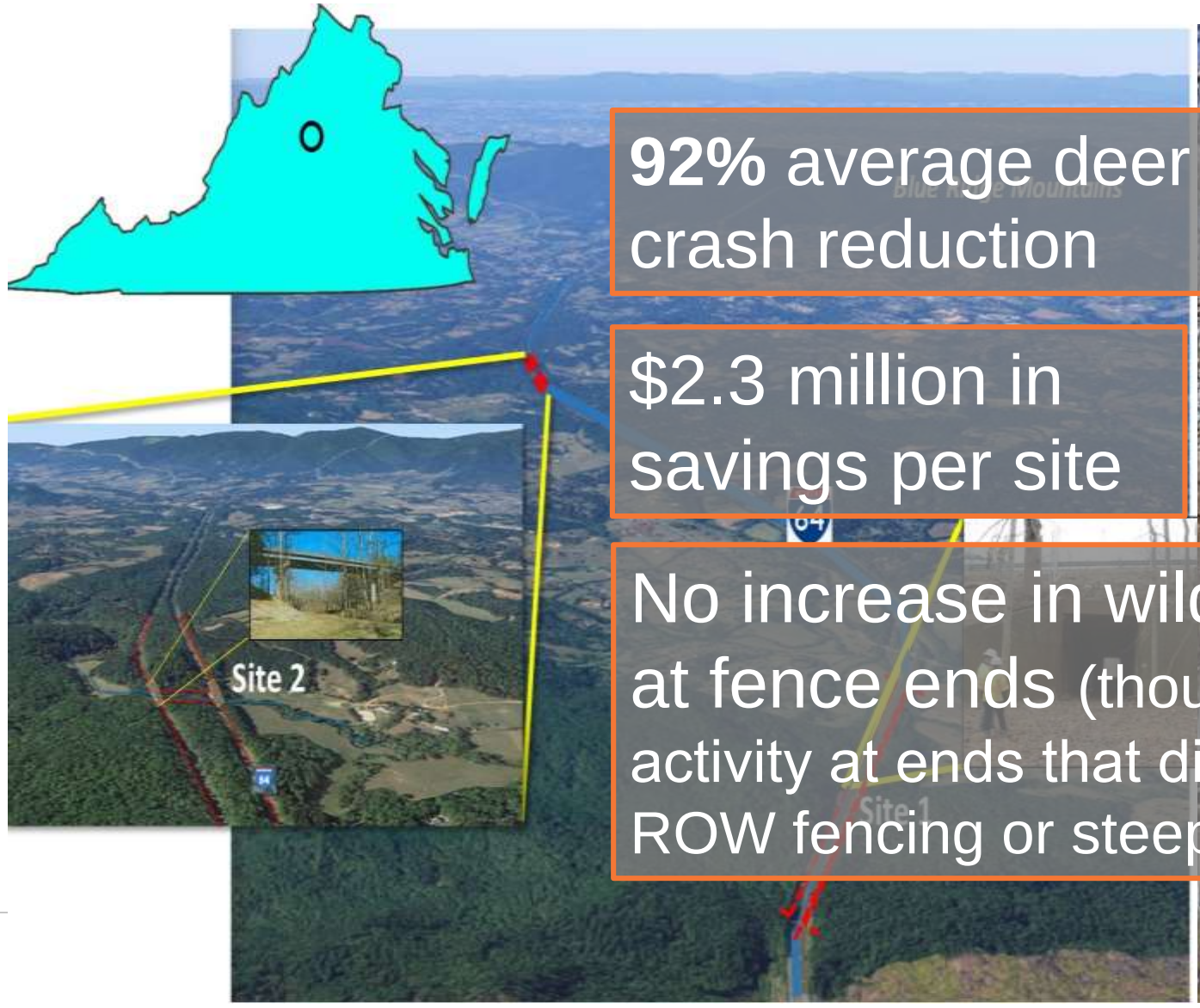
Enhancing Existing Underpasses with Wildlife Fencing

High roadside activity adjacent to unfenced underpasses

8-10 deer crashes per mile per year along the 1-mi road segments

Donaldson, B.M, Kweon, Y. Roadside Activity and Behavior of White-Tailed Deer and Other Wildlife near Unfenced Underpasses. *Transportation Research Record 2571*, Washington, DC, 2016.

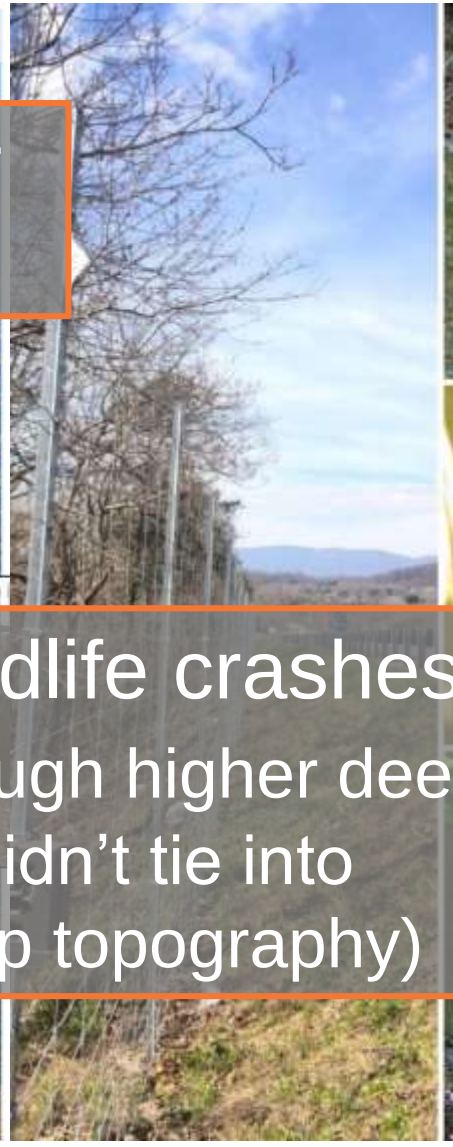
Enhancing Existing Underpasses with Wildlife Fencing



92% average deer crash reduction

$2.3 million in savings per site

No increase in wildlife crashes at fence ends (though higher deer activity at ends that didn't tie into ROW fencing or steep topography)

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Wildlife Use of the Underpasses after Fencing Installation

420% increase in use by deer

165% increase in use by other mammals (bear, bobcat, coyote, fox, etc.)

