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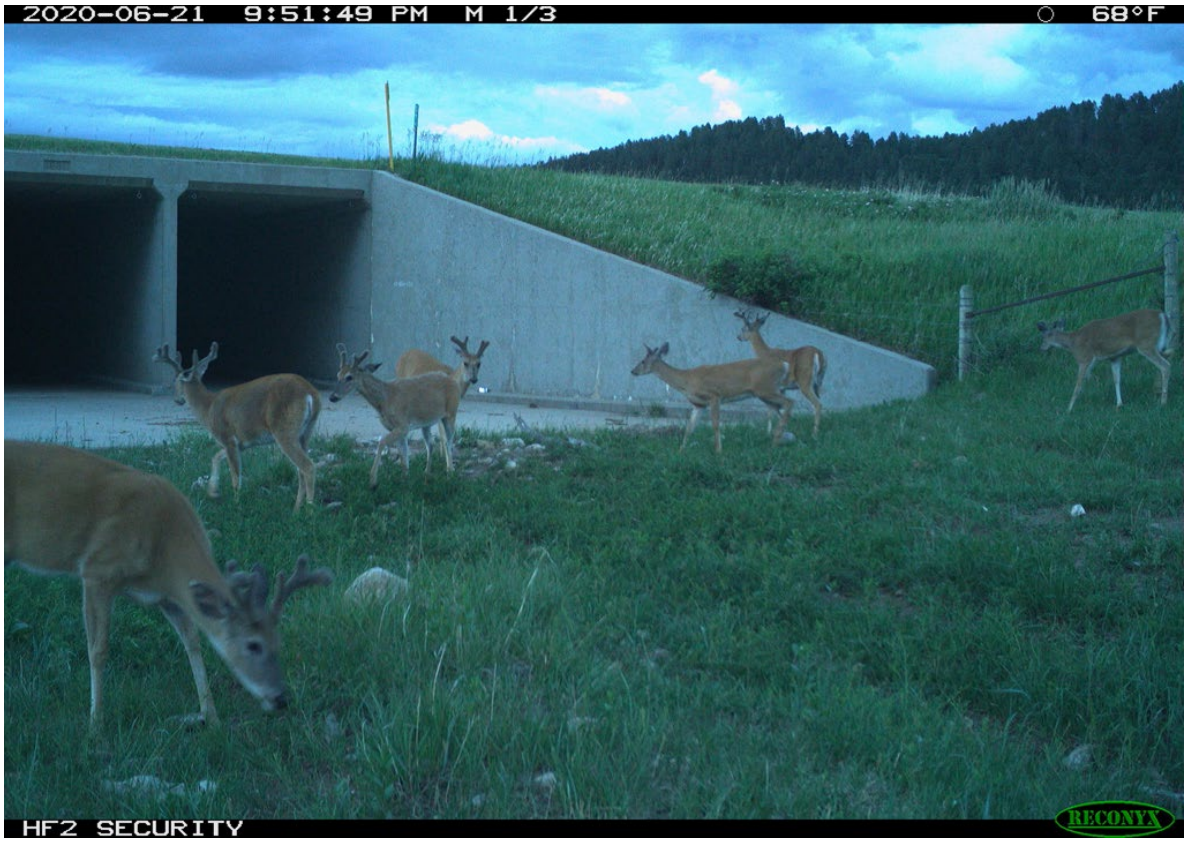

Guidelines for Wildlife Vehicle Collision Mitigation

Study SD2019-02

DRAFT Final Report

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16. Abstract

Vehicle collisions with wildlife are a national problem that affects motorists in every U.S. state, and challenges state DOTs seeking to minimize these crashes. New data shows U.S. drivers on average have a 1 in 116 chance of a collision with an animal. The company estimates there were over 1.9 million animal collision insurance claims in the U.S. between July 1, 2018 and June 30, 2019 (State Farm 2019). Wildlife vehicle collisions represent a substantial safety and economic concern for the traveling public in South Dakota. During the five-year span of 2014-2018 there were 22,955 reported wildlife vehicle collisions on South Dakota roadways (SD-DPS, 2019). Estimates show that tens of thousands of large ungulates are killed on South Dakota roadways each year. Large ungulates are a valuable resource to the state. Annually, an estimated $683 million dollars attributed to hunting are directly spent in South Dakota (Southwick Associates, 2017). The value of individual animals is difficult to assess and can vary greatly depending on factors used in the determination. This proposed research is a stepping-stone on the road to South Dakota becoming more proactive in identifying problem areas where wildlife moves across roads and creating the necessary mitigation to ensure the safety of the traveling public and preserve wildlife populations.

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Acronym	Definition
AVC	Animal Vehicle Collisions
DOT	Department of Transportation
FHWA	Federal Highway Administration
HWY	Highway
MRM	Mile Reference Marker
NDOT	Nevada DOT, and Nebraska DOT
PAS	Passage Assessment System
PI	Primary Investigator
PDO	Property Damage Only Crashes
QA/QC	Quality Assurance/Quality Control
SAT	Study Advisory Team
SDARS	South Dakota Accident Reporting System
SDDOT	South Dakota Department of Transportation
SDGFP	South Dakota Game Fish and Parks
SDDPS	South Dakota Department of Public Safety
STIP	Statewide Transportation Improvement Program
USDOT	United State Department of Transportation
UDOT	Utah Department of Transportation
WYDOT	Wyoming DOT
WVC	Wildlife-vehicle Collision

1 EXECUTIVE SUMMARY

South Dakota Department of Transportation (SDDOT) recognizes that wildlife-vehicle collisions (WVC) are a safety problem for motorists and an ecological problem for wildlife populations across the state. This research project was initiated to help identify solutions for reducing these collisions through sound decision-making within the SDDOT project development and design offices. Research results provide examples and guidance to address the problem of WVC and the work being conducted and needed to help reduce these collisions.

2 PROBLEM DESCRIPTION

Wildlife-vehicle collisions in South Dakota account for more than 25% of all crashes. Over 60% of these crashes occur on SDDOT-administered highways. It is estimated that on average over 20,000 large ungulates are lost to vehicle collisions throughout the state each year. Previous research has identified areas with the highest WVC rates in the state. Although locations in the Black Hills area rate the highest, additional information has shown that WVC occurrences are a statewide issue. To improve the safety of the traveling public and help maintain wildlife populations in South Dakota, SDDOT would need to identify locations with the most potential to incorporate WVC mitigation measures and to plan projects to implement those measures. To date there is no known guidance within SDDOT to assist in the planning, design, and implementation of WVC mitigation strategies and measures.

Work has been done nationally, resulting in wildlife collision avoidance strategies with a wide range of approaches. For the consideration of WVC mitigation within South Dakota priorities will be focused on the use of physical strategies (e.g. fencing, underpass, obstacles, habitat manipulation, etc.) Selecting the optimal, most cost-effective approach to mitigation is an involved process relying on an accurate and comprehensive assessment of site-specific characteristics, wildlife species, habitat and ecosystem, property ownership, and traffic conditions.

Research is needed to look at ways to reduce WVCs in South Dakota through:

- identification of key wildlife crossing locations
- creation of guidelines for scoping, investigation, design, and development
- creation of a methodology to evaluate mitigation needs
- determination of whether existing structures can be retrofitted or included for the use of wildlife crossings

- incorporation of wildlife crossings, fencing, or other useful techniques into currently planned transportation projects

The Federal Highway Administration (FHWA) and state DOTs are increasingly recognizing that WVCs are a serious problem for motorists and wildlife alike. Reducing these collisions necessitates several important steps for DOTs that include incorporation of initial planning, collaboration among agencies, and the creation of scientifically and engineer-based wildlife mitigation along transportation corridors.

Finally, successfully reducing WVCs requires access to the best available scientific and engineer-supported WVC mitigation techniques and their efficacy for protecting motorists. This can help create wildlife mitigation for different situations across the different ecoregions present in South Dakota. In turn early identification of WVC mitigation needs and the incorporation of specified data could help SDDOT create the most cost-effective wildlife mitigation for South Dakota's transportation networks. Tailored guidance for implementing mitigation techniques will be essential to achieving WVC reduction goals across South Dakota.

With this project, SDDOT will be positioning itself to incorporate a guide to assist in the early identification, research applicability of mitigation needs, design, and implementation of WVC mitigation into transportation planning and projects. This will allow SDDOT as an agency to better address the WVC problem in the state in a research-based, cost-effective, and efficient manner.

2.1 Financial Costs to South Dakota Citizens of Reported WVC Crashes

South Dakota averages close to 5,000 reported WVC on its roads and highways each year (data from South Dakota Department of Public Safety, SDDPS). The total accurate crash entries with codes for the severity of the WVC's were tallied for 2014 through 2018. In the 5-year period, 22,955 collisions with wildlife were reported, and 9 people died as a result of those collisions (Table 1).

Table 1. Number of WVC Crashes of Different Severity Types Reported to SDDPS 2014 through 2018.

