

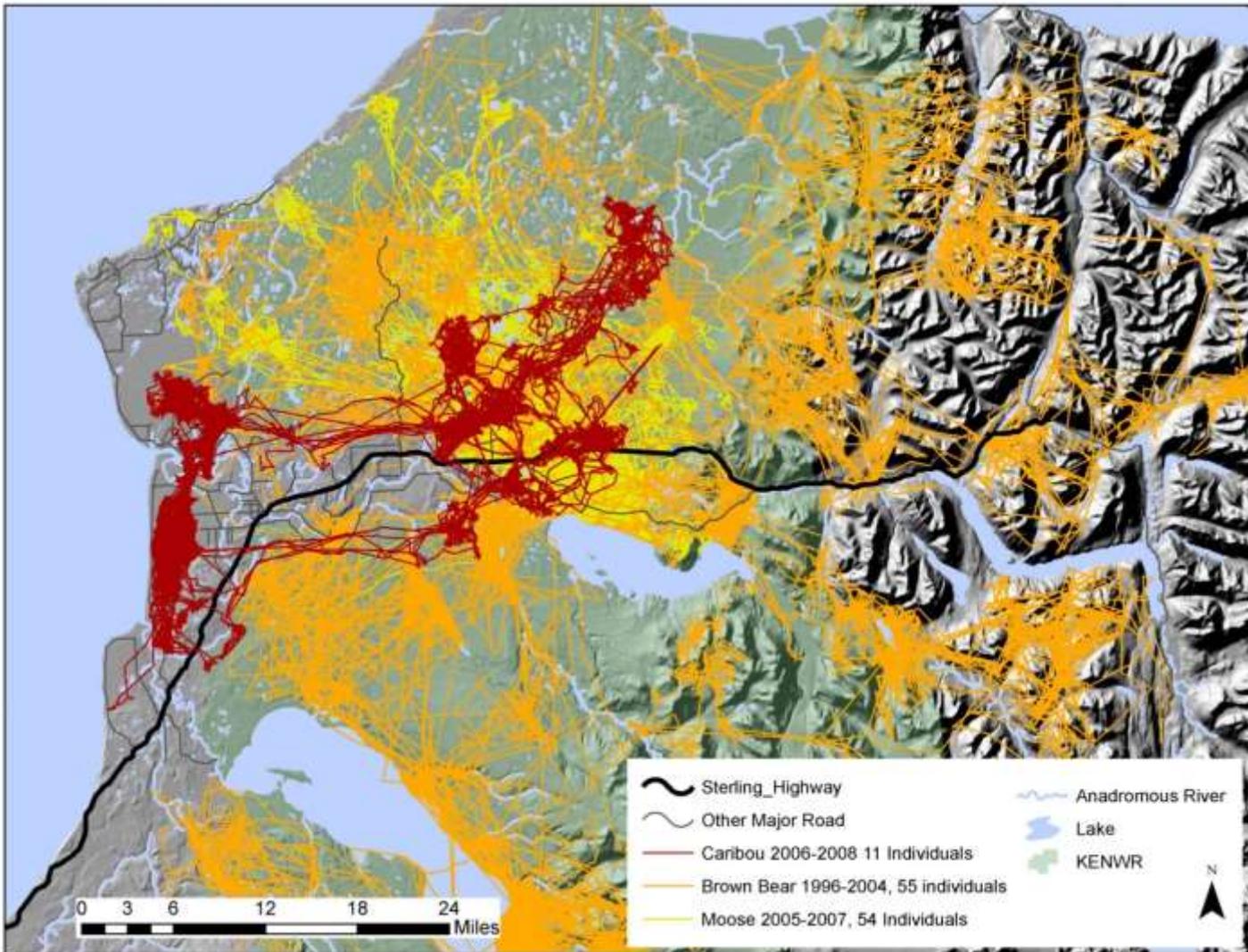
Why does the moose cross the road?

Sterling Highway MP 58-79 Improvement Project
Jim's Landing to Sterling

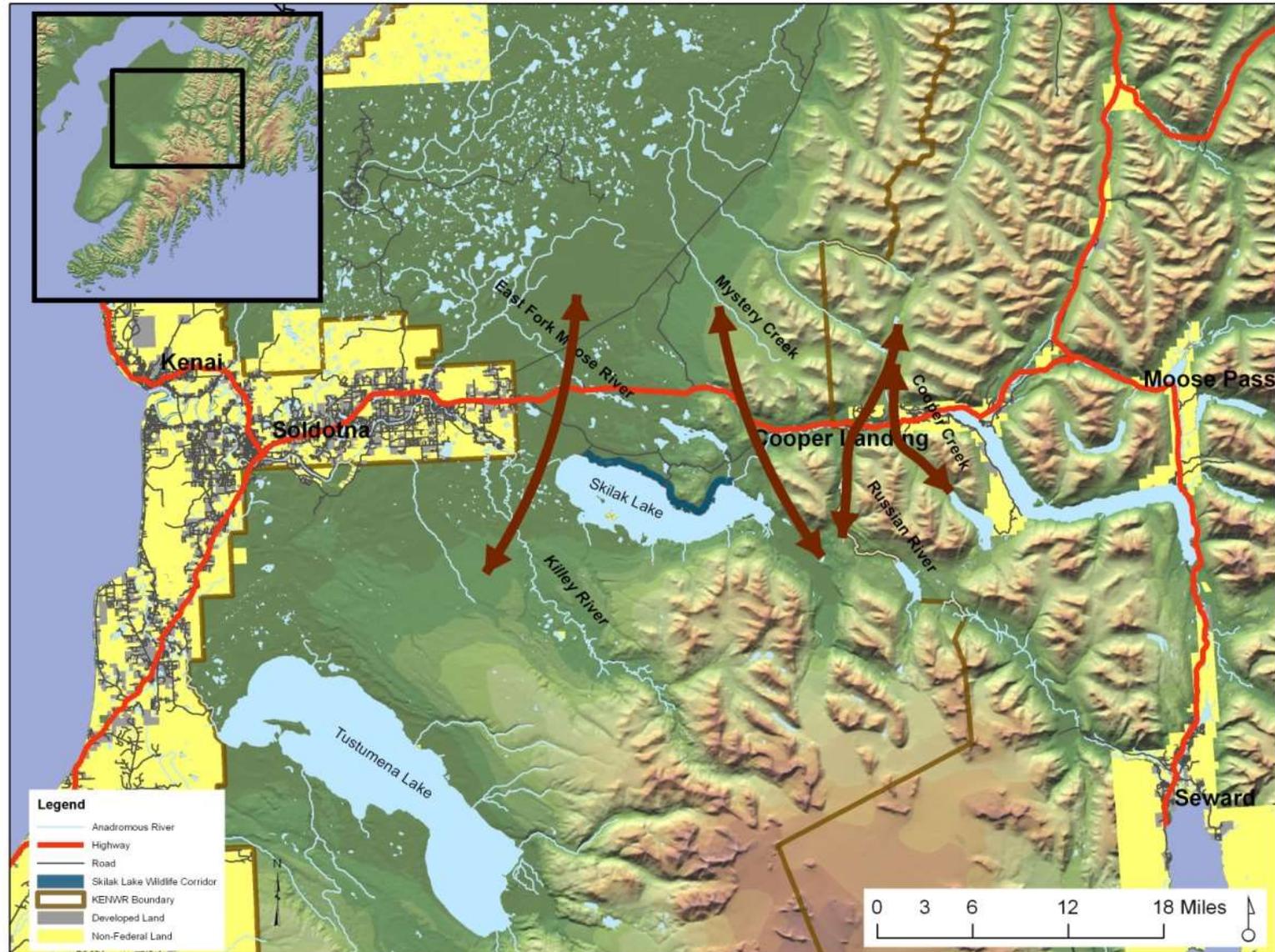
John Morton
Kenai National Wildlife Refuge