Donaldson, B.M. and Elliott, K.E.M. Enhancing Existing Isolated Underpasses with Fencing Reduces Wildlife Crashes and Connects Habitat. *Human-Wildlife Interactions*, Vol. 15, Issue 1, Article 20, 2021.

Research to Implementation

Research

DOT Champions

Researchers and Champions discussed findings with Divisions

DOT Divisions

- Operations
- Location and Design
- Structure and Bridge
- Maintenance

Implementation (Researchers + Divisions)

- New policies
- Guidance manual
- Bridge designs
- Carcass removal app

Research to Implementation

Research → DOT Champions → DOT Divisions → Implementation (Researchers + Divisions)

Researchers and Champions discussed findings with Divisions

- Operations
- Location and Design
- Structure and Bridge
- Maintenance

→

- New policy
- Guidance manual
- Bridge designs
- Carcass removal app

Implementation
New Addition to Project Scoping Report

PM-100
Revised 9/1/2021

Scoping Report

Date:	Click to enter a date.		
Project Information			
UPC	VA_UPC	State Project Number	VA_PRJ_NUM
District	VA_DIST	Residency	VA_RES
City/County	VA_CO_CTY_NAME	Route	VA_ROUTE
Street Name	VA_POOL_ST_NAME	Road System	VA_POOL_RD_SYSTEM
Project Manager	VA_MGR		
FHWA 534#	VA_POOL_FHWA_534	Federal Number	VA_POOL_FED_NUM
Termini Start	VA_POOL_START_LOC		
Termini End	VA_POOL_END_LOC		
Project Length			
Project Category M, I-V	Choose an item. *(Refer to Category Definitions on PMO Website)*		
Project Narrative			

Relevant Cost and Schedule Risks: ☐			
☐	Technical	☐	Environmental
☐	Structures & Geotech	☐	Permits
☐	Stormwater	☐	Political & delayed decisions
☐	Design and access issues	☐	Stakeholder issues
☐	Construction & MoT	☐	Multiple contracts
☐	R/W acquisition	☐	Fiber Optics
☐	Utilities	☐	ITS Architecture Requirements (See IIM-OD-21-02 / IIM-LD-261)
☐	Large Animal Crash Countermeasures (See IIM-LD-262)		

Large Animal Crash Countermeasures

Implementation

New Policy

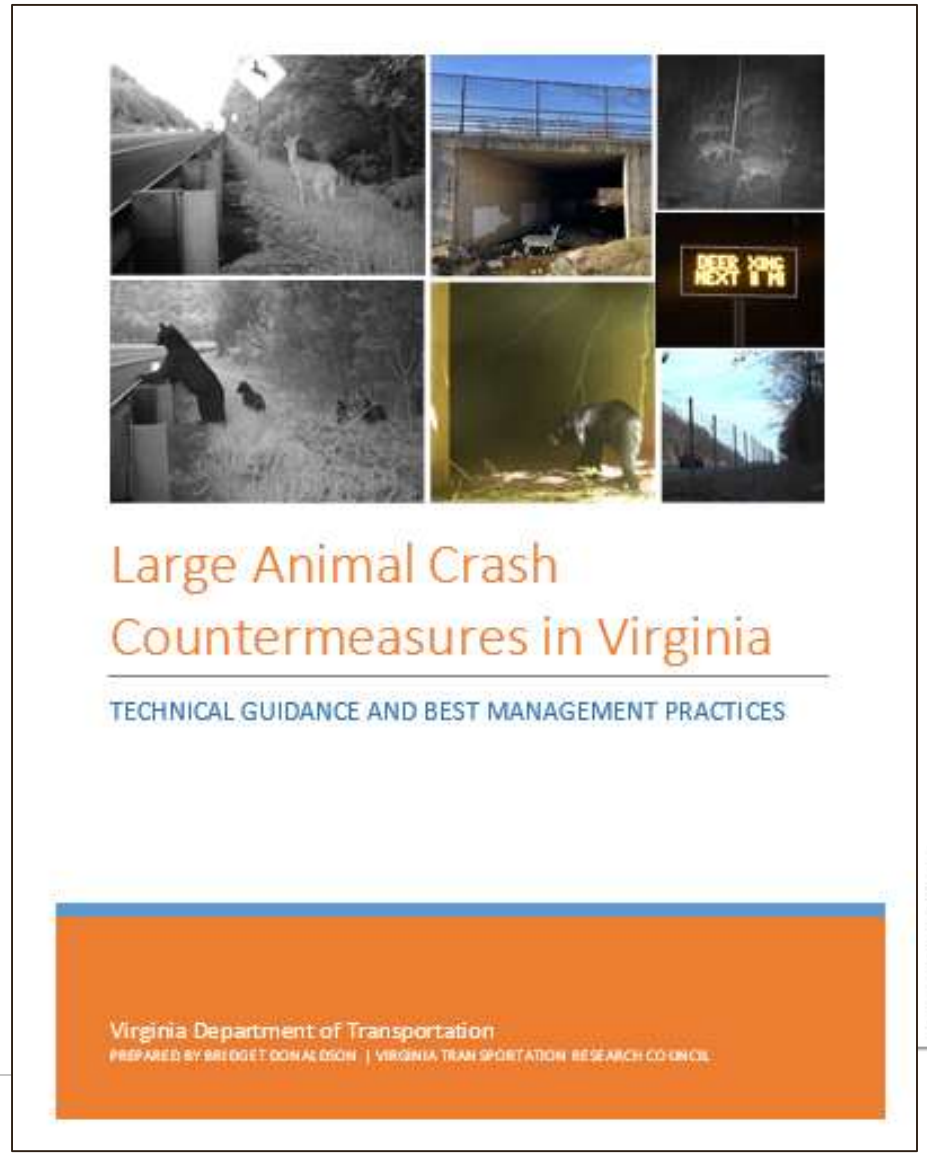
Traffic Engineering Division and Location and Design Division