CRASH INJURY TYPE	NUMBER OF REPORTED WVC 2014 - 2018	AVERAGE REPORTED WVC PER YEAR
Fatal to Human	9	1.8
Serious, Visible, and Possible Injury to Human	288	57.6
Property Damage Only	22,658	4,532
Totals	**22,955**	**4,591**

These crashes can be translated into monetary costs to the South Dakota public, based on SDDOT use of national standards for average monetary values for each crash type. South Dakota uses the U.S. Department of Transportation (US DOT) values as a base for costs of each crash type (U.S. Department of Transportation 2020). Fatal Crash Cost was based on "Guidance on Treatment of the Economic Value of a Statistical Life in US Department of Transportation Analyses." The US DOT estimates a human fatality and/or an crash with injury costs an average $395,313 per incident with the lowest value of $18,491 for the average value of a property damage only crash (U.S. Department of Transportation 2020). These costs include medical bills, vehicle repair and towing, loss of income, crash cleanup and other factors. Vehicle insurance industry estimated costs are strictly those claimed for insurance purposes. Costs for the associated impacts to travel congestion and impedance on other drivers can only be estimated for impact purposes.

Table 2. Average Annual Estimated Costs to Society of WVC Reported to South

Dakota Department of Public Safety 2014 through 2018

CRASH INJURY TYPE	AVERAGE REPORTED CRASHES PER YEAR	SDDOT AVERAGE $ VALUE PER CRASH	TOTAL MONETARY VALUE
Fatal	1.8	$395,313	$711,563
Serious, Visible, and Possible Injury to Human	57.6	$395,313	$22,770,029
Property Damage Only	4,532	$18,491	$83,801,212
Totals	**4,591**		**$107,282,804**

Reported WVC crashes on all South Dakota roads cost the public an average of $107.2 million every year.

2.2 Estimated Costs to Society of Wildlife Killed in Collisions

Estimates of the number of large ungulates killed and their monetary worth lost to WVC are difficult but not impossible to generalize. The above crash value estimates are calculated based on transportation agency estimates and are considered costs to society. The value of wildlife is not listed as a factor in these calculations. Research in Utah investigating the ratio of mule deer and other large wildlife carcasses found along the road as related to reported crashes generated a ratio of 5.26 carcasses found for every single reported crash (Olson 2013, Olson et al. 2014a). In Virginia, the ratio was as high as 9.7 white-tailed deer carcasses collected for every reported WVC crash (Donaldson and Lafon 2008). The magnitude of unreported collisions with wildlife is potentially due to factors such as under insured motorists, or those lacking insurance have little to gain in reporting collisions, limited damage to a motor vehicle, or that tractor-trailer trucks receive little to no damage from large ungulate collisions and their drivers may incur punitive actions if they report collisions. Notably, there is a time investment for motorists to report collisions that may hinder on scene reporting.

If the 5.26 correction value from Utah is used, South Dakota's yearly average of 4,591 WVC reported crashes may equate to as many as 24,149 large ungulates lost to WVC in South Dakota annually.

Large ungulates are a valuable resource to South Dakota. Annually, an estimated $734 billion attributed to hunting and wildlife watching are directly spent in South Dakota (Southwick Associates, 2017). The value of individual animals is difficult to assess and can vary greatly depending on factors used in the determination. The South Dakota legislature set the civil damage liability at $1,000 per non-trophy deer and $5,000 per non-trophy elk to be assessed in instances of poaching. Bissonette and Hammer (2000) estimated the value of deer in Utah to be $2,420 based on the amount hunters spent to harvest deer in that year. Applying that methodology to South Dakota using information estimated by Southwick Associates (2017) and South Dakota GFP (2017), deer hunters directly spent $160,312,211 to harvest 51,932 deer in 2017. Using the total spent directly by deer hunters in 2017 divided by the total take of deer in 2017 yields a value of $3,086 per animal.

In Utah, 65% of deer killed in vehicle collisions have been documented to be female with 40% being adult female (Olson, 2013). The proportion of female-male deer mortality on roadways could have a significant effect on overall population abundance and have implications for game managers. Lowering WVCs should be a safety, biological, and economic concern of the state of South Dakota. WVC also involve elk and bighorn sheep, which are valued more highly by SDGFP, as well as other species, and it is likely that this lost value of wildlife remains an underestimate.

It is estimated that each year South Dakota loses an average of over 24,000 large ungulates due to collisions with vehicles, at a cost of over $74 million to potential South Dakota revenue.

These costs are presented separately from the SDDOT crash cost estimates because US DOT crash cost estimates, which are the base of SDDOT estimates, are considered the overall cost to society; they do not include the value of wildlife. The value of the wildlife is presented as an individual number so wildlife management agencies such as SDGFP can better understand the toll of WVC on ungulates and include these figures in proactive steps to reduce costs to wildlife populations and to South Dakota revenue provided by the harvest of large ungulates each year.

With such large monetary consequences and impacts to both the traveling public and the

survival of wildlife populations, it is recommended that SDDOT create standardized guidance documents for evaluating and addressing WVC mitigation. These guidance documents should include a systematic, reliable system for identifying transportation improvement projects throughout the state of South Dakota that would benefit from the inclusion of WVC mitigation measures.

This study is another step for SDDOT to becoming more proactive in identifying problem areas where wildlife needs to move across roads and in developing the necessary mitigation to protect the traveling public and help preserve wildlife populations. SDDOT has the opportunity to integrate scientific and research-based guidance documents and training into their transportation planning and project designs to assist in creating wildlife mitigation infrastructure. This will allow SDDOT and its partners to better address the WVC problem in the state in a scientifically, cost-effective, and efficient manner. In turn, these actions have the potential to save South Dakotans millions of dollars with reduced WVC occurrences, and to save the state's wildlife populations from further mortality incidents due to vehicle collisions.

3 RESEARCH OBJECTIVES

This study addressed three primary objectives:

3.1 Develop a methodology to evaluate mitigation needs and options in planned construction projects

Evaluate existing SDDOT WVC mitigation measures implemented in past construction projects and the processes to identify these needs. Analyze current methodology and expand on the processes that are currently working for SDDOT.

3.2 Apply the methodology to one or more locations

Apply the methodology identified during objective one to planned construction projects to determine the viability.

3.3 Develop guidance premised on best practices for reducing WVC in South Dakota

Develop guidance premised on best practices for reducing WVC in South Dakota

The objectives were accomplished through the completion of the tasks of this study. The first objective, develop a methodology to evaluate mitigation needs and options in planned construction projects, was accomplished through Tasks 2 through 4. This resulted in the review and evaluation of the current methodologies throughout the nation and within SDDOT. This includes the current processes to incorporate WVC mitigation into SD transportation planning. The development of guidance and outreach materials documenting the methodology and illustrating its application in the case study projects was completed in Task 7. Objective two, apply the methodology to one or more locations, was accomplished through the completion of Task 6 where current SDDOT transportation projects were utilized to determine the effectiveness of draft guidance documents developed in the previous objective. Objective three, develop guidance premised on best practices for reducing WVC in South Dakota, was based on the data and information gathered in the previous two objectives where the team examined the best practices and mitigation measures throughout the nation and implemented these measures into current SDDOT transportation projects. The completion of objective three was accomplished throughout Tasks 6 and 7.

4 RESEARCH TASK DESCRIPTIONS

4.1 Task 1. Kickoff Meeting

Meet with project technical panel to review project scope and work plan.

Kit Bramblee, the Principal Investigator (PI), met with the project technical panel in Pierre, South Dakota on June 27th, 2019. This meeting resulted in:

1. An agreed-upon scope of work and detailed work plan
2. Initial assessment of WVC reporting and mitigation planning processes in South Dakota; and the primary outcome of the guidance being developed for SDDOT

4.2 Task 2. Through a review of the literature and consultation with experts, describe prevailing and best practices across the nation for mitigation of WVCs and application of models of wildlife habitat and ecosystems and WVC occurrence and distribution.

Task 2 included an extensive literature review that included research documents and planning materials from multiple government agencies, educational institutes, private research consultants, and many other professional organizations. Consultations with other state DOTs were a main focal point in determining best practices across the nation. Contacts were made with multiple agencies in determining methods to utilize in analyzing wildlife habitat and ecosystems for the occurrence of wildlife crossings and implementation of mitigation measures.

The research team collected as much literature pertaining to the use and implementation of wildlife crossings as they could via internet searches, reference documents for wildlife professionals and suggestions from wildlife education experts. The research team also conducted informal interviews with environmental personnel within select western and plains states known to be most progressive in dealing with WVCs and wildlife mitigation.

The research team completed a brief literature overview to document the effort. Pertinent information was included in this literature review. The literature review breakdown can be found as *Appendix A*. A list of agency personnel contacted for information pertinent to WVC mitigation can be found as *Appendix B*. From the information gathered during this task, a draft SDDOT guidance document was started. The evolution of these documents changed as

correspondence and sharing of the document occurred within SDDOT and with outside agency personnel.