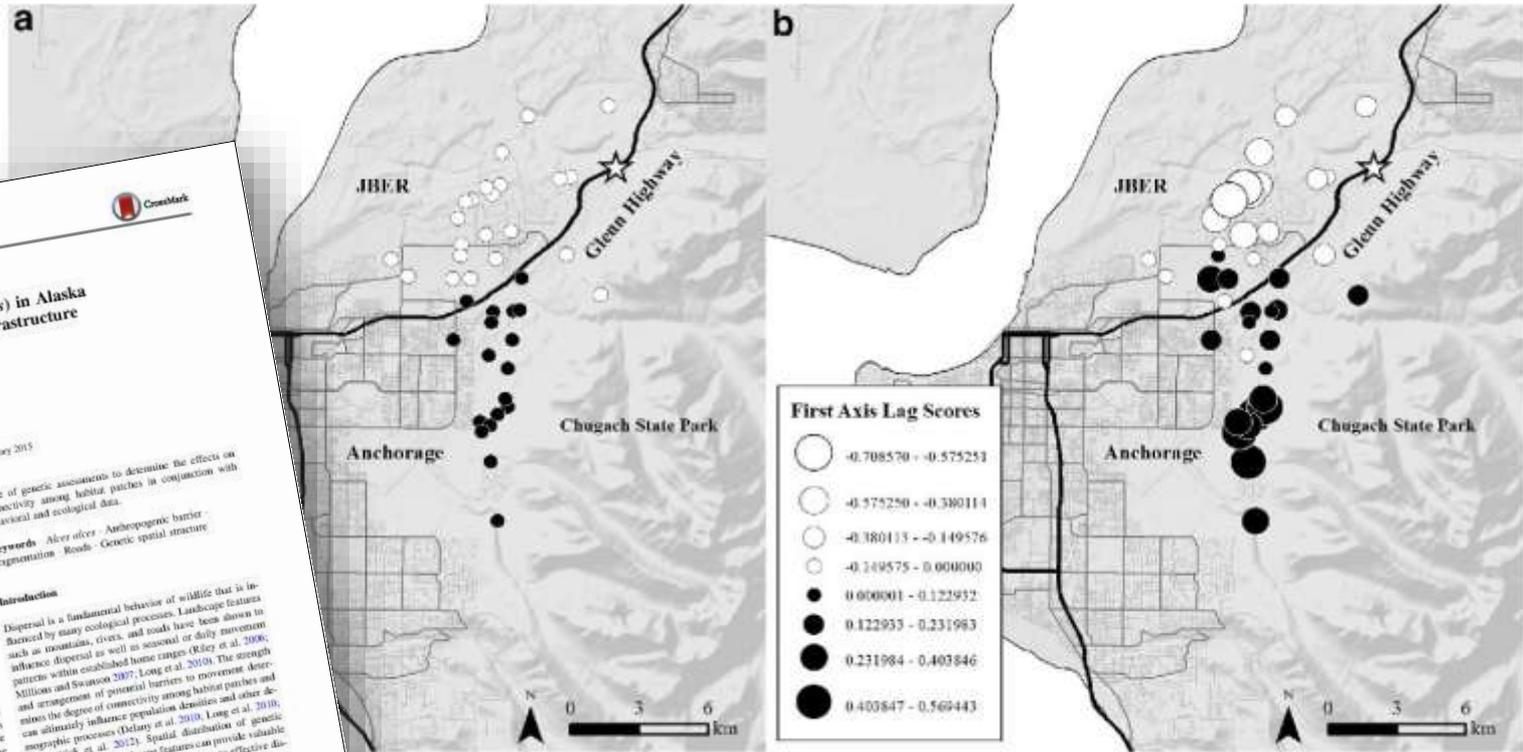
Caribou (n=11), brown bear (n=55) and moose (n=54) avoid the Sterling development corridor and cross in the project area



Only 3 landscape-scaled corridors remain for north-south wildlife movement (<20% of area historically available)



Glenn Highway divides Anchorage moose into 2 genetically distinct subpopulations



Bayesian clustering

sPCA

- based on microsatellite allelic frequency (n = 40)



 CrossMark

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RESEARCH ARTICLE

A genetic discontinuity in moose (*Alces alces*) in Alaska corresponds with fenced transportation infrastructure

Robert E. Wilson · Sean D. Farley · Thomas J. McDonough · Sandra L. Talbot · Perry S. Barboza

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Abstract The strength and arrangement of movement barriers can impact the connectivity among habitat patches. Anthropogenic barriers (e.g. roads) are a source of habitat fragmentation that can disrupt these resource networks and may have an influence on the spatial genetic structure of populations. Using microsatellite data, we evaluated whether observed genetic structure of moose (*Alces alces*) populations were associated with human activities (e.g. roads) in the urban habitat of Anchorage and rural habitat on the Kenai Peninsula, Alaska. We found evidence of a recent genetic subdivision among moose in Anchorage that corresponds to a major highway and associated infrastructure. This subdivision is most likely due to restrictions in gene flow due to alterations to the highway (e.g. moose-resistant fencing with one-way gates) and a significant increase in traffic volume over the past 30 years. Genetic subdivision was not observed on the Kenai Peninsula in an area not bisected by a major highway. This study illustrates that anthropogenic barriers can substructure wildlife populations within a few generations and highlights the value of genetic assessments to determine the effects on connectivity among habitat patches in conjunction with behavioral and ecological data.

Keywords *Alces alces* · Anthropogenic barrier · Fragmentation · Roads · Genetic spatial structure

Introduction Dispersal is a fundamental behavior of wildlife that is influenced by many ecological processes. Landscape features such as mountains, rivers, and roads have been shown to influence dispersal as well as seasonal (Riley et al. 2006; Millions and Swanson 2007; Long et al. 2010). The strength and arrangement of potential barriers to movement determines the degree of connectivity among habitat patches and can ultimately influence population densities and other demographic processes (Delany et al. 2010; Long et al. 2010; Heupel et al. 2012). Spatial distribution of genetic variation relative to landscape features can provide valuable insight into the effects of potential barriers to future alterations (i.e. gene flow) and help predict how future alterations to the landscape may impact a population (Coulon et al. 2006; Ross et al. 2010; Coster and Kovach 2012). Human activities can strongly impact natural communities. Urban infrastructures, especially roads, have been shown to be a major contributor to the fragmentation of wildlife habitats (Gerlach and Massol 2000; Miller and Hobbs 2002; Riley et al. 2006; Balkasol and Wain 2009; Selva et al. 2011; Schuster et al. 2013). Habitat alteration by roads and other anthropogenic developments can modify daily or seasonal movement patterns, disrupt social structure, and increase mortality due to vehicle collisions,