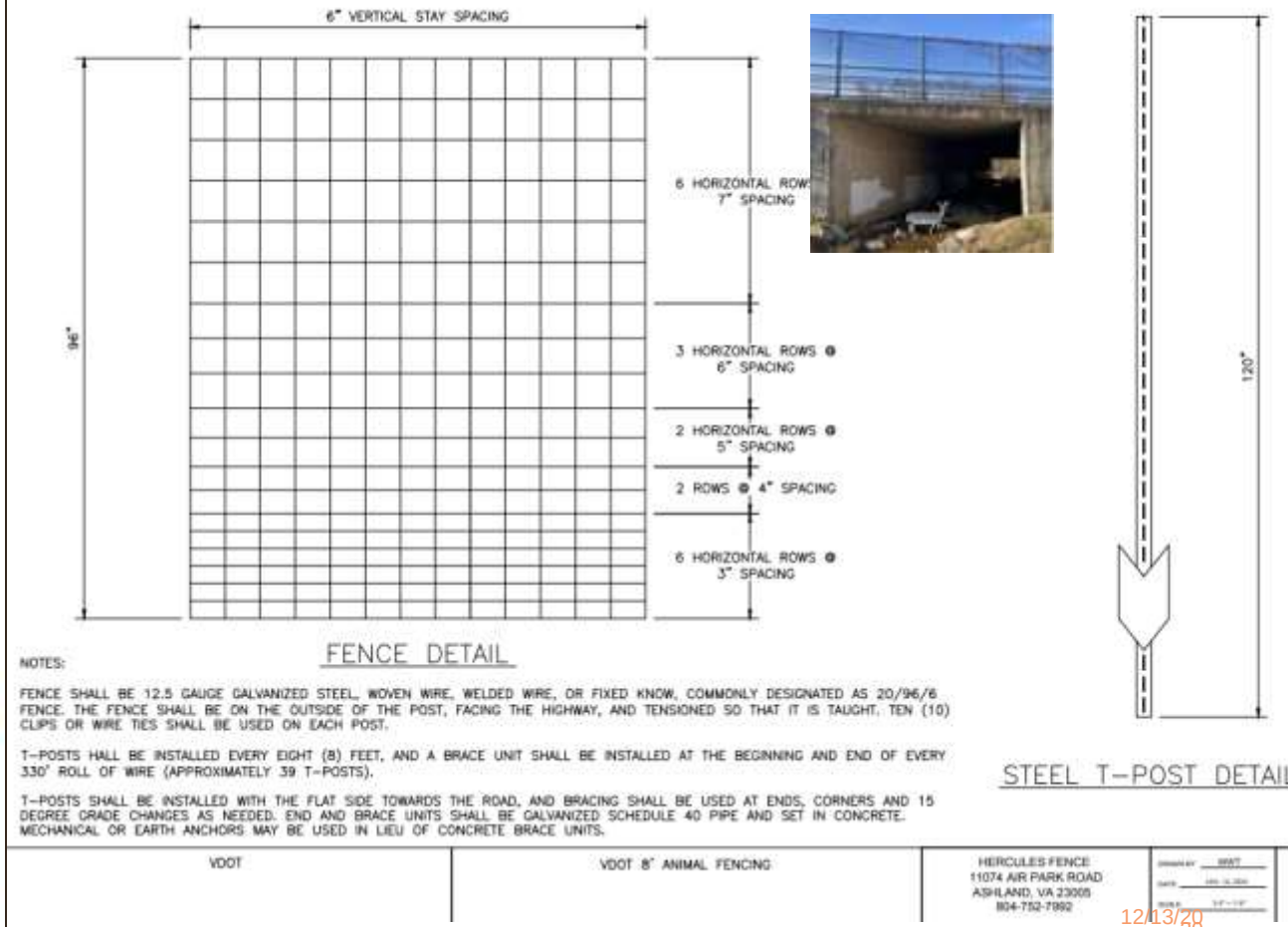
INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: Large Animal Crash Countermeasures
SPECIFIC SUBJECT: Policy for Determining Areas with a High Risk of Large Animal-Vehicle Crashes and Guidance for Implementing Countermeasures