4.3 Task 3. Describe SDDOT's current methodology for identifying animal collision mitigation needs, selecting mitigation treatments, and evaluating effectiveness.

Contacts to primary SDDOT personnel and cooperating agencies in person, by email, or by phone for interviews regarding past and current methodology used to identify WVC mitigation needs was completed. These identified stakeholders in reducing WVCs and protecting wildlife movements where they are bisected by roads were asked to provide information regarding their role in WVC mitigation.

Primary forms of contact for this task were via email, virtual meetings, and an online-based questionnaire due to the complexity of the required virtual workspace in 2020. Questions asked were broad in terms of methodology for WVC mitigation. The primary purpose of this task was to determine if there has been any implementation of WVC mitigation in South Dakota, what these methods have been, and their effectiveness. To reach a broad spectrum of participants, a list of questions was compiled and reviewed by the panel and SDDOT Research Department staff. A virtual questionnaire containing these approved questions was distributed on June 16, 2020 via the online tool Survey Monkey.

Results can be found in brief form in Chapter 5, Findings and Conclusions. Greater detail of personnel included in the distribution list for the questionnaire can be found *in Appendix B.* The complete questionnaire utilized to collect this data can be found in *Appendix C.*

4.4 Task 4. Based on the findings of Task 2, design a more comprehensive methodology for identifying animal collision mitigation needs, selecting mitigation treatments, and evaluating effectiveness, including benefit-cost analysis of mitigation strategies.

Task 4 included the development and determination of proper implementation of WVC mitigations into the SDDOT transportation project cycle.

Methodology for the development of guidance for SDDOT at all project levels was drafted from the results of Tasks 2 and 3. Data collected during the previous tasks was used to determine the

triggers for the identification of WVC mitigation in a transportation project. Based on these triggers, additional investigation efforts for pertinent data collection were determined from correspondence and literature documentation in Tasks 2 and 3. The initial product of the investigative efforts for a transportation project identified will ultimately be the determination of a mitigation strategy that will be cost-effective and functional to increase the safety of the traveling public. A determination of whether mitigation is viable on a transportation project will either eliminate the need or support the implementation of a determined mitigation strategy. If a WVC mitigation effort is deemed necessary for the transportation project a preferred design alternative or WVC mitigation measure will be identified with the cooperation of multiple SDDOT sections.

The work completed during Tasks 3 and 4 was key to the project addressing objective one: develop a methodology to evaluate mitigation needs and options in planned construction projects. This primary objective will be used to move SDDOT forward into the future of WVC mitigation.

Results can be found in brief form in Chapter 5, Findings and Conclusions. Drafted guidance documents to be incorporated into SDDOT project development and design can be found in *Appendix D*.

4.5 Task 5. Interim Report and Second Meeting Between Researcher and Technical Panel

Task 5 was to prepare an interim report summarizing findings and recommendations from Tasks 2 through 4 and to meet with the technical panel to review the report and discuss project direction. This task was completed with the submission of the interim report that summarized findings and recommendations from Tasks 2 through 4. A virtual meeting of the technical panel and the principal investigator, Kit Bramblee, occurred on August 10, 2020.

4.6 Task 6. To the extent possible within the study duration, apply the improved methodology on projects IM-FP 0901(195)36 Meade PCN 021G, Rapid City Area Wildlife Fencing project PCN 06Y4, and US16 from Rapid City to the Keystone Wye PCN 073F.

Task 6 was to implement the drafted methodology developed during Task 4 into currently active SDDOT projects to determine feasibility.

Currently active SDDOT projects were reviewed for applicable actions to incorporate WVC mitigation. Utilizing the methodology developed in Task 4, the primary investigator was able to identify three current SDDOT transportation projects at varying levels of completeness and complexity to use as case studies for this task.

IM-FP 0901(195)36 Meade PCN 021G
I90 EBL - Fm W of Exit 37 (Pleasant Valley) to Exit 40 (Tilford)
Grading, Interchange Reconstruction (Exit 37), PCC Surfacing, Replace Str Bridge, Tilford Port of Entry

Executive Summary of Project Approved Scope:

The purpose of this project is to reconstruct the Interstate 90 eastbound lanes from west of exit 37 (Pleasant Valley Road) to the multi-plate culvert for the railroad underpass at MRM 38.34. Also, the reconstruction of the westbound on-ramp and eastbound off-ramp at Exit 40 (Tilford) due to the deteriorating pavement condition. This project will include replacing the interchange at Exit 37 (Pleasant Valley Road - Structure# 47-061-480), portland cement concrete (PCC) surfacing, and replacing all the pipe within the project limits under the eastbound lanes. This project will also include reconstructing the eastbound on and off-ramps at the Tilford Port of Entry. The work required for demolishing the existing Tilford Port of Entry inspection building, reconfiguring the layout and constructing a new inspection building at the current site is still being determined under a separate contract and may be included with this project or tied as a separate project.

This project also includes replacing structure# 47-064-484 over Pleasant Valley Creek with new structures under both the eastbound and westbound lanes. The Pleasant Valley Creek structure is currently a triple 10'x10' reinforced concrete box culvert (RCBC) constructed in 1956. An additional twin 7'x7' RCBC at approximately MRM 36.00+0.627 should also be replaced with a new structure under both the eastbound and westbound lanes. The Office of Bridge Design has determined that replacement is necessary, due to the structures nearing the end of their useful service life. The size and type of the new structures will be determined during design. Structure# 47-068-495 is a 38'x23'x397' steel multi-plate culvert located 1.6 miles northwest of the Tilford Interchange over the RCP&E railroad constructed in 1981 and extended on the westbound lanes in 2008. The multi-plate culvert will not be replaced with this project but may need to be extended depending on design. Structure# 47-068-501 is a triple 8’ x 4’ x 226.4’ RCBC that may need to be extended if the acceleration lane exiting the Tilford Port of Entry is reconstructed and lengthened.

IM 0902(175) Lawrence PCN 06Y4
Rapid City Area
Wildlife Fence

Executive Summary of Project Approved Scope:

An on-site inspection was completed on February 22, 2019, on Interstate 90 from Exit 8 to Exit 14 near Spearfish to help identify locations that may benefit from installing wildlife fencing due to the high number of wildlife vehicle collisions. The recommendation from the inspection team was to install an 8' high wildlife fence only in locations where chain-link fence currently isn't in place on Interstate 90 eastbound and Interstate 90 westbound from Exit 8 to Exit 14 near Spearfish. The SDDOT Highway Safety Office calculated a B/C = 9 for installing wildlife fencing through this corridor.

Contact Kit Bramblee in the SDDOT Environmental Office for additional information.

PL 0100(79) Pennington PCN 073F
US16 from Rapid City to the Keystone Wye
Study

Project Background, Understanding, and Need for Study:

As part of the US16/US16B/Catron Boulevard Intersection Alternatives Study completed in 2016, it was determined that the US16/US16B/Catron Boulevard intersection would need to be modified to provide an acceptable traffic level of service.

SDDOT intends to let for construction a project to modify the US16/US16B/Catron Boulevard intersection in federal fiscal year 2026. There are other intersections of concern along the US16 corridor in the vicinity of the US16/US16B/Catron Boulevard intersection that may impact or be impacted by what happens at that intersection. One of these intersections, Neck Yoke Road, has been identified for a safety intersection improvement project also in federal fiscal year 2026. Beyond these two intersections, the overall corridor, from Cathedral Drive/Fairmont Boulevard in Rapid City, to the Keystone Wye, will be reviewed for items such as: safety, operational, access, geometric, and ITS-related needs. This study will help determine those impacts and bring the US16/US16B/Catron Boulevard intersection and US16/Neck Yoke Road intersection projects to fruition.

This study will determine an ultimate recommendation for the intersections of US16/US16B/Catron Boulevard and US16/Neck Yoke Road while completing a planning level corridor analysis for the remainder of the corridor study area. Additional objectives include:

1. Determine the need for the addition or removal of access roads (frontage and/or rearage) and/or auxiliary lanes along the US16 mainline as part of the planning level corridor study. This should include a review of the roadways within the unincorporated community of Rockerville, SD that are under SDDOT jurisdiction and developing an access management plan along the entire corridor.
2. Create environmental documents for the US16/US16B/Catron Boulevard intersection and US 16/Neck Yoke Road intersection and an environmental overview for the entire US 16 corridor within the study limits.
3. Create final products for use by the City of Rapid City, the Rapid City Area MPO, and the SDDOT, which will provide guidance to implement recommended improvements for future construction.

This task was pertinent to meeting Objective 2: apply the methodology to one or more locations. The lessons learned from the incorporation of the draft methodology into action projects were a required step in the revision of the completed guidance documents in subsequent tasks.