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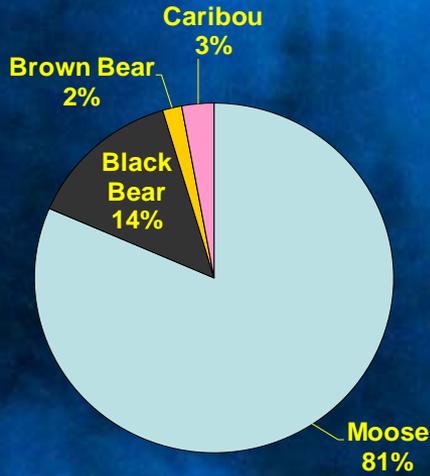
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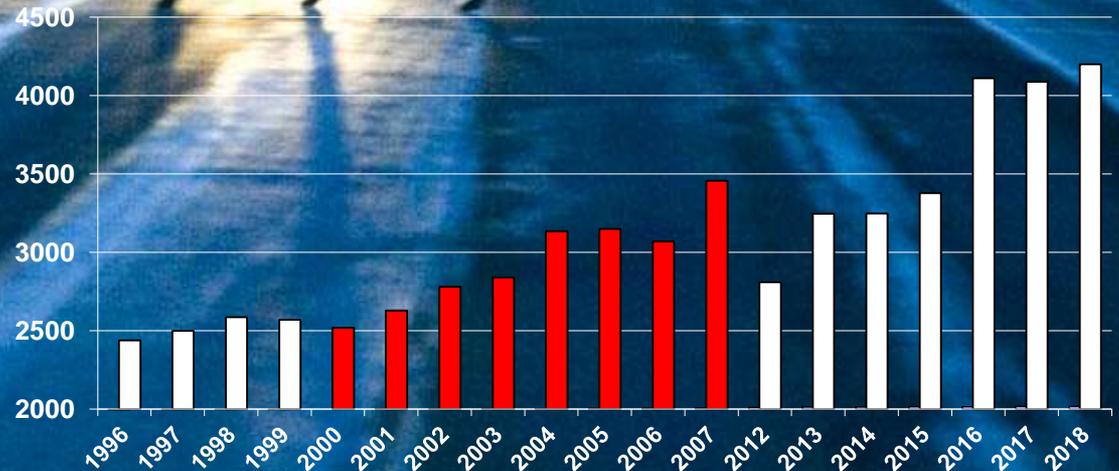
WILDLIFE-VEHICLE COLLISIONS

Sterling Highway MP 58 – 79
2000 to 2007 (n = 168)
22.4 WVC/year

Source: Alaska State Troopers

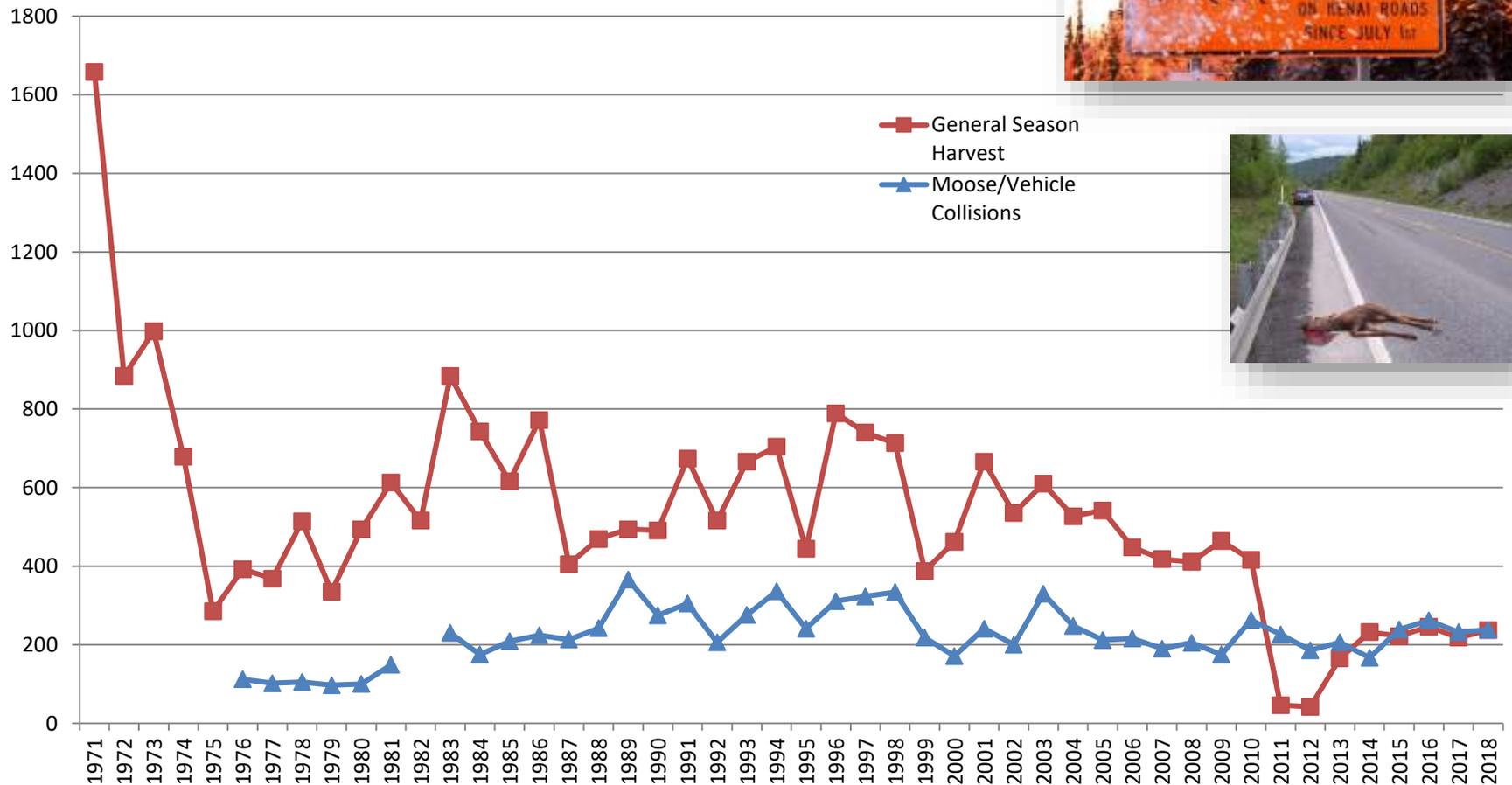


Traffic Volume
(AADT)



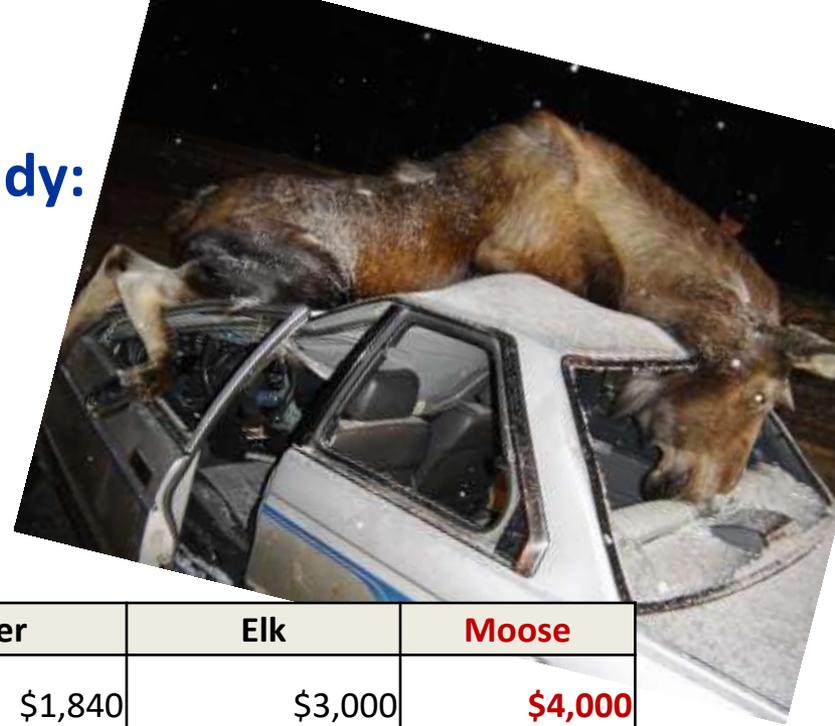
Source: Alaska DOT

Vehicle collisions kill as many moose as harvested by hunters (~250 per year)