Implementation

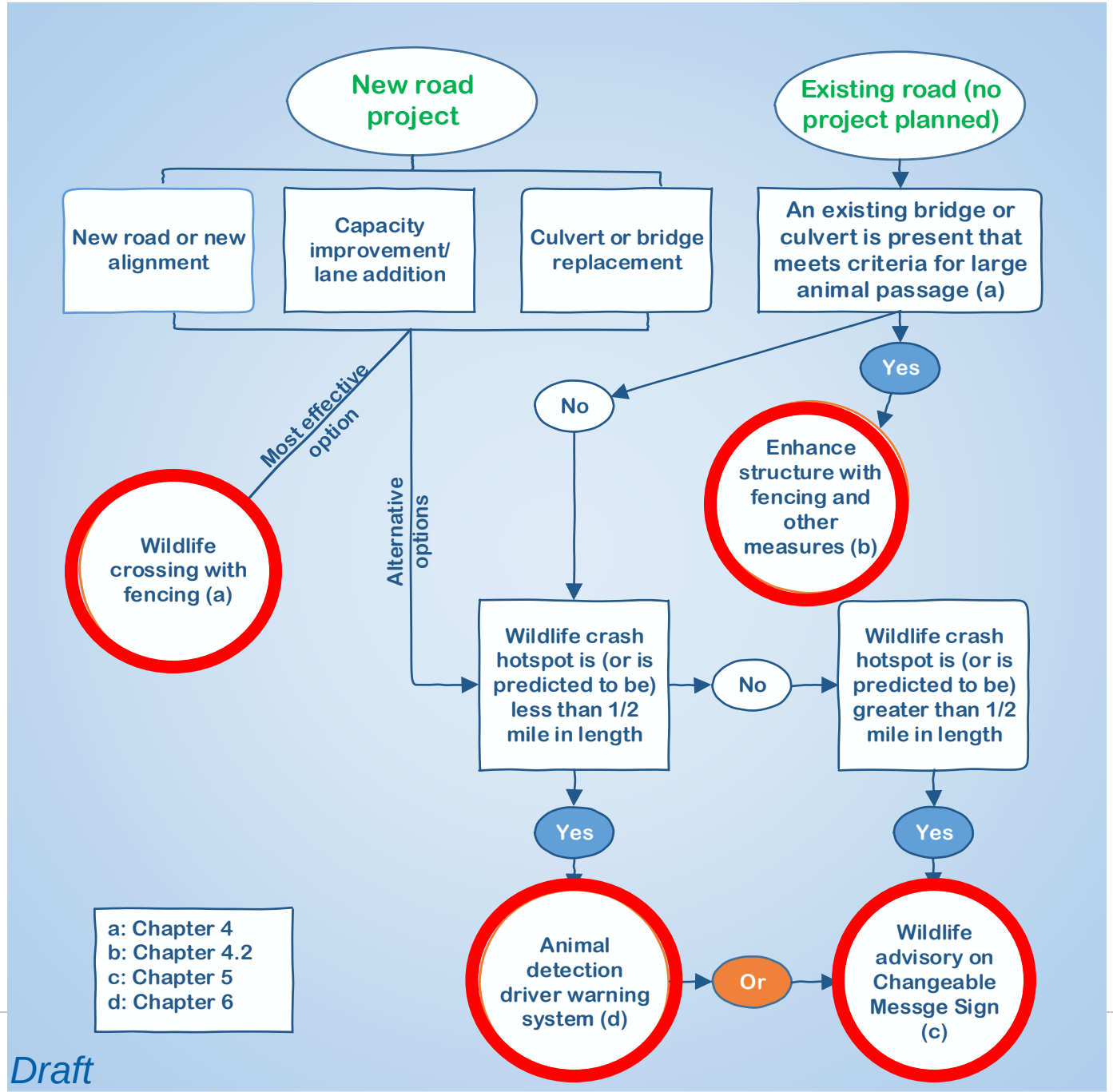
VDOT Guidelines for Large Animal Crash Countermeasures