4.7 Task 7. Develop guidance and outreach materials documenting the methodology and illustrating its application in the case study projects.

Building upon the summary of best practices and lessons learned from across North America, as well as the internal examination of current practices in South Dakota and extensive literature review, a specific set of guidelines was developed for SDDOT. The guidance covers protocols and methodology for incorporating WVC mitigation into a transportation project; investigating WVC data; primary contacts within SDDOT to inform of future involvement; types of WVC mitigation measures; design alternatives; determining the best and most cost-effective wildlife mitigation strategies for each location where mitigation is prioritized and effective monitoring strategies.

Results derived from previous tasks helped to develop Task 7. Information from Task 2, describing the mitigation options available to reduce WVC was used to develop guidance and options for South Dakota. WVC crash and carcass and other GIS layers gathered in Tasks 3 and 4 were used to develop informative maps and databases. Contacts with the SDDOT highway

safety engineer and the SDGFP chief conservation officer helped to develop values for the cost of WVCs and the value of the individual wild animals lost to such collisions. These, in turn, were used to document the extent of the WVC problem in monetary terms and to help evaluate how well potential wildlife mitigation measures would pay off over time in reduced collisions. Section 5, Findings, sub section 3, presents guidance recommendations for future action.

The primary investigator provided electronic copies of the guidance documents and supporting materials to the research panel for review and comment in October of 2020. One panel member provided feedback and comment.

4.8 Task 8. Meet with Technical Panel to Review and Approve Materials

Primary Investigator met with Technical Panel to review and approve materials.

The primary investigator provided electronic copies of the guidance documents, supporting materials and the draft final report to the research panel for review and comment in January of 2020.

4.9 Task 9. Final Report

In accordance with Guidelines for Performing Research for the South Dakota Department of Transportation, prepare a final report and executive summary of the research methodology, findings, conclusions, and recommendations.

The draft final report was developed in accordance with the *Guidelines for Performing Research for the South Dakota Department of Transportation* and delivered to the Project Manager for this research in January 2020.

4.10 Task 10. Executive Presentation

Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project.

The Principal Investigator for the project, Environmental Scientist Kit Bramblee, presented research results to the SDDOT Research Review Board.

5 FINDINGS AND CONCLUSIONS

This section begins with results from Task 2, an extensive literature review of current and past research throughout North America and abroad to identify areas within the transportation project life cycle to integrate WVC mitigation. The literature review evolved into resource agency contacts, data collection and documentation of best-known practices and finally an outreach research questionnaire (5.1). The second part of this section (5.2) illustrates how more comprehensive methodologies for identifying animal collision mitigation needs; selecting mitigation treatments; and evaluating effectiveness, including benefit-cost analysis of mitigation strategies, was drafted for SDDOT's primary offices involved in implementing mitigation measures. These guidance documents are intended to be a user-friendly way to assist SDDOT in progressing toward a more reliable process to address WVCs via the understanding of effective mitigation approaches. The start of a mitigation strategy hitting the ground is the design of the measure determined the most feasible and effective. To lead the design, a standard for construction needs to be determined. Part of this section (5.3) elaborates on the fulfillment of this need within SDDOT for a specific transportation project. An additional section (5.4) will elaborate on the findings and lessons learned from the implementation of previously developed draft guidance documents into active SDDOT transportation projects, helping to continue building a final product for this research. Final findings and conclusions for actions taken within this research for monitoring pre- and post-construction will be discussed in the last section (5.5).

5.1 An Extensive Literature Review

In Task 2 the researchers sought out literature from across North America and abroad to gain as much knowledge as possible to provide the most accurate and updated information to the users. Information from across North America pertaining to WVC mitigation strategies design alternatives, data collection, field analysis, guidance, monitoring, and costs were the primary review topics. The results are presented in three parts:

5.1.1 Electronic Literature Reviews

5.1.2 Resource Agency Contacts

5.1.3 Outreach Questionnaire

5.1.1 Electronic Literature Review

Literature and research documents discovered and evaluated during an extensive search of multiple online resources were inventoried. From these online resources over twenty-three separate relevant documents were identified. Multiple other documents with additional information pertaining to WVC mitigation were deemed unnecessary as overlapping

information was discovered in the initial review.

The process of retaining and inventorying the most pertinent documents for relevance to this research was undertaken by the research team early in the course of review to establish a better understanding of past and current processes for transportation agencies to integrate WVC mitigation into the projects. Each electronic file was reviewed. Information from each document was compiled within a central repository to be utilized in future research plans, guidance, and reports. Trending and obvious duplicate data and resources were noted as likely future reference items for building the most accurate and prevailing guidance for SDDOT. A complete list of these resources can be found in *Appendix A*.

***Finding*:** Research leads compiled a collection of literature to determine comprehensive methods for WVC mitigation previously documented and utilized throughout the nation.
Conclusion: Over twenty-three electronic documents stemming from a sorted search of pertinent information was reviewed and cataloged. From this review the research team resolved that previously applied methodology throughout the nation would be viable to incorporate into SDDOT's future transportation improvement scoping, design and ultimately construction.

5.1.2 Resource Agency Contacts

A priority function of the literature review entailed outreach to supporting and specific resource agencies abroad. Contacts with local agencies within South Dakota were conducted to collect data on crash analysis involving wildlife. The research team collected data from the South Dakota Department of Public Safety (SDDPS) for the most recent information and locations involving documented wildlife collisions throughout the state of South Dakota (*Appendix E*). Data collected from this outreach was utilized in assessing monetary dollar amounts associated with wildlife collisions in South Dakota.

South Dakota Game, Fish and Parks (SDGFP) was consulted for information pertaining to wildlife movements and key habitat identification in the review of transportation projects. Information gathered from discussions with SDGFP personnel was utilized on a project by project basis. Consultation with SDGFP Environmental Review Senior Biologist for future transportation consultation involving WVC mitigation was completed to ensure proper questions and review points were reached. Identification of proper SDGFP personnel to include in consultation was determined and an updated template for SDDOT's National Environmental Policy Act (NEPA) agency coordination letter was drafted to include such SDGFP staff (*Appendix F*).

The US Fish and Wildlife Service (USFWS), Ecological Services, South Dakota Field Office's

Wildlife and Fisheries Biologist was contacted for input on a draft template NEPA agency coordination letter that included WVC mitigation language. No feedback or comment was received from the USFWS. A template NEPA agency coordination letter was completed for future transportation projects that include WVC mitigation measures. (*Appendix F*)

State Farm insurance company was contacted during the initial literature review for South Dakota Collision information and costs per crash. State Farm Insurance was found to be the only identified agency providing public records of wildlife collision data in the South Dakota area. South Dakota ranked #4 in the 2019-2020 census for states most likely to have a wildlife involved collision with a 1 in 53 chance. Since 2015 South Dakota has hovered in the #4 through #6 rated state in the nation for the likelihood of travelers to be involved in a wildlife collision with West Virginia, Montana, Pennsylvania, Iowa, or Wisconsin helping to round out the top 5. This information leads the research team toward a conclusion that something should be done where feasible to show that South Dakota is taking an active role in protecting the traveling public and the wildlife this state is known for nationally.

https://newsroom.statefarm.com/animal-collision/

Figure 1. State Farm 2019-2020 Animal Collision Likelihood by State

Outreach to western US state transportation agencies provided key information to be included

in SDDOT guidance and design alternatives. These contacts with relevant transportation agencies currently implementing WVC mitigation into transportation project reviews were the primary consideration of agency contacts. Conversations via email and electronic correspondence occurred with Wyoming, Nevada, Utah, and Montana DOTs. Key takeaways on transportation project identification, design alternatives, maintenance, and past implementation of guidance into agency procedures were documented. Stemming from this correspondence SDDOT Standards Engineers were able to establish newly developed standard plates for wildlife fencing, wildlife escape ramps, and wildlife jump-outs to be used in current and future transportation projects (*Appendix H*).

Finding: Agency outreach is and will continue to be a key tool to be promoted in the advancement of WVC mitigation. Resource agencies from across the nation are willing to assist in the advancement and implementation of WVC mitigation. Over ten different agency personnel, from outside of the South Dakota resource agencies, were contacted. Each individual and agency provided key pieces of input to assist in the development of a final product for this research.

Conclusion: SDDOT's responsibility to take advantage of its partnerships and peer contacts throughout the western US that have engaged in WVC mitigation is paramount to staying on the innovative side of mitigation practices. The knowledge gained from this outreach is, and can continue to be, a driving force in the integration and ultimately the construction of WVC mitigation within the SD transportation system.

5.1.3 Outreach Questionnaire

A research-based questionnaire was developed to collect information on current and past practices of WVC mitigation, anticipated struggles with implementing these practices, and agency interest in participating in the development of WVC mitigation with SDDOT partnering resource agencies. The research panel reviewed and provided feedback on the 7 questions and the 48 identified contact individuals. The final questionnaire was created utilizing the online resource Survey Monkey and distributed via email to the panel selected 48 agency personnel (*Appendix C*).