Wildlife-Vehicle Collision Reduction Study: Report To Congress, FHWA 2008

**\$7 - \$9 million per year
on Kenai Peninsula!**



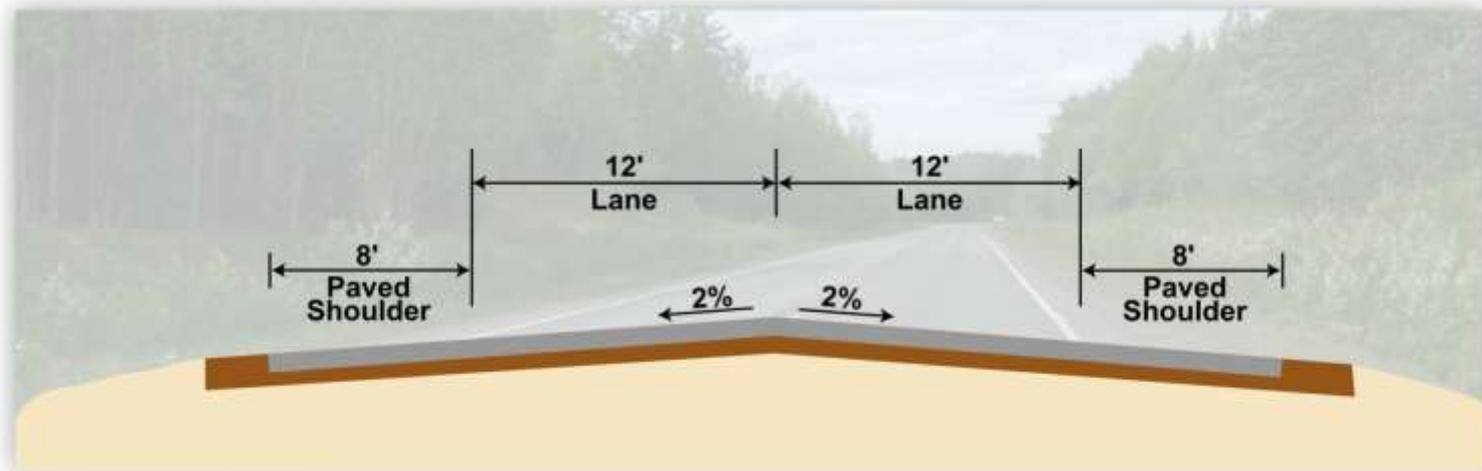
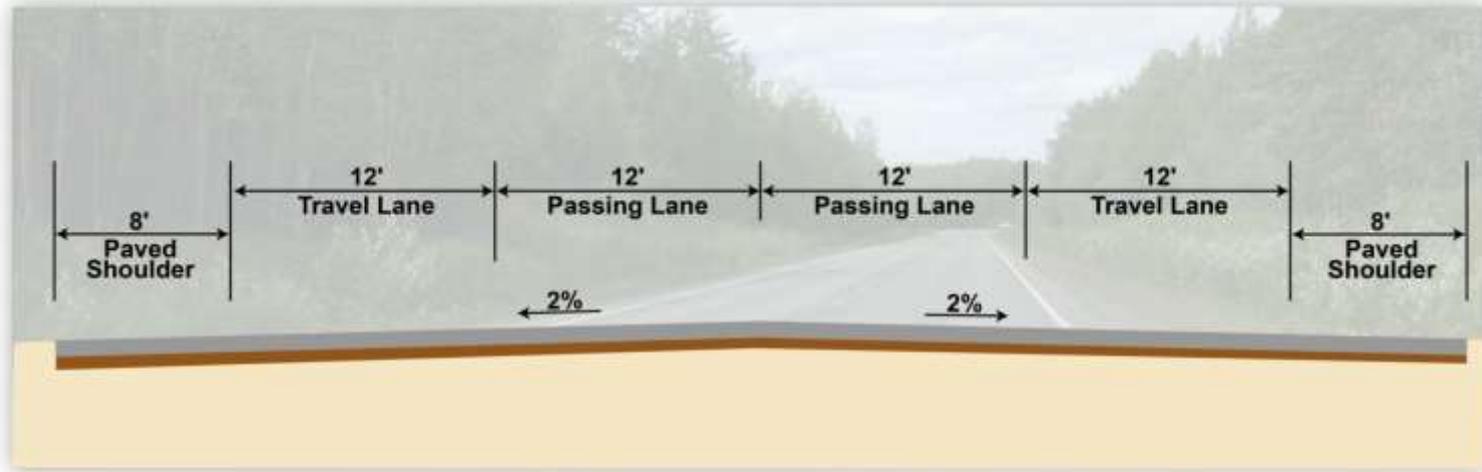
	Deer	Elk	Moose
Vehicle repair costs per collision	\$1,840	\$3,000	\$4,000
Human injuries per collision	\$2,702	\$5,403	\$10,807
Human fatalities per collision	\$1,671	\$6,683	\$13,366
Towing, accident attendance and investigation	\$125	\$375	\$500
Monetary value animal per collision	\$2,000	\$3,000	\$2,000
Carcass removal and disposal per collision	\$50	\$100	\$100
TOTAL	\$8,388	\$18,561	\$30,773

Sterling Hwy MP 58-79 project components

- Repave the existing highway
- Construct passing lanes
- Widen highway shoulders to 8'
- Improve drainage and hydrologic connectivity
- Maintain 55 mph posted speed
- Wildlife enhancement features