Implementation

VDOT Guidelines:
Decision chart for selecting a wildlife crash countermeasures



Implementation

Bridge Manual: Chapter on Underpass Enhancements

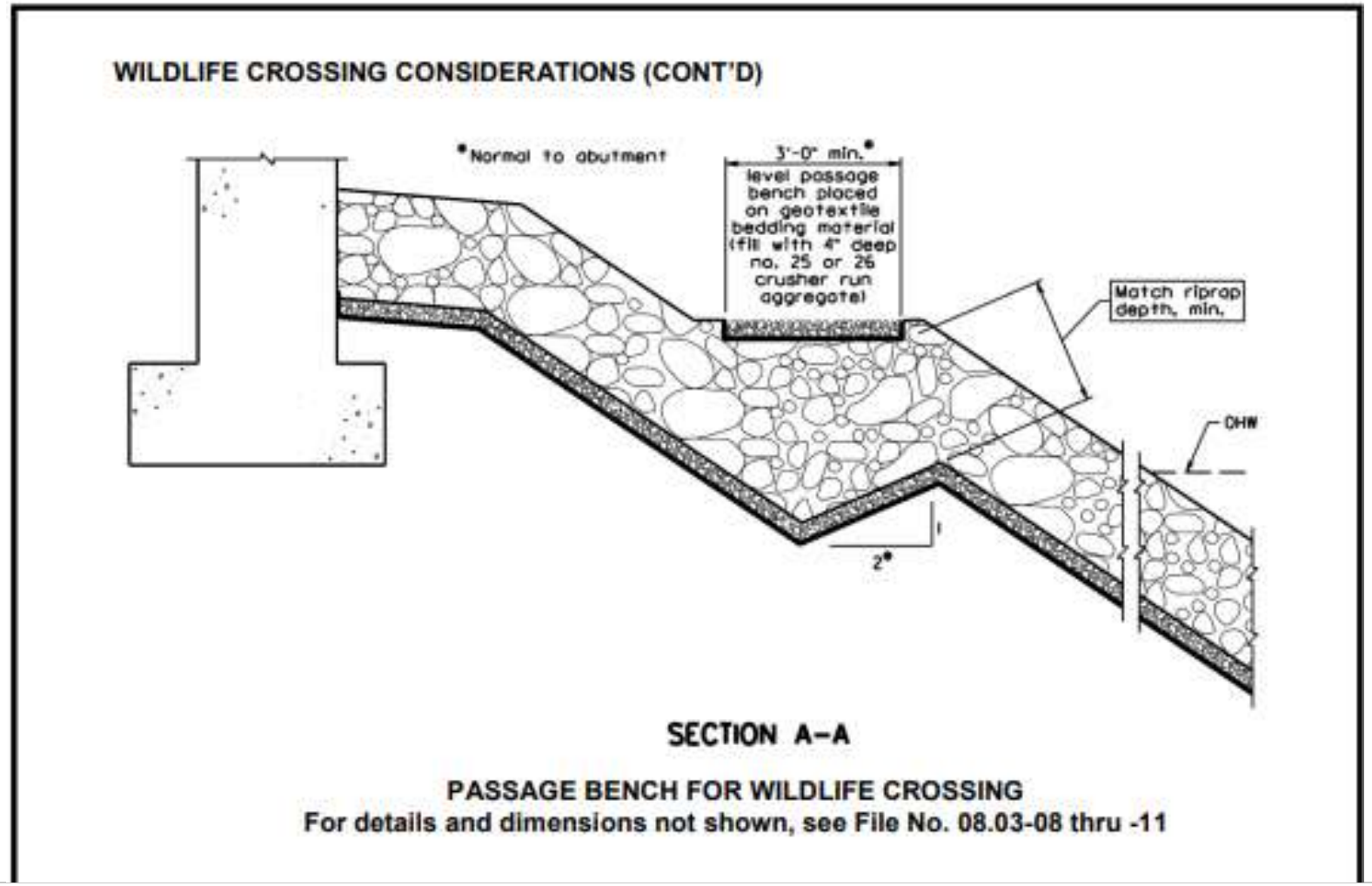
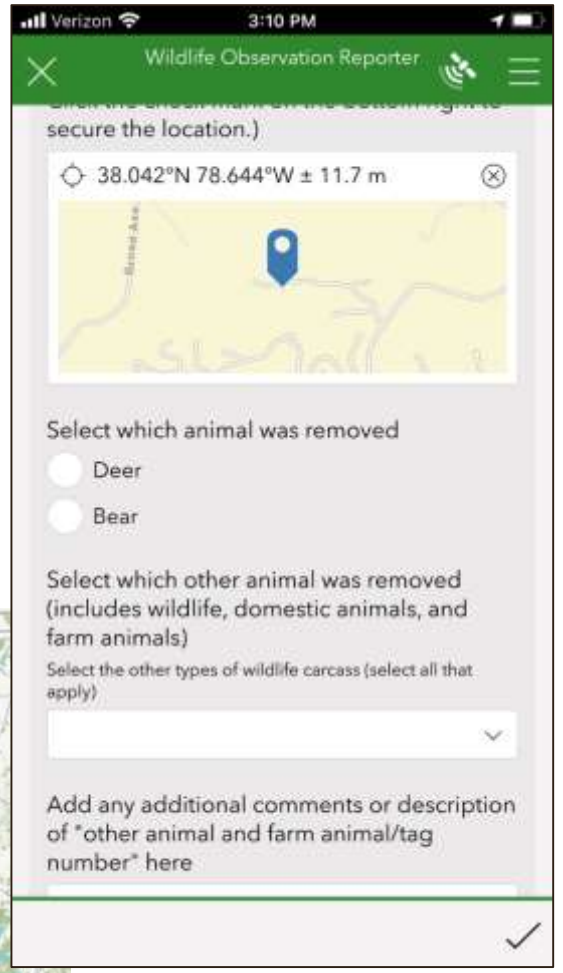


Image credits: Minnesota DOT

Implementation

Carcass Removal App

- For the collection of spatially accurate roadkill data
- To provide tools for simple visualization and identification of wildlife crash hotspots



Relevant State Legislation

Research findings were used to help inform legislative decisions regarding the creation of a Virginia **Wildlife Corridor Action Plan** (2020):

Virginia code, section 29.1-579

Tasks the Virginia Department of Wildlife Resources, Virginia DOT, the Virginia Department of Conservation and Recreation, and the Department of Forestry to identify wildlife corridors and wildlife crash hotspots in Virginia

Related legislation was passed in 2021 that built upon this by directing several state agencies to incorporate the recommendations from the Wildlife Corridor Action Plan into their planning process

Thank you

Bridget.Donaldson@VDOT.Virginia.gov

Safety Data Analytics Project

Enhance Crash Understanding With Data Combination

CTB Briefing

Nathan O'Kane, P.E.

12/7/2021

Data Source	Data Owner / VDOT Contact	Data Contents	Date (Range)	% Crashes Matched	Description	Readiness for Analysis
Virginia Roads: CrashData	Shan Di, Ralph Jones	890k Rows 69 Cols	2014 - 2021	100%	Base dataset with multiple types of factors	●
Police Crash Reports (RNS)	Shan Di	875k Rows 86 Cols	2014 - 2021	100%	Detailed information surrounding crashes like types of vehicles, includes police descriptions	●
Police Report Descriptions	Nathan O'Kane	782k Rows 2 Cols	2014 - 2020	90%	Text descriptions from police crash reports	●
SmarterRoads: Traffic Volume	Ralph Jones	122l Rows 5 Cols	1986-2019	100%	Percent of types of traffic (like truck, 2 axle, 3 axle etc) and ADT information by road segment	●
Pavement Rating	Tanveer Chowdhury, Raja Shekharan	23k Rows 173 Cols	2013 - 2020	71%	Robust set of pavement measurements	●
Guardrail	Ning Li, Mia Li	62k Rows 17 Cols	NA	100%	Guardrail positions	●
Curve Analysis	Shan Di	664k Rows 22 Cols	NA	100%	Measurements relating to Radius/Angle/Length of curves	●
Health Opportunity	Mark Cole, Stephen Read	1880 Rows 20 Cols	NA	100%	All fields are candidates for data integration. Useful for ethical and predictive reasons	●
US Census	N/A	2k Rows 125 Cols	2012 - 2019	99.7%	Information is valuable for ethical checks as well as relationships to crashes	●
NOAA	N/A	Python Package	2015 - 2020	97.5%	Historical hourly weather data for Virginia, to provide more insight into weather conditions at time of crash	●
Suncalc	N/A	Python Package	2015 – 2020	100%	Historical sunrise and sunset times for Virginia	●
SCRIM	*Stephen Read, Shan Di, Edgar de Leon*	*Unknown*	*2018 - 2020*		*Friction and other pavement related data*	●