Although only a 38% response rate was seen, feedback from this questionnaire identified some key aspects of WVC mitigation in South Dakota. First, there is a lack of knowledge and understanding throughout all agencies in how to implement and coordinate the use of WVC mitigation on transportation projects. Second, there have been past efforts within SDDOT and other state agencies to implement mitigation measures, but these appear to be on a small scale. Lastly, there was considerable interest from all parties in becoming more involved in advancing WVC mitigation measures in South Dakota. From the provided answers and additional

comments, a consensus for mitigation needs was observed. Compiled data from the responses received can be found in *Appendix I*.

***Finding*:** The lack of coordination and use of inter and intra-agency communication is limiting the ability for accurate data collection and agency subject matter expert input.
Conclusion: South Dakota state government agencies may be deficient in their use of representative agency knowledge. The use of outside agency resources will need to increase so that species-specific mitigation measures are meeting their goals and needs. A comprehensive and continually updated state agency employee organization chart for each agency should be readily available to identify primary contacts for expert feedback. Interest in providing input and feedback is high amongst state and federal agencies, but the awareness of job-related specialties and expertise is not known amongst agencies.

5.2 South Dakota Department of Transportation Guidance Documents

The following section contains a brief background on the development of the guidance documents from the beginning of the research to the final review by SDDOT section leadership and managers. These guidance documents were the primary objective of the research project and included review by the research panel as well as primary users within SDDOT. The outcome and inclusion of this guidance have the potential to tailor and drive the future use of WVC mitigation in transportation projects throughout South Dakota.

5.2.1 WVC Mitigation Guidance Development

Stemming from the extensive literature review in Task 2, information was collected for the best practices to guide the use of WVC mitigation as a standalone project or to be integrated into existing transportation improvement projects. A bulleted list of all primary identified objectives to complete the guidance information was the first step in laying out the draft information. Information from multiple sources, including federal and state research projects, scientific collegiate papers, and personal communications with internal and external government and private agencies, were taken into consideration.

***Finding*:** An overabundance of information to incorporate into a draft guidance document can easily make for a long process of WVC mitigation investigating.
***Conclusion**:* Drafting an initial guidance document for review and ultimately incorporation into active transportation projects helped in painting a large picture of everything that would, or would not, need to go into a final product. This initial guidance used information gathered in the above findings from section *5.1 An Extensive Literature Review.*

5.2.1.1 WVC Guidance Incorporation into Established SDDOT Project

From the data collected, a single lengthy draft guidance document was developed that included all aspects of WVC mitigation. Based on Objective #2 to apply this methodology to one or more projects, it was determined that the earliest stages of a project's development would be ideal. The US16 Corridor Study from Rapid City, SD to the Keystone Wye (PCN 073F) was a project in its infancy being considered for future transportation improvements. The principal research investigator contacted the environmental leads with HDR Engineering for the study. HDR Engineering was tasked to complete a corridor study between Rapid City, SD and what is known as the Keystone Wye on US Highway 16. Part of this corridor study included the investigation of environmental impacts of a transportation improvement project. It was requested that HDR utilize the current draft guidance as a template to complete this portion of the corridor study. In the process of utilizing this draft guidance, it was also requested of them to provide comment and feedback of its usefulness. *Appendix J* shows presentation slides utilized to present the guidance information during an initial Study Advisory Team (SAT) meeting. A separate teleconference with the primary investigators, Mark Traxler, (HDR Wildlife Biologist) and Laura Lutz-Zimmerman, (HDR Environmental Scientist) was conducted in May 2020. Mr. Traxler and Ms. Lutz-Zimmerman provided valuable feedback from the use of the draft guidance documents while completing office and field data collection for the US16 Corridor Study. This feedback and additional comments provided were incorporated into the final SDDOT guidance document versions.

***Finding*:** With the assistance of an experienced wildlife biologist and environmental scientist from HDR Engineering, valuable feedback on the data, usability, and final product of the draft WVC guidance was achieved.

Conclusion: Feedback received from the employment of draft guidance into an active SDDOT transportation corridor study proved to be a successful task. By taking feedback from the clients, employees, staff, and users of these WVC guidance documents SDDOT can continue to evolve these into a key piece of usable information.

5.2.1.2 WVC SDDOT Guidance Review Requests

Guidance documents were broken into three separate sections. These sections included Project Development (Scoping), Environmental, and Design. There were multiple iterations of layout and data representations for each guidance document. Each of the individual documents were provided to key representatives in each of the identified departments within SDDOT for review and comment. Primary management staff from these departments were given the opportunity

to provide valued feedback.

In August of 2020 a meeting with key representatives from SDDOT Project Development staff was arranged to discuss the layout and ultimate feedback needed to identify a project for review of WVC mitigation. It was determined during this meeting that the primary responsibilities of the Project Development scoping team would be to identify projects supporting WVC investigation from existing crash data, wildlife carcass collection data and the primary transportation improvement activities scoped for the project being reviewed. Based on comments received during this meeting the draft guidance document for Project Development was revised.

All employees of the SDDOT Environmental Section were included in the review of all draft guidance documents. Email correspondence with attached documents was provided in August 2020. Feedback from 4 of the 9 personnel was received and considered while drafting final documents. Comments in relation to layout and linking of information within the documents were the primary concern of Environmental personnel. Draft documents were altered to include new language and links to pertinent information stored within a central electronic location in SDDOT's secure data hub.

Design engineering managers from SDDOT Bridge Design, Road Design, and SDDOT Region Engineers were included in email correspondence for review of design guidance documents in August 2020. Feedback from the Bridge Design Manager was recorded and comments in relation to structural alternatives and timelines were considered for WVC mitigation structures. No additional feedback was received from this outreach.

***Finding*:** Feedback from primary sections with SDDOT advanced the evolution of the final draft of three SDDOT WVC Mitigation Guidance documents.
Conclusion: As stated through previous conclusions, using inter- and intra-agency subject matter experts to provide valuable feedback on the usability and applicability of these guidance documents will prove invaluable. SDDOT Environmental staff will play a key role in the evaluation of transportation projects referred by SDDOT Project Development staff for WVC mitigation investigation.

5.2.1.3 Inclusion of WVC Guidance into SDDOT Standards

The research team discussed with SDDOT managers in the Project Development and Environmental Sections the best approach to implementing these guidance documents into common practice in the transportation project life cycle. Alternatives such as including them in each offices respective manuals or having them exist as standalone references were considered.

Adoption of the guidance was accepted and encouraged.

***Finding*:** There is more than one practicable alternative to include the use of WVC mitigation guidance documents in the development of a transportation project. Finding the most applicable alternative will be up to SDDOT management.
Conclusion: The most feasible alternative determined was including language and guidance in the next draft of the SDDOT Environmental Procedures Manual. Reference to this section within the manual could be included in each, or any, supporting SDDOT offices manuals and guidance for future transportation projects.

5.3 Wildlife Mitigation Standard Plates

SDDOT utilizes predetermined standard plates to guide the awarded contractor(s) for the completion of transportation projects. Standard plates assist design engineers, project engineers and contractors in determining the appropriate specifications, dimensions, materials, and layout of the transportation structure or material being employed. To accurately incorporate wildlife mitigation strategies into the SDDOT transportation planning process, standard plates for design and construction needed to be developed. The research team assisted the SDDOT Standards Engineer in completing this task.

5.3.1 Standard Plate Outreach

Outreach to partnering western US transportation agencies was key in determining the appropriate standard plates that worked and are currently working for wildlife mitigation measures. The primary focus for SDDOT was to develop standard plates for currently active wildlife mitigation projects. Since wildlife fencing was a priority, the focus of the research team was on the identification of the best available and proven wildlife fencing standard plates. Discussions with transportation agencies from the Utah Department of Transportation (UDOT), Nevada Department of Transportation (NDOT), and Colorado Department of Transportation (CDOT) were initiated to identify standard plates for wildlife fencing, escape ramps and jump-outs. From these discussions and email correspondence, it was determined that the most efficient and feasible standard plates for SDDOT to utilize had been designed and utilized by UDOT in multiple transportation-related projects and standalone wildlife mitigation projects. Although UDOT's standard plates were selected as a template for SDDOT to design their own standard plates, it must be noted that the other cooperating transportation agencies utilize very similar designs and methodologies. Insight and recommendations from these agencies were incorporated into the progression and completion of the first SDDOT standard plates for wildlife fence and escape ramps.

***Finding*:** Each transportation agency throughout the US has a different process in the development of standard construction plates. Western US transportation agencies best mirror the materials and design most applicable to South Dakota.
Conclusion: Continued outreach to partnering western transportation agencies will only strengthen and evolve the best practices for the design of future WVC mitigation alternatives. SDDOT should promote these agency connections to advance the development of future WVC standard plates.