Typical Section



Wildlife Overpass



Wildlife Underpass

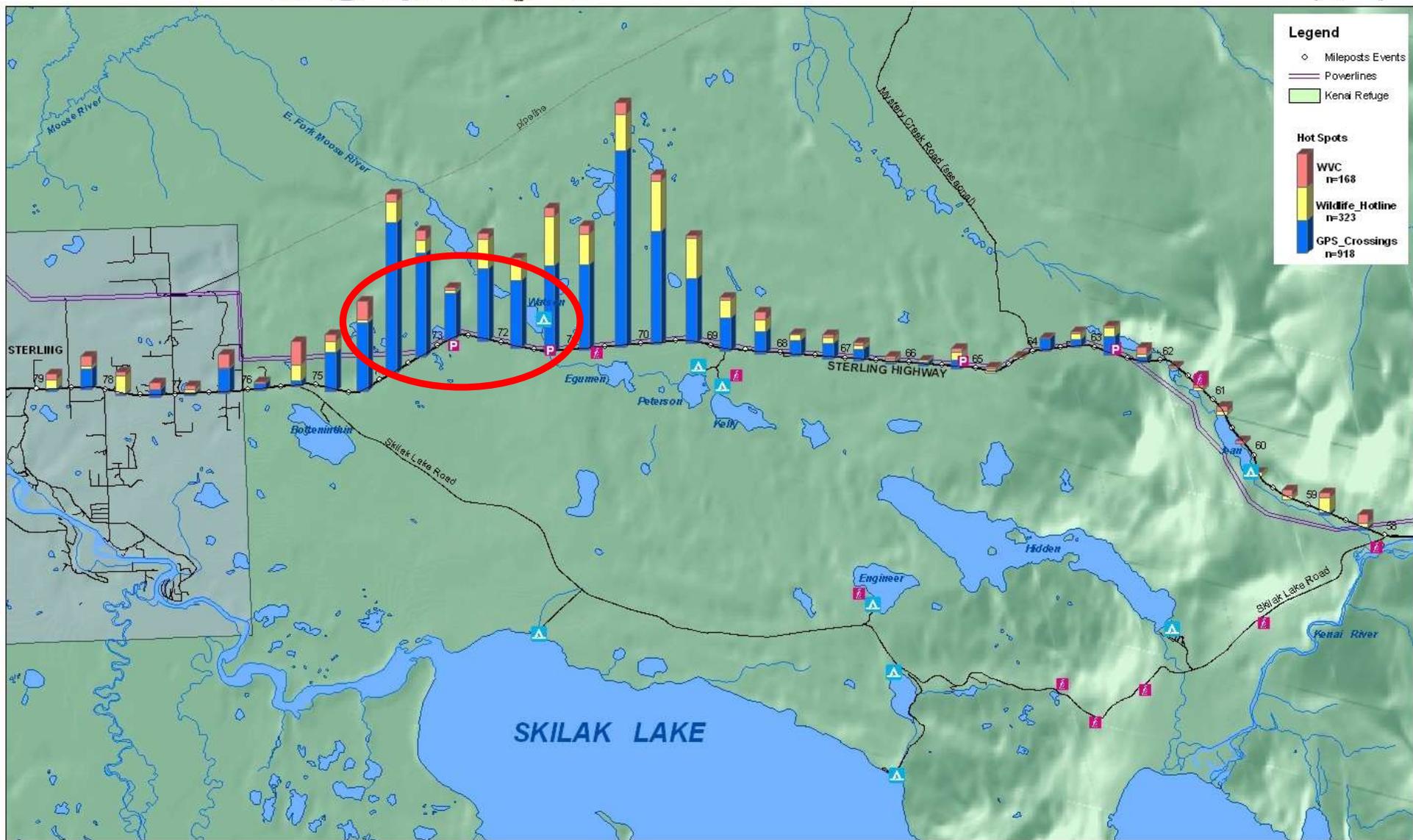


STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group
Kenai Peninsula, Alaska

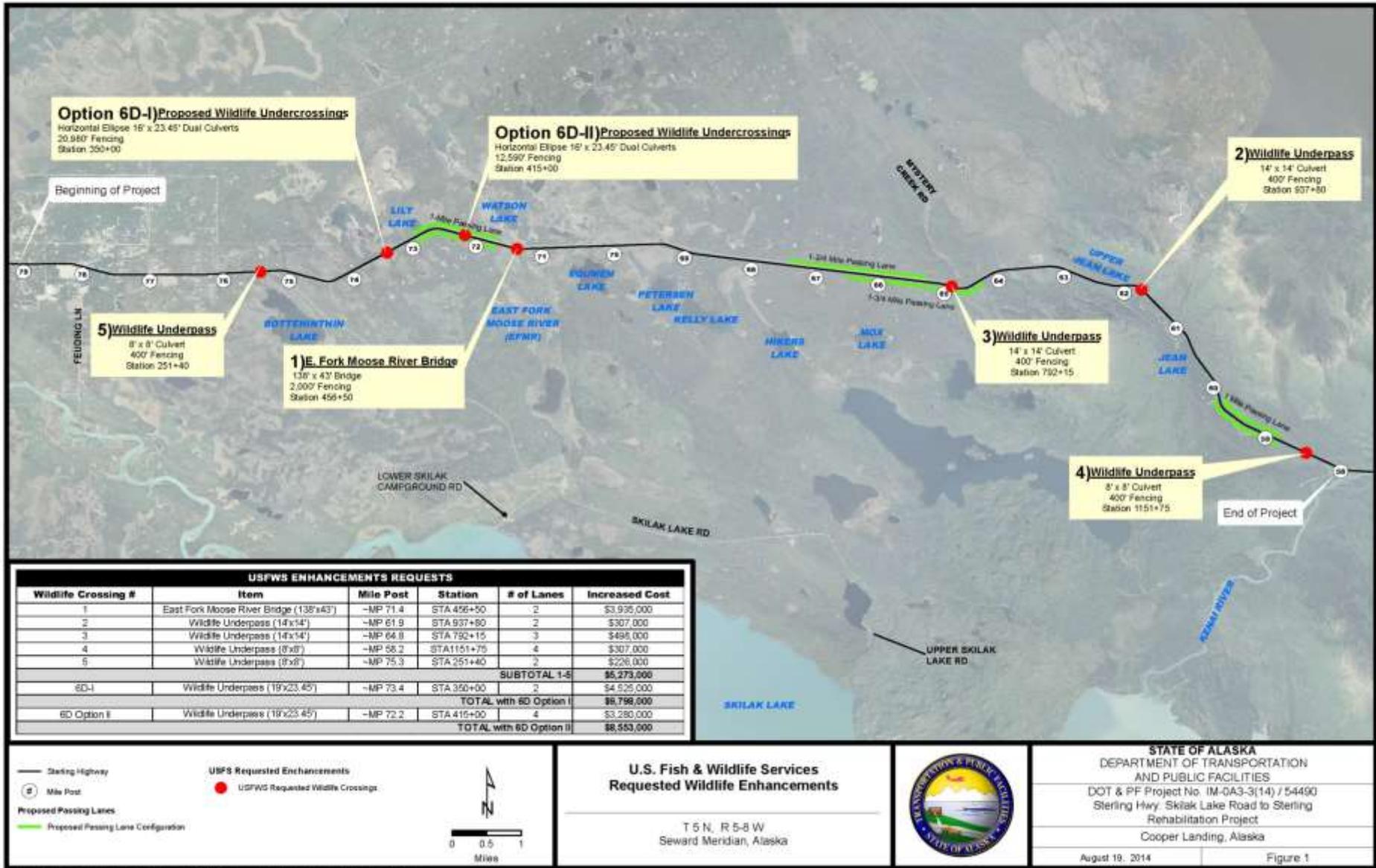


SEGMENTS OF HIGHEST CONCERN
Total WV Collisions, Hotline Sightings, and GPS Crossings



Map 3. Hot spots (sum of WV Collisions, Wildlife Hotline, and GPS Crossings) along the Sterling Highway.





Option 6D-I) Proposed Wildlife Undercrossings
 Horizontal Ellipse 16' x 23.45' Dual Culverts
 20,960' Fencing
 Station 350+00

Option 6D-II) Proposed Wildlife Undercrossings
 Horizontal Ellipse 16' x 23.45' Dual Culverts
 12,590' Fencing
 Station 415+00

2) Wildlife Underpass
 14' x 14' Culvert
 400' Fencing
 Station 937+80

3) Wildlife Underpass
 14' x 14' Culvert
 400' Fencing
 Station 792+15

4) Wildlife Underpass
 8' x 8' Culvert
 400' Fencing
 Station 1151+75

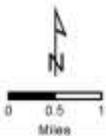
5) Wildlife Underpass
 8' x 8' Culvert
 400' Fencing
 Station 251+40

1) E. Fork Moose River Bridge
 138' x 43' Bridge
 2,000' Fencing
 Station 456+50

USFWS ENHANCEMENTS REQUESTS					
Wildlife Crossing #	Item	Mile Post	Station	# of Lanes	Increased Cost
1	East Fork Moose River Bridge (138'x43')	-MP 71.4	STA 456+50	2	\$3,935,000
2	Wildlife Underpass (14'x14')	-MP 61.9	STA 937+80	2	\$307,000
3	Wildlife Underpass (14'x14')	-MP 64.8	STA 792+15	3	\$495,000
4	Wildlife Underpass (8'x8')	-MP 58.2	STA 1151+75	4	\$307,000
5	Wildlife Underpass (8'x8')	-MP 75.3	STA 251+40	2	\$226,000
SUBTOTAL 1-5					\$5,270,000
6D-I	Wildlife Underpass (16'x23.45')	-MP 73.4	STA 350+00	2	\$4,525,000
TOTAL with 6D Option I					\$9,795,000
6D Option II	Wildlife Underpass (16'x23.45')	-MP 72.2	STA 415+00	4	\$3,280,000
TOTAL with 6D Option II					\$8,553,000