	Analysis/Insight	Data Sources Used	Analysis Approach	Primary Tools
1	Distracted Driving Has a Larger Impact in Rainy Conditions	• VA Roads Crash Data • NOAA Weather Data	Analyze NOAA weather data and a range of pre-crash conditions to identify influence of precipitation and potential interactions with other crash attributes	tableau
2	Pavement Quality and Speeding Tie to More Severe Crashes	• VA Roads Crash Data • Pavement Rating Data	Analyze IRI pavement ratings and a range of pre-crash conditions to identify influence of pavement conditions and potential interactions with other crash attributes	tableau
3	Patterns in Roadway Departures Point to Specific Countermeasures	• All Data Sources	Apply machine-learning clustering analysis to 40+ fields across the Analysis Dataset, and evaluate cluster traits for crash patterns that might inform specific actions	python, Azure Machine Learning, ArcGIS
4	Clustering of Intersection Crashes Shows Patterns in Attributes & Locations	• All Data Sources	Apply machine-learning clustering analysis to 40+ fields across the Analysis Dataset, and evaluate cluster traits for crash patterns that might inform specific actions	python, Azure Machine Learning, ArcGIS
5	A Multi-Attribute Analysis of Intersection Crashes Ranks Relative Factors	• All Data Sources	Carry out logistic regressions of sets of crash attributes on specific types of crashes, to develop a multi-factor model of severe crashes; iterate on models to improve predictability	python, Azure Machine Learning
6	Community Characteristics are Reflected in Crash Outcomes	• VA Roads Crash Data • Health Opportunity Index • US Census Data	Through hypothesis testing with Health Opportunity Index and Census data, we have identified crash trends reflected in area characteristics	tableau
7	Curve characteristics have an impact on crash outcomes	• VA Roads Crash Data • Curve Data	Group curves together based on similar measurable characteristics to identify trends	python, tableau
8	Analysis of Curve Data Reveals Specific Hot Spots for Severe Crashes	• VA Roads Crash Data • Curve Data	Identify hot spots by grouping like curves together based on specific measurable characteristics and evaluating counts and rates of severe crashes	tableau, ArcGIS
9	Sharper Curves Exacerbate the Impact of Speeding	• VA Roads Crash Data • NOAA Weather Data • Curve & Pavement Data	Using the engineered field Curve Sharpness, analyze the impact of curves in tandem with specific crash attributes to explore how those attributes are impacted by curves	tableau

2 Pavement Quality and Speeding Tie to More Severe Crashes

Summary

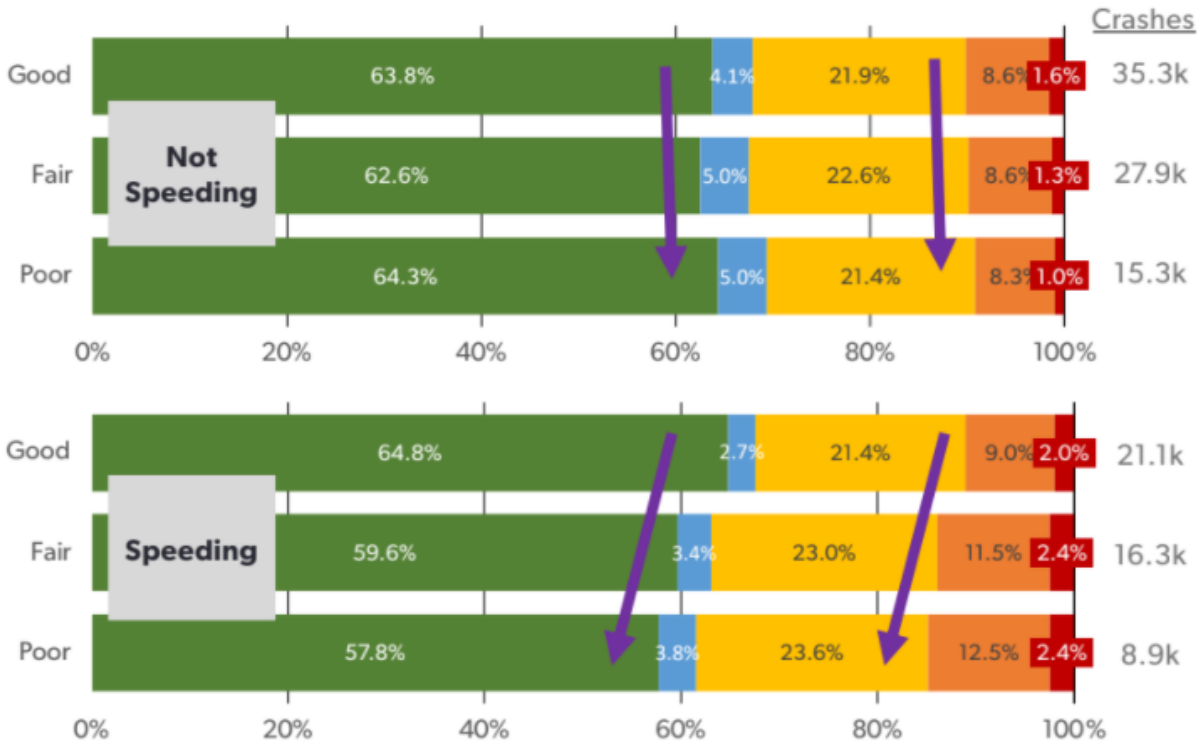
Speeding drivers, as indicated in the police crash report, seem to have more high-severity crash outcomes when driving on poorer pavement conditions