5.3.2 Standard Plate Design

As stated in the previous section, SDDOT utilized UDOT provided standard plates to assist in the building of wildlife fencing and wildlife escape ramps. The SDDOT Standards Engineer worked in cooperation with the research team to complete the final approved standard plates. Design specifics and questions on dimensions and materials were the primary focus of concern for this new endeavor. The Standards Engineer from SDDOT took hold of this innovation for SDDOT and created a very usable standard plate that will assist engineers and contractors in successfully completing current and future wildlife fencing and mitigation projects. As SDDOT continues to utilize these standard plates for future transportation projects, improvements and updates will only make them better. Continued coordination with other transportation agencies to help understand best practices and design changes from lessons learn will be crucial in staying up to speed with the changing programs of wildlife mitigation for the transportation industry. Examples of approved SDDOT wildlife fencing and wildlife escape ramp standard plates can be found in *Appendix H*.

***Finding*:** SDDOT has the expertise and abilities to continue to advance the design and use of standard construction plates for use in future WVC mitigation measures.
Conclusion: Generating additional standard plates for other WVC mitigation alternatives will only help in moving future transportation projects to the finish line in a timely manner. Not stopping at just wildlife exclusion fencing and escape ramps will provide design engineers with a toolbox of mitigation measures to choose from if WVC mitigation is determined appropriate for a transportation project.

5.4 Transportation Project Trials

For SDDOT to utilize the products of this research there is a need to continue work to define the extent of transportation projects appropriate for including WVC mitigation strategies. To better understand how the strategies and guidance being developed within this research there was a definite need to include the process into active transportation projects. This section demonstrates this process. These active SDDOT transportation projects were identified prior to

the approval of this research based on locations and stage of development within the project cycle.

5.4.1 IM 0902(175) Lawrence PCN 06Y4 Rapid City Area Wildlife Fence

Standalone WVC mitigation projects have already addressed primary concerns, locations of highest mitigation need, and appropriate mitigation strategies. The SDDOT transportation project identified in the Rapid City Area addressed WVC concerns along a specific corridor of Interstate 90. SDDOT personnel had previously identified a stretch of Interstate 90 via a prior research project (SD2014-03) and crash data provided by the SDDOT Highway Safety Engineer. This project began at approximately mileage reference marker (MRM) 8 and ran the length of Interstate 90 eastbound and westbound to MRM 14. This segment of interstate is located adjacent to the city of Spearfish, SD and sees high volumes of interstate and intrastate commerce and urban traffic from the northern Black Hills area. The preferred mitigation strategy was the installation of wildlife exclusion fencing and escape ramps along the Interstate 90 right-of-way (ROW).

From the beginning of this research the wildlife fencing project was in its infancy. The purpose, need, and overall geographic location had been identified, but limited background information, data, and design had been determined. Coordination with SDDOT project development staff, SDGFP terrestrial biologist, SDDOT Rapid City Area operations staff, and SDDOT Environmental staff included an on-site visit for the project in February 2019. Discussions for the primary purpose and need for the project were addressed. Wildlife movements, appropriate designs, pre and post monitoring and locations for WVC mitigation needs were proposed. Field review and investigations of locations for wildlife collisions and movement locations were identified and discussed. Opportunities for multiple transportation projects in the northern Black Hills were reviewed during this scoping meeting. Additional meeting minutes elaborating on discussions and field investigation determinations can be found in *Appendix K*.

The scope of work for the Rapid City Area Wildlife Fence within the SDDOT Statewide Transportation Improvement Program (STIP) was very broad in nature. The scope of work included the implementation of wildlife fencing in previously identified locations from field investigations in the Rapid City Area. Close coordination between the research team and the SDDOT Rapid City Senior Region Design Engineer for all aspects of this project was a key to the successfully completed project from project location identification to SDDOT bid letting.

The research team assisted by first conducting an overall review of the project's previously identified location of interest. Research team members utilized guidance documents,

specifically the SDDOT Environmental Wildlife and Roads Decision Guide (*Appendix D.2*), to complete the appropriate amount of review of the project location. Aerial imagery was used to help guide the decisions made in the preliminary investigation of the project. From this data collection, the research team was able to provide design engineers the appropriate location for the starting point and ending point of the wildlife fencing project. These points tied into existing ROW fencing that included 6' chain link pedestrian exclusion fencing progressing from on-ramp and off-ramp locations of Interstate 90. Next, the research team conducted a field investigation to verify wildlife fence locations and identify wildlife escape ramp and jump-out locations. On November 30, 2020, the research team visited multiple potential locations for wildlife escape ramps and jump-outs in the Spearfish, SD area along Interstate 90. From the field data collected utilizing the SDDOT Environmental Guidance for identifying WVC mitigation, the team was able to provide valuable feedback to the design engineer.

Research team members then provided mapping details to assist with design and identified locations of mitigation measures. Mapping included locations of terrain features, transportation infrastructure, property ownership, existing fences, proposed wildlife fence, proposed wildlife jump-outs, and wildlife escape ramp locations with preferred design alternatives. From this information, the design engineer was able to produce a set of plans for agency review. Comments received from SDDOT staff during this review period assisted in the production of final plans for the construction of wildlife fence, wildlife jump-outs, and escape ramps in and along the Interstate 90 ROW through Spearfish, SD. This plan set would be the first of its kind for SDDOT and a great move forward for the implementation of WVC mitigation into future SDDOT transportation projects. A copy of the final plans awarded for the construction can be found in *Appendix L*.

Public comment and outreach were accomplished through the use of SDDOT internet blogs, social media outlets, and local news providers. Additional outreach to local conservation groups was achieved via direct email correspondence. Adjacent landowners to the Interstate 90 ROW in which wildlife fencing was anticipated were also contacted to ensure any concerns were addressed. This public outreach prior to the implementation of the WVC mitigation project proved to be a powerful tool to gain the trust and support of the public for this project. SDDOT's Environmental Scientist was the primary contact for questions, comments, and concerns. Based on public evaluation, support for the project was received. The public service announcements can be found in *Appendix M*.

***Finding*:** Standalone WVC mitigation projects can successfully apply the SDDOT WVC Mitigation Decision Guides to help in determining final design alternatives.
Conclusion: The use of all three drafted decision guides would not be required for a previously identified standalone WVC mitigation project. The use of the information found in each

guidance document ensured that SDDOT Environmental staff and design engineers reviewed all primary considerations for the project. A successful interaction among SDDOT, SDGFP, and the City of Spearfish staff proved to provide useful input for this project. Public outreach prior to the final design alternative ensured customer feedback was received and considered.

5.4.2 IM-FP 0901(195)36 Meade PCN 021G
I90 EBL - Fm W of Exit 37 (Pleasant Valley) to Exit 40 (Tilford)
Grading, Interchange Reconstruction (Exit 37), PCC Surfacing, Replace Str Bridge, Tilford Port of Entry

Transportation projects with extensive infrastructure modifications and design changes offer an opportunity for a wide review of potential WVC mitigation options. These types of projects can include work that may extend from ROW line to ROW line and further throughout the project corridor. With included structure replacements and grading in the scope of work, a review for potential WVC mitigation was found to be warranted utilizing the SDDOT Project Development Wildlife and Roads Decision Guide (*Appendix D.1*).

Prior to this project being reviewed for WVC mitigation measures a team of SDDOT project development staff, SDGFP terrestrial biologist, SDDOT Rapid City Area operations staff and SDDOT Environmental staff conducted an on-site visit in February 2019. Discussions for the primary purpose and need for this extensive project were discussed. Wildlife movements, past safety concerns including wildlife collisions, pre and post monitoring and potential WVC mitigation needs were reviewed. Field review and investigations of locations for wildlife collisions and movement locations were identified and discussed. Through the data collected and interagency communication, it was clear that all parties showed interest in further investigation in the future use of WVC mitigation into the transportation project.
The primary investigator reached out to the SDDOT Consultant Management Engineer in charge of guiding the transportation project through the review and design. SDDOT Environmental staff were brought on board with the project review to assist with the identification and discussion of measures to be taken to reduce WVC incidents throughout the project corridor. Utilizing the previously developed WVC guidance documents for the SDDOT Environmental staff we were able to analyze and complete an in-depth review of the project for mitigation purposes.

Based on the data collected while utilizing Environmental WVC guidance documents, it was determined that WVC mitigation measures were feasible. Incorporation of the preferred mitigation strategy based on this in-depth review into the project planning and review was done through intra-agency communication with SDDOT design engineers, hydraulic engineers and the awarded consulting firm working to complete the preferred alternative for design and

environmental clearances for the project. Review and approval from SDDOT Area and Region Engineer staff were considered and requested once proposed mitigation measures were determined.