— Existing Highway
 ● Mile Post
 Proposed Passing Lanes
 — Proposed Passing Lane Configuration

USFWS Requested Enhancements
 ● USFWS Requested Wildlife Crossings



U.S. Fish & Wildlife Services
 Requested Wildlife Enhancements

T 5 N, R 5-8 W
 Seward Meridian, Alaska

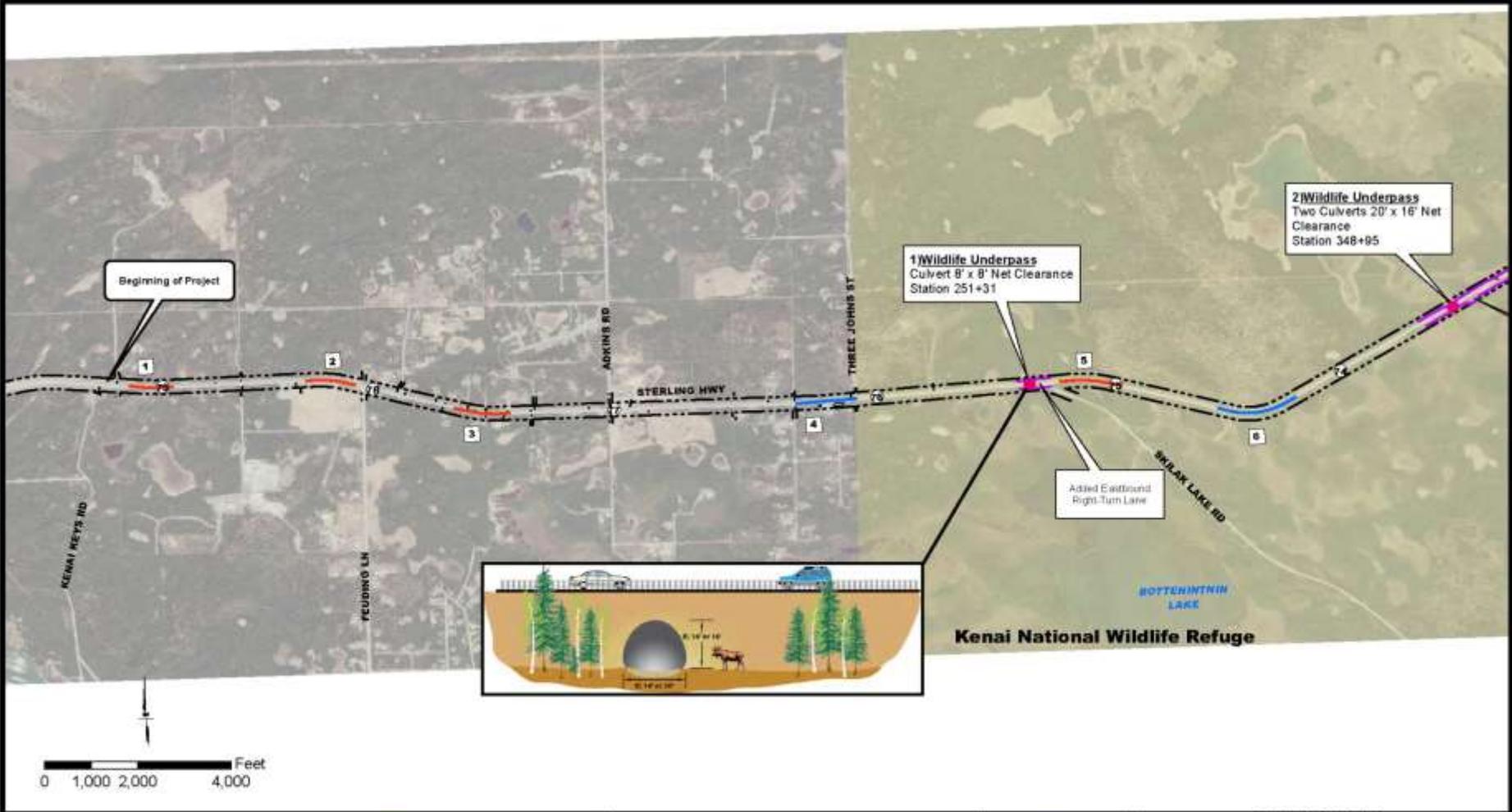


STATE OF ALASKA
 DEPARTMENT OF TRANSPORTATION
 AND PUBLIC FACILITIES
 DOT & PF Project No. IM-0A3-3(14) / 54490
 Sterling Hwy. Skilak Lake Road to Sterling
 Rehabilitation Project
 Cooper Landing, Alaska

August 19, 2014

Figure 1

MP 75.3 8'x8' underpass



- Milepost
- Wildlife Crossing Enhancements
- Kenai Wilderness
- Kenai National Wildlife Refuge
- 300-ft Right-of-Way
- Passing Lanes
- Moose Fence
- Horizontal Curve Improvement
- Superelevation Improvement
- Curve Number

**Project Overview of
Proposed Improvements**

T 5 N, R 5-8 W
Seward Meridian, Alaska



STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

Project No. 0A3-3(14)Z548900000
Sterling Hwy MP 58-79: Skilak Lake Road to Sterling
Rehabilitation Project
Sterling, Alaska