Takeaway: Poorly rated pavement coincides with increased severity of crashes involving speeding

Analysis

Influence of Pavement Rating and Speed on Crash Severity

Severity of Roadway Departure crashes for IRI ratings and speeding drivers



Note that other underlying factors (such as the variation of pavement ratings for different road types) can contribute to observed trends

Drivers that are not speeding appear to have similar crash severity outcomes across all IRI rating types. This suggests that there is not a relationship between not speeding, IRI pavement rating, and crash severity

Drivers that are speeding appear to have increasing crash severities as IRI rating decreases from Good to Poor. This suggests that as a driver speeds and IRI pavement ratings worsen, there is an increased likelihood for a higher-severity crash

CapTech

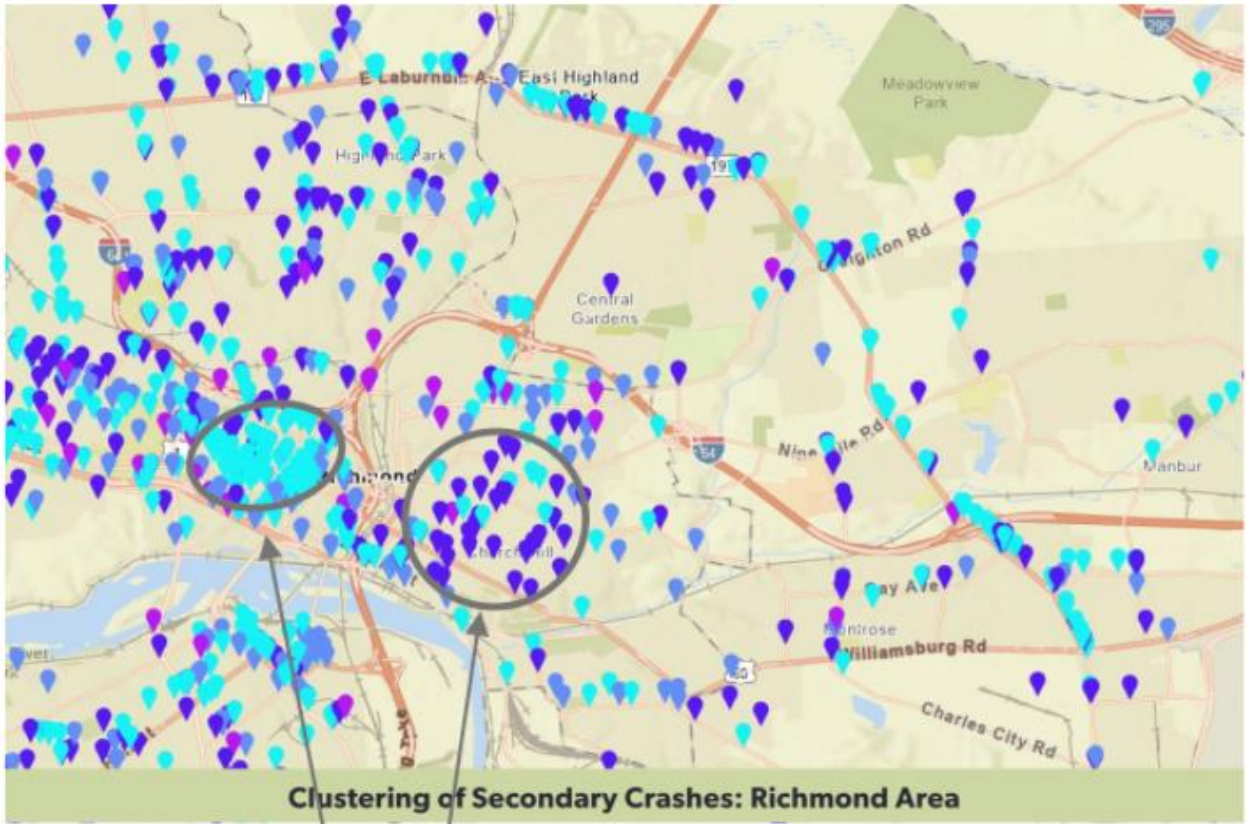
4 Clustering of Intersection Crashes Shows Patterns in Attributes & Locations

Summary

A multivariate, hierarchical clustering analysis of intersection accidents yields thematic crash patterns that align with intuitions of different intersection types. Some geographic patterns emerge, without including geography in the analysis

Takeaway: Clustering of intersection crash attributes reveals intuitive patterns, driven strongly by roadways and environments

Analysis



Clustering of Secondary Crashes: Richmond Area

Geographic similarities in clusters arise, without including crash locations in the analysis

Cluster		Characteristics
	0	• Two Car • Traffic Signal/Stop Sign intersections • Tend to be Angle/Rear crashes
	1	• 3-way intersections • Tend to 2 car crashes
	2	• Angle Crashes • Urban • Low Speeding % • Four-way intersections • 2 car crashes
	3	• High Severity • Fixed Object Off Road • Distracted, Unbelted, Alcohol, Higher Speed crashes • Evening/Late Night • Tends to be unsignalized
	4	• Low counts; one-car accidents • Two-way Intersection • No traffic control device • High severity • Located frequently near DC

CapTech

7 Analysis of Crash Severities and Curve Characteristics

Summary

We assessed curve crash locations, severity counts, and other crash characteristics in a comprehensive view. After grouping similar curves, we inspected specific curve hot spots using satellite imagery and street views