Currently proposed mitigation measures include wildlife exclusion fencing, wildlife escape ramps, wildlife jump-outs, and two wildlife underpass structures. Approximately 8 miles of total wildlife exclusion fencing has been proposed within the preliminary design for the project. Within the length of the proposed wildlife fence, wildlife jump-out locations at existing RCBC locations were incorporated to allow for locations of wildlife departure from the highway ROW. Included for additional escape avenues for wildlife that finds its way into the highway ROW are three escape ramp structures. The two structures utilize a channelized escape ramp design to assist in specifically directing large ungulates to the escape ramp location and ultimately out of the highway ROW. An additional escape ramp is what is typically referred to as a standard escape ramp design. This design does not include the lengths of wing fence to assist in guiding wildlife to the escape location. The determination to utilize two different types of escape ramp designs was based on field data collection, ROW real-estate dimensions, and review of safety parameters for clear zone. Lastly, it was determined that two existing RCBC locations held the workable specifications to include the re-design to be utilized as functional wildlife underpasses. The design dimensions for the proposed structure were reconfigured to accommodate the movement of wildlife under Interstate 90 at these drainage locations.

The preliminary plans to incorporate WVC mitigation into this project are still under review and revision at the time of this report. Stemming from the thorough review of this project the successive review of additional transportation projects along the Interstate 90 corridor in the northern Black Hills of South Dakota has begun. The consensus at the time of this report from all parties involved was the need for WVC mitigation measures to be considered for this project and future transportation projects near this location. Future involvement and continuous inter- and intra-agency communication will only strengthen the willingness and knowledge needed for future SDDOT projects to follow a similar path of WVC review.

***Finding*:** Transportation projects that are in the infancy of determining design alternatives can easily be assessed for an inclusion of WVC mitigation measures.
Conclusion: Even though the primary purpose of a transportation project may not be WVC mitigation, the review to include alternatives for increasing motorist safety need to be addressed. By including SDDOT Environmental staff knowledgeable in the use of WVC mitigation into the early evaluation and design of a transportation project, key conditions can be identified to continue to look for safety alternatives to mitigate WVC's.

5.4.3 PL 0100(79) Pennington PCN 073F US16 Corridor Study Rapid City to Keystone Wye

Transportation projects in their inception can be difficult to determine if there is a need for WVC mitigation. The driving purpose for the development of a SDDOT Project Development Guidance document was the initial identification of transportation projects for further investigation into WVCs. Selecting triggers to acknowledge the need for further investigation early in the project cycle will allow SDDOT to, at a minimum, perform a quick review of the transportation project corridor, and anticipate work being completed within. This corridor study did just that for the anticipated work on US Highway 16 west of Rapid City, SD.

Identification for the need to pursue additional investigation into the project led the research team into requesting the awarded consultant engineer to complete a wildlife study. The wildlife study was to be included in the US16 Corridor Study. To assist in conveying the information to the awarded consultant, the research team provided a draft version of the Environmental Decision Guide. Although the engineering consultant had experienced staff on hand familiar with WVC mitigation, the use of the draft Environmental Decision Guide brought additional information to be highlighted with the Corridor Study.

The final product of the desktop and field research conducted by the engineering consultant was presented to a large group of SDDOT and FHWA staff during a SAT meeting in October 2019. Discussion on the need, viability, and inclusion of measures to exclude wildlife movement across US Highway 16 were discussed. Wildlife movements and documentation of WVC within the corridor were presented to the team. Discussion of the presented information warranted additional information on the proposed WVC mitigation measures.

The research team deliberated with the South Dakota FHWA Environmental Protection Specialist over the findings presented during the SAT meeting. Based on these findings it was determined that the above project was not viable for the inclusion of WVC mitigation at this time.

***Finding*:** Not all transportation projects are going to be viable for the incorporation of WVC mitigation.
Conclusion: By using the drafted SDDOT WVC guidance documents, the above project was identified through SDDOT Project Development for the need of further investigation for WVC mitigation measures. Through the application of draft SDDOT Environmental guidance information, it was determined that this project was not a viable transportation project to

include mitigation. Future transportation project evaluation in such a manner should continue to promote the use of developed guidance.

5.5 Monitoring

Pre- and post-monitoring is key to determining if a mitigation strategy works. In all scientific evaluations data to support or contradict the thesis of the primary investigator needs to be collected. This information is the backbone of research and proves or disproves its viability to be useful to its consumers. The same methodology should always be applied to transportation alternatives that include WVC mitigation.

The research team started off this assignment with immediate monitoring of project locations anticipated to be included in this proposal. Transportation projects considered to be in immediate need of monitoring were the projects listed above in sections *5.4.1 Rapid City Area Wildlife Fence* and *5.4.2 I90 Eastbound Lanes Reconstruction.* Due to the nature of each of these projects and the anticipated suitability of WVC mitigation into each of these projects they were chosen for monitoring. Wildlife Camera Traps (ReconyX HyperFire 2 Covert IR Camera & ReconyX HC600 HyperFire) were installed in seven locations. Locations of camera placement were determined based on WVC safety data provided by SDDOT's Highway Safety Engineer and field determined wildlife crossing locations based on terrain and transportation structure orientation. Camera installation occurred on May 18, 2020 and continues to be monitored at the time of this publication.

Four wildlife camera traps were installed in key locations identified along the Rapid City Area Wildlife Fence (Spearfish, SD) project corridor. Three initial cameras at WVC identified hotspots and crossing locations were installed where terrain features such as creek bottom and drainages intersected the Interstate 90 ROW. A final single camera was installed by the research team upon the request of SDDOT Rapid City Area maintenance staff at the end of existing 6' chain link fence that runs a large portion of the Interstate 90 ROW in the Spearfish, SD corridor. This final location was to determine movements parallel to existing fence.

Cameras were named respectively for their locations near prominent terrain features or man-made structures. Two cameras were placed at the underpass of Spearfish Creek to Interstate 90 (Spearfish Creek East and Spearfish Creek West). Data from these cameras showed considerable movements of white-tailed deer through this location. As many as 24 white-tailed deer movements were documented under these existing Interstate 90 bridge structures in one 24-hour period. This data assisted in the determination to utilize these existing bridge structures as wildlife underpass features. By directing wildlife, with the use of wildlife fence, to adopt this preferred location, the learning curve for movement under Interstate 90 is anticipated to be

shortened for wildlife in this area.

A camera was placed near the Spearfish Golf Course in a location of high WVC interactions. This location exhibits a dominate vegetated drainage that meets the Interstate 90 ROW. This location was initially determined as a primary travel corridor for white-tailed deer feeding on the adjacent golf course grounds and moving to bedding areas in the heavily treed hills across Interstate 90. Camera data showed moderate movements of white-tailed deer in this location with peaks occurring in the late summer and early fall time periods. Data obscurity due to utility construction activities in the area may be a contributing factor to reduced wildlife movements in the late fall and early winter time period. Data collected from this location supported the construction of wildlife fencing through this corridor with the identification of wildlife movement captured in photos moving perpendicular to the Interstate 90 ROW. Captured images showed white-tailed deer movement from this vegetated drainage up to the interstate roadway.

Additional wildlife camera traps were placed in locations to conduct pre-monitoring for multiple construction projects on the Interstate 90 corridor between Sturgis, SD and Tilford, SD. With the research team providing design recommendations to SDDOT engineers during the early stages of conception, these project locations required additional investigation for further WVC mitigation measures. To identify potential wildlife crossing locations, the research team stationed three wildlife camera traps at SDDOT Environmental Guidance field identified locations. Cameras were placed at two of the largest existing RCBC structures within the project's anticipated construction limits. These two locations were named Pleasant Valley Creek and Ft. Meade for their geographic locations. The purpose of these two locations was due to the identified habitat, wildlife travel corridors they provided, and the potential to utilize future structures at these locations as wildlife underpasses. To support the use of wildlife underpass structures at these locations, the research team needed to know whether wildlife was currently using the existing structures or, at a minimum, approaching them. Wildlife movements through and approaching each of the structures were documented to provide additional support for the consideration of WVC mitigation design alternatives. Data documenting wildlife movements at these two locations can be found in *Appendix N*.

The final monitoring location was located adjacent to Interstate 90 near the Tilford Port of Entry, north of Tilford, SD. At this location, a large railroad underpass exists. This multiplate structure has the potential to provide movement as a wildlife underpass for very large to very small species. Crash data collected from the SDDOT Highway Safety Engineer identified this location as a potential hot spot for wildlife movements. To determine wildlife actions at this location a wildlife camera trap was positioned based on utilization of the field data collected and applied from the SDDOT Environmental Guidance document. Data acquired to date at this camera trap location provided supporting information for wildlife movements up to the Interstate 90 ROW

and road system. Supporting carcass collection data from SDDOT carcass collection mobile app showed that white-tailed deer movements over the Interstate 90 roadway occurred concurrently with the monitoring period. Investigation of the soils within the large multiplate structure during each monthly camera trap check supported the assumption that ungulate species were approaching, but not passing through the structure under I90. This could be due to multiple factors but provided additional information that was noted for future determination of viability.