April 4, 2017

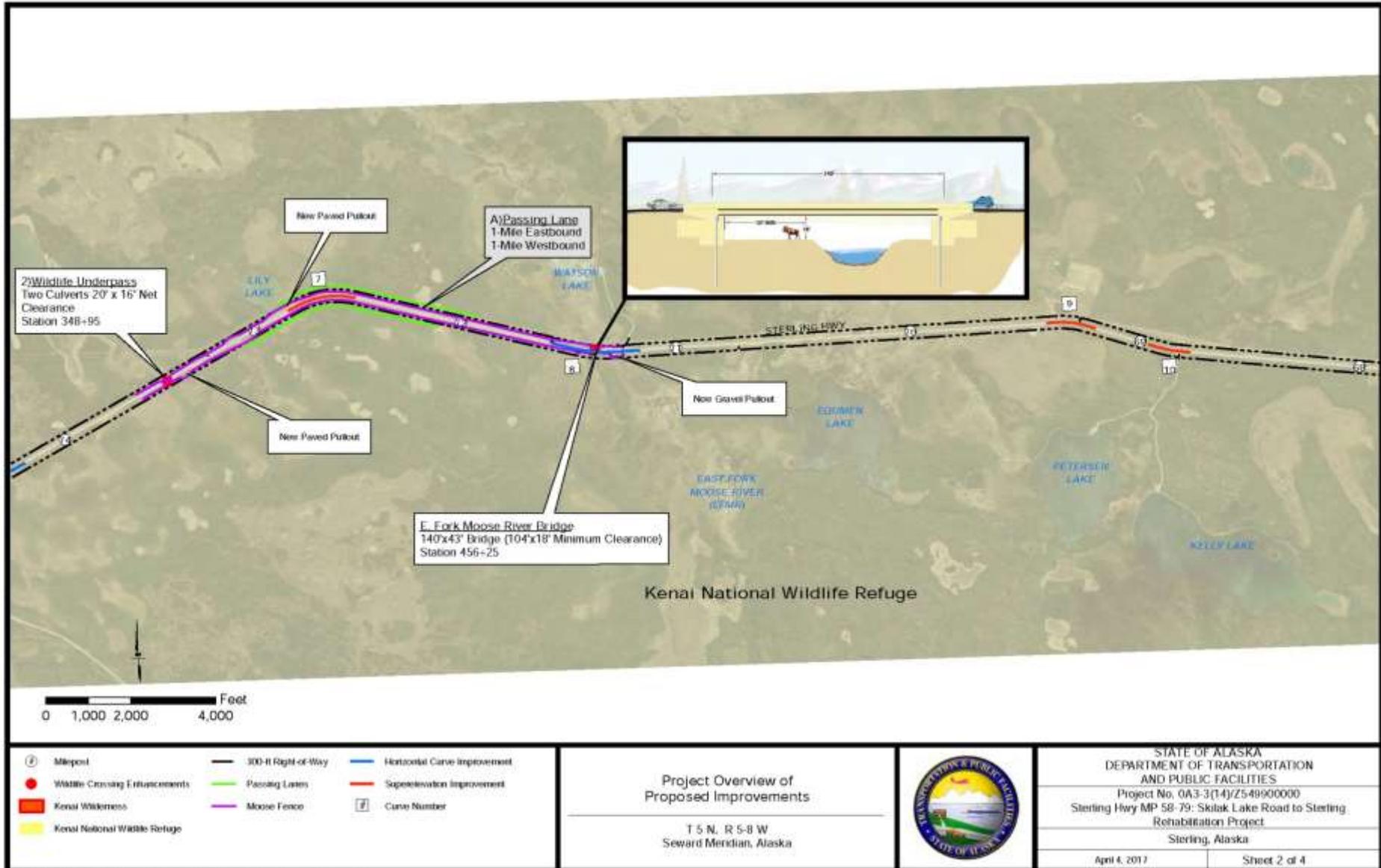
Sheet 1 of 4



MP 75.3



MP73.4 20'x16' underpasses (2), EFMR 104'x18' bridge



MP 73.4



East Fork of Moose River

**OLD
10' culvert**



**NEW
104' X 18'
bridge**



Moose Fence

- **2.3-mile (x 2) Fence 9-ft tall with 1-ft gap at bottom**

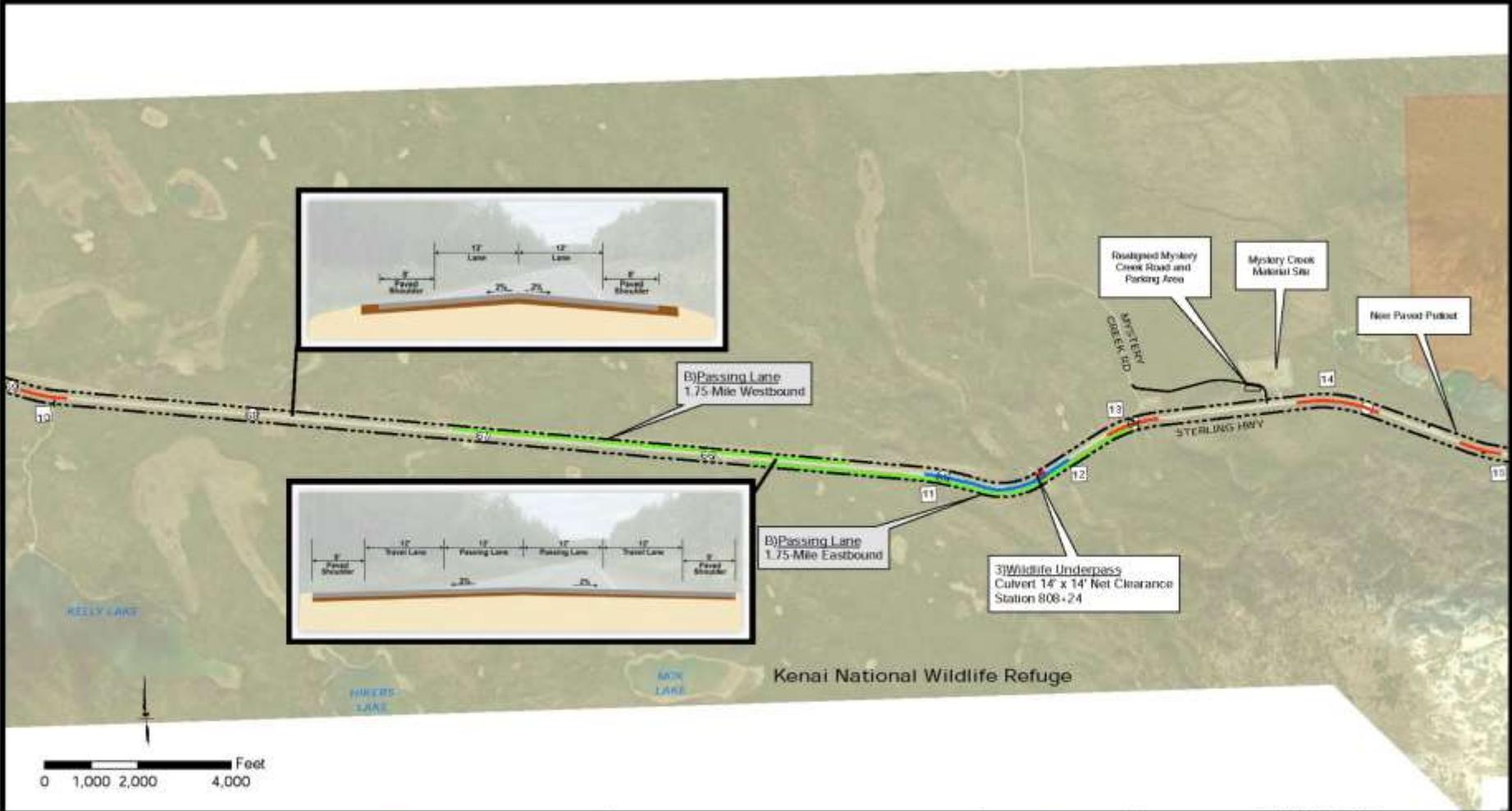


Moose Fence

- 2.3-mile (x 2) fence 9-ft tall with 1-ft gap at bottom
- 22 jump-outs alternating every 1/8-mile



MP 64.8 14'x14' underpass



- 2 Milepost
- Wildlife Crossing Enhancements
- Kenai Wilderness
- Kenai National Wildlife Refuge
- 300-ft Right-of-Way
- Passing Lanes
- Moose Fence
- Horizontal Curve Improvement
- Superelevation Improvement
- 7 Curve Number