Takeaway: Further analysis of the crash severities and curve characteristics will likely yield more insights

Analysis

Identification of Curve Hot Spots for Severe Crashes

Top locations of severe crashes, grouped by curve radius/angle

VROADS Location	Pavement/PCR Road Name	Curve/CapTech Curve Bucket	Curve Curve Type	CapTech Sharpness	VROADS RD Count	Guardrail No GR KAB Count	VROADS Total KAB Count
Norfolk Hampton Roads	I-64 Interstate	Large Radius Radius: 2.5k, Angle: 81	Simple	0.18	25	158	168
Springfield NOVA	I-495 Interstate	Large Radius Radius: 1.9k, Angle: 45	Simple	0.16	6	55	58
Richmond Richmond	I-64 Interstate	Large Radius Radius: 2k , Angle: 56	Reversed	0.17	5	46	50
Richmond Richmond	I-195 Interstate	Sm Radius, Lg Angle Radius: 771, Angle: 53	Simple	0.26	42	54	55
Richmond Richmond	I-64 Interstate	Sm Radius, Lg Angle Radius: 967, Angle: 77	Simple	0.28	2	23	26
Norfolk Hampton Roads	I-264 Interstate	Sm Radius, Lg Angle Radius: 911, Angle: 65	Simple	0.26	3	18	19
Centreville NOVA	SR-898 Primary	Sm Radius, Sm Angle Radius: 928, Angle: 27	Simple	0.17	0	23	23
Virginia Beach Hampton Roads	SR-632 Primary	Sm Radius, Sm Angle Radius: 980, Angle: 26	Simple	0.16	0	19	19
Chesterfield Richmond	SR-637 Secondary	Sm Radius, Sm Angle Radius: 603, Angle: 26	Reversed	0.21	0	14	14

* Lists of hot spots for different roadways and crash types to be provided in Excel

Curve Radius-Angle Buckets

Radius-Angle Buckets	KAB Count
Large Radius	18,481
Small Radius, Large Angle	9,338
Small Radius, Small Angle	12,803

Curve Sharpness: Engineered Field

- Smaller radius curves are sharp curves
- Sharp curves have large angles are long and sharp increasing potential risk.
- *Curve Sharpness* = $(Angle/Radius)^{0.5}$

CapTech

VDOT Safety Data Analytics - 2021

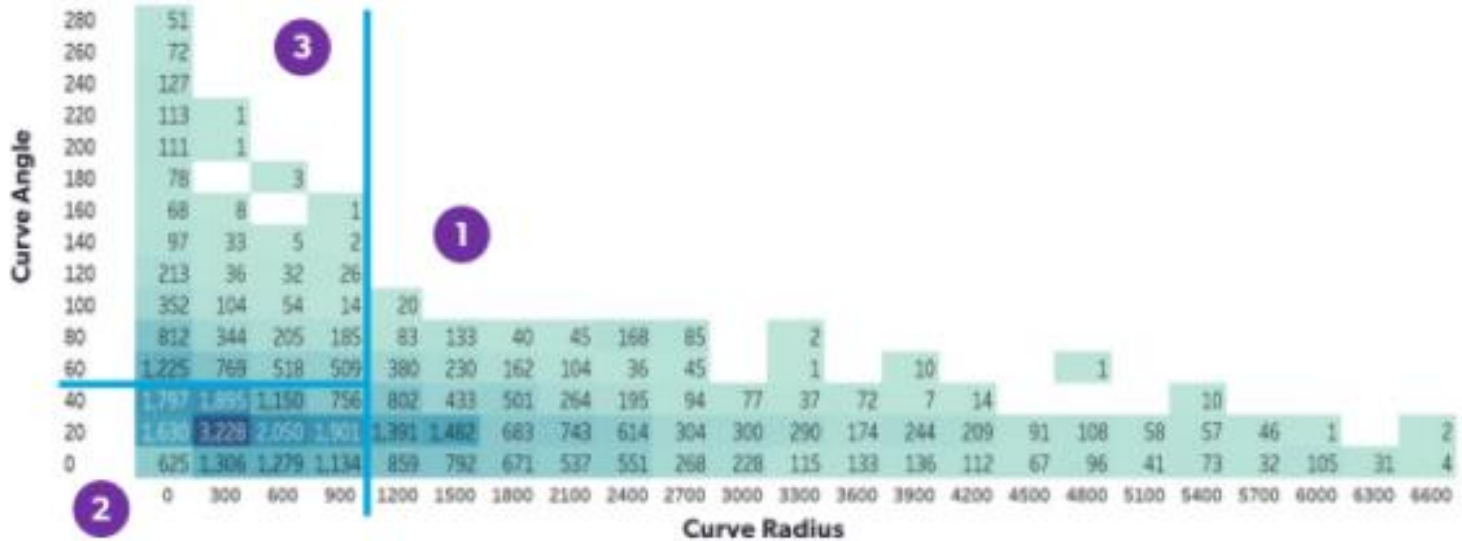
Curve Angle v. Curve Radius Heatmap

By aggregating curve angle and curve radius into specific bins, the team can access similar curve characteristics to discover insights

1. **Large Radius Bin** - All locations that have a radius greater than 1,000 (18,481 crashes)
2. **Small Radius, Small Angle Bin** - All crash locations that have a radius less than 1,000 and an angle less than 45 (12,803 crashes)
3. **Small Radius, Large Angle Bin** - All crash locations that have a radius less than 1,000 and an angle greater than 45 (9,335 crashes)

Curve Angle and Curve Radius Distribution

KAB crash severities by curve angle and curve radius bins



Next Steps

- QA/QC of the Analysis Dataset and Results
- Scaling the results and method accross the department
- Evaluate Enhancements to Crash Dataset
- Developing Countermeasures with CO TED and Districts