Project Overview of Proposed Improvements

T 5 N, R 5-8 W
Seward Meridian, Alaska

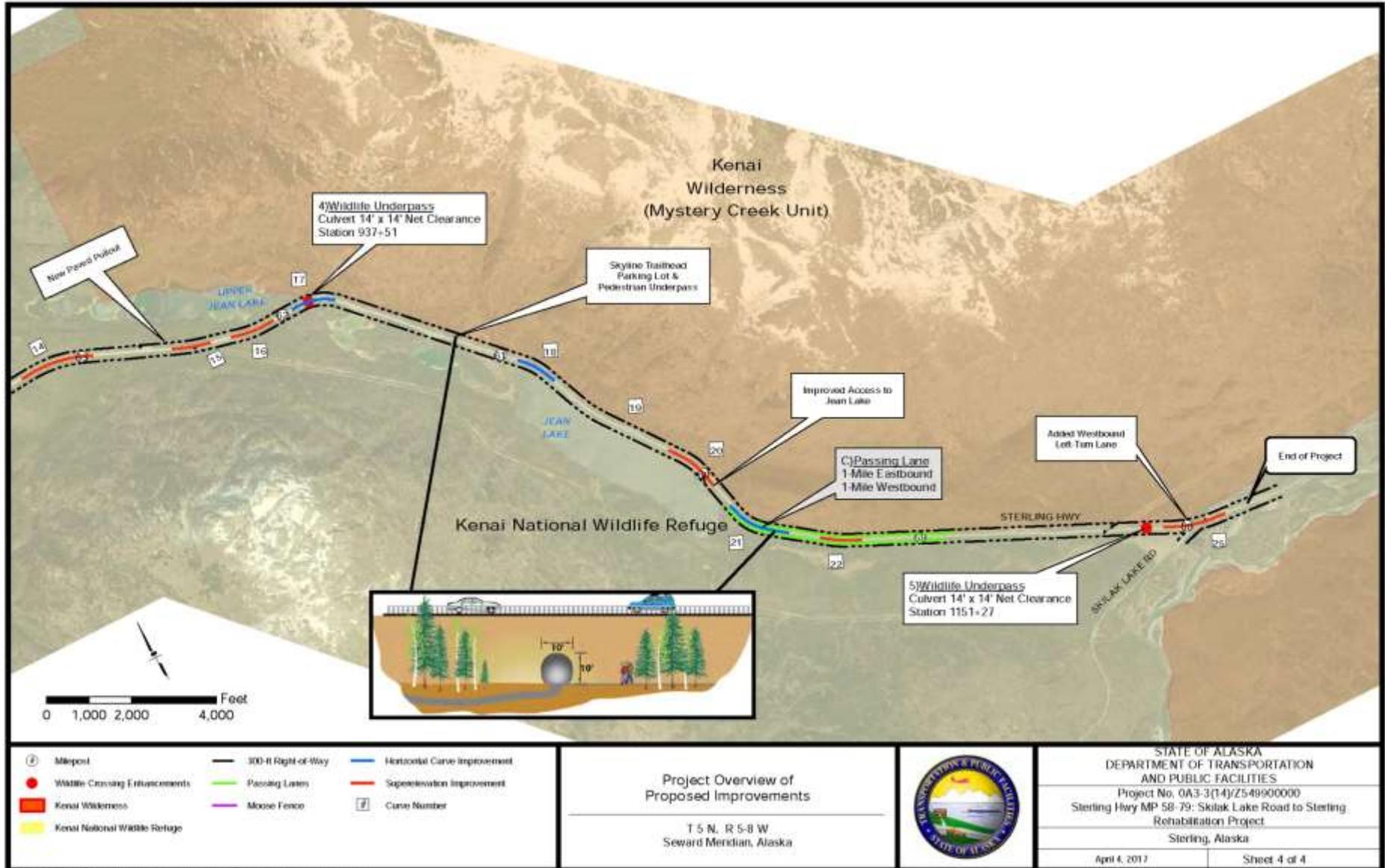


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Sterling Hwy MP 58-79: Skilak Lake Road to Sterling
Rehabilitation Project
Sterling, Alaska

MP 64.8



MP 61.9, 58.2 14'x14' underpasses





MP 61.9



MP 58.2

Additional Components

- Mystery Creek realignment/gravel pit restoration
- Skyline Trail pedestrian underpass/kiosk
- New paved pullouts at Lily Lake and MP 73.4
- Paving pullout at MP 62.7
- Turn lanes at Skilak Lake Road intersections
- Improved access road to Jean Lake
- Fish habitat in revetment along Kenai River braid at MP 57.8
- Improved hydrologic connectivity



Mystery Creek Road/Gravel Pit

- Extract 5.5 acres gravel from existing MP 63.4 material pit
- Realign road through gravel pit to improve safety/provide parking area
- Existing road access closed and partially reclaimed
- Spruce saplings translocated by YCC for reclamation

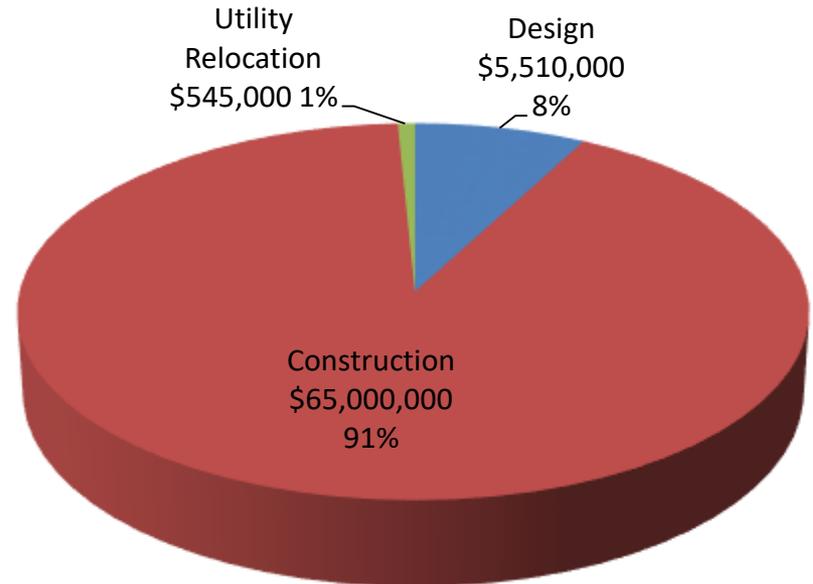


\$10.5 million wildlife mitigation

Milepost	Structure (net clearance)	Cost
75.3	structural plate pipe-arch 8' X 8'	\$550,410
73.4	structural plate horizontal ellipse 20' X 16'	\$1,255,690
	structural plate horizontal ellipse 20 X 16'	
	additional fill for 6a and 6B (~ 20,000 yd ³)	\$508,405
71.4	East Fork Moose River bridge (104' X 18')	\$2,473,104
64.8	structural plate underpass 14' X 14'	\$957,183
61.9	structural plate underpass 14' X 14'	\$572,740
58.2	structural plate underpass 14' X 14'	\$627,661
	retaining walls for wildlife undercrossings	\$718,189
	cast-in-place retaining wall (Jean Lake)	\$1,752,622
71.3-73.6	moose fence, 9' high,	\$487,041
	22 jump-outs	\$398,323

MP 58–79 project total cost \$71 million (bid amount)

- **93.4% Federal funds**
- **\$10.5 million wildlife mitigation**
 - \$1.5 million NWRS-WO funds
 - \$1.3 million gravel
- **\$0.6 million Skyline Trail underpass**
 - \$1 million FLAP grant



Do they work?



\$400K post-construction monitoring of wildlife and invasive plants

- 1st structures for wildlife outside of Anchorage area in Alaska
- 1st use of certified weed-free gravel and soil on a highway project in Alaska
- 1st time ADOT&PF has taken responsibility for invasive plant management





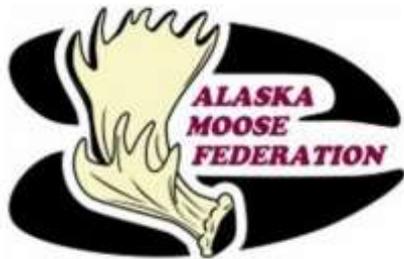
Cooper Landing Bypass

**4 large underpasses
and 1 vegetated
overpass (1st in
Alaska!) will be
constructed**



Partnership and Collaboration!

Andy Loranger, John M. Morton, Lynnda Kahn, Rick Ernst – Kenai NWR
Cynthia Ferguson, Christopher L. Post, Kathy Shea, Drew Vonlindern, Shaun Combs – Alaska DOT&PF
Steven Noble, Richard Pribyl, Zaid Hussein – Dowl HKM



U.S. Department
of Transportation
**Federal Highway
Administration**

THANK YOU