***Finding*:** Pre-monitoring data collected from the use of wildlife camera traps at locations identified using the developed SDDOT Environmental Guidance document help provide additional information to support or disparage the use of WVC mitigation.

Conclusion: Future field monitoring should continue to take place post-construction at any of the above identified locations that WVC mitigation measures have been approved. SDDOT needs to find the value in collecting pre and post monitoring data to include in the decision-making process for a transportation project. Future monitoring protocols will need to be developed for consistency of data collection and determination of the value of data being collected for this decision-making process.

6 RECOMMENDATIONS

The process of identifying existing transportation projects, for future WVC mitigation needs in South Dakota and developing targeted strategies to reduce WVCs builds upon current information being collected by SDDOT, SDGFP, and other supporting agencies. This research project is an additional step of a continually developing process South Dakota should implement to reduce WVCs throughout the state. Future strategies will depend upon South Dakota improving and accepting newly recommended processes and guidance, and continuing to establish new procedures using the recommendations presented below. These actions will enable South Dakota to accurately define the scope of the WVC issues, to integrate wildlife considerations into transportation planning, and to implement targeted mitigation strategies to reduce WVCs.

6.1 Recommendation 1: Incorporate Wildlife Vehicle Collision Mitigation into the SDDOT Environmental Procedures Manual

SDDOT will need to develop standardized language to include in the existing SDDOT Environmental Procedures Manual. By including guidance and language in future SDDOT transportation projects in a standardized and referenced producers manual, not only will SDDOT employees be able to use the information, but all other partnering agencies will as well.

6.2 Recommendation 2: SDDOT Includes, at Minimum, Annual Discussions or Coordination with Cooperative Federal, State, and Local Agencies and Interest Groups Focused on Wildlife Vehicle Collision Mitigation.

South Dakota state government agencies may be deficient in their use of representative agency knowledge. The use of outside agency resources will need to increase so that species-specific mitigation measures are meeting their goals and needs. A comprehensive and continually updated state agency employee organization chart for each agency should be readily available to identify primary contacts for expert feedback. Interest in providing input and feedback is high amongst state and federal agencies, but the awareness of job-related specialties and expertise is not known amongst agencies. Including these outside agencies in the initial transportation planning process and design review can capture this knowledge and expertise early in the process.

6.3 Recommendation 3: SDDOT Continues to Develop and Updated Existing Standard Plates for Construction of Wildlife Vehicle Collision Mitigation Measures.

SDDOT has the expertise and abilities to continue to advance the design and use of standard construction plates for use in future WVC mitigation measures. Generating additional standard plates for other WVC mitigation alternatives will only help in moving future transportation projects to the finish line in a timely manner. Not stopping at just wildlife exclusion fencing and escape ramps will provide design engineers with a toolbox of mitigation measures to choose from if WVC mitigation is determined appropriate for a transportation project.

6.4 Recommendation 4: SDDOT Creates an Electronic Carcass Data Entry Method for All Employees, Law Enforcement, and Designated Supporting Agencies

SDDOT should initiate the development of an electronic method to report carcass data by DOT employees, cooperative law enforcement agencies, and other supporting agencies. Both a smartphone app and a web-based reporting system would allow instant mapping of the carcass data by internal and external agency personnel using smartphones or computers. SDDOT, in cooperation with SDGFP, could then train supporting agency personnel who may be involved in WVC carcass reporting or removal with the WVC carcass app or software to submit a report. A benefit would include contracted carcass collectors being notified or observing reported carcass locations, in turn speeding up removal from transportation networks. Additional benefits of carcass location data would also help in the identification of mitigation locations and species of concern.

6.5 Recommendation 5: SDDOT Creates a Pre- and Post-Construction Monitoring Plan for Each Transportation Project Implementing Wildlife Vehicle Collision Mitigation Measures

SDDOT staff, with the assistance of SDGFP biologists, should create a concise monitoring plan focused on transportation projects and key wildlife species of concern. Monitoring is a key component in determining the effectiveness of mitigation measures. Without the knowledge and data collected from the comparison of pre- and post-construction monitoring most agencies would never know if the effort is functioning as intended. By creating a standardized monitoring plan each SDDOT staff member involved would have a better understanding of measures of mitigation that work best throughout the state of South Dakota. Monitoring plans should include specific data requirements such as key locations, timing, intent, and additional measurable targets to determine success.

6.6 Recommendation 6: SDDOT Integrates WVC Priority Areas into Environmental Review

Currently, the SDDOT transportation review process conducted by Project Development staff does not include an analysis of the WVC potential in future projects. This includes the environmental review process completed by SDDOT Environmental staff. Utilizing the developed guidance created during this research project would fill this void. This guidance would be a trigger for environmental review, agency consultations, a benefit/cost analysis to determine whether mitigation can pay for itself in terms of WVCs avoided, and ultimately designer alternatives. This standardized process which would save SDDOT personnel many hours each year in data searching, and ultimately save South Dakota taxpayers dollars each year because fewer WVCs would occur in the state with developed wildlife mitigation.

6.7 Recommendations Summary

The recommendations presented in this section would come about over time, with SDDOT addressing certain recommendations immediately, and others over the course of the coming months and years. The overall objective of all these recommendations is to help decrease WVC in South Dakota, which would help keep motorists safe, while helping wildlife to move across the landscape. The results would be increased motorist safety, and protection of wildlife populations from the effects of roads and traffic.

The cost savings to the state agencies and the traveling public in South Dakota hold great potential. As the efforts increase over time, the potential cost savings would be projected to be in the millions of dollars every year.

7 RESEARCH BENEFITS

This research marks another step toward actively implementing WVC mitigation in South Dakota. Guidance documents developed, reviewed, and utilized by SDDOT staff during this research project proved their worth in identifying viable transportation projects to investigate for WVC mitigation measures. Two of the three transportation projects assigned to be included in the research were determined viable for WVC mitigation measures. Although WVC mitigation measures have been implemented in the past by SDDOT, no project has directly addressed specific species and locations until this research project helped identify locations and measures required. Future SDDOT transportation projects will benefit from this further in-depth review, but the biggest benefit will come to the motorists traveling South Dakota's roadways.

This research resulted in the identification of an evident and feasible processes to greatly improve the useability of currently collected data and the worth of collecting additional data. This added comprehensive analysis will assist in the identification of WVC problem areas and the mitigation actions required to improve the safety of the traveling public. This only strengthens SDDOT's mission statement, "To efficiently provide a safe and effective public transportation system."

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9 Appendices

Appendix A: Literature Review

Literature Review

Define Problem

Wildlife-vehicle collisions (WVCs) represent a substantial safety and economic concern for the traveling public in South Dakota. During the five-year span of 2014-2018 there were 22,955 reported wildlife vehiclecollisions (WVCs) on South Dakota roadways. (SD-DPS, 2019). The actual number of WVCs could be closerto five times higher than accident report totals as many collisions go unreported (Olson, 2013). Cramer etal. (2016) estimated over 24,700 large ungulates are killed on South Dakota's roadways every year. According to the Insurance Information Institute (2019), South Dakotan's have among the highest chancesof hitting a deer in the country ranking number four in 2019 and ranked in the top five during both 2016 and 2017 (Figure 1).

Figure 1. Likelihood of having a deer collision annually in the United States (State Farm, 2019)

In a report to Congress, Huijser et al. (2008) estimated the average cost of a WVC to be $6,126 per incidentexcluding the value attributed to the animal. Based on a 19.5% inflation rate in 2020 this estimate wouldaverage $7,318. Injuries to motorists in the Midwest occur in approximately 3.8 percent of WVCs and fatalities occur more rarely at 0.03 percent. Large ungulates are a valuable resource to the state. Annually, an estimated $734 billion attributed to hunting and wildlife watching are directly spent in South Dakota (Southwick Associates, 2017). The value of individual animals is difficult to assess and can vary greatly depending on factors used in the determination. South Dakota legislature set the civil damage liability at $1000 per non-trophy deer and $5000 per non-trophy elk to be assessed in instances of poaching. Bissonette and Hammer (2000) estimated the value of deer in Utah to be $2,420 based on the amount hunters spent to harvest deer in that year. Applying that methodology to South Dakota using information estimated by Southwick Associates (2017) and South Dakota GFP (2017), deer hunters directly spent $160,312,211 to harvest 51,932 deer in 2017. Using the total spent directly by deer hunters in 2017 divided by the total take of deerin 2017 yields a value of $3,086 per animal.

In Utah, 65% of deer killed in vehicle collisions have been documented to be female with 40% being adult female (Olson, 2013). The proportion of female-male deer mortality on roadways could have a significanteffect on overall population abundance and have implications for game managers. For the last five years,as an example, the number of recorded WVCs in just Meade County has been trending upward (Figure 2). Lowering WVCs is a safety, biological, and economical concern of the state. Multiple mitigation measuresalong with their associated costs should be considered when evaluating a strategy for reducing WVCs.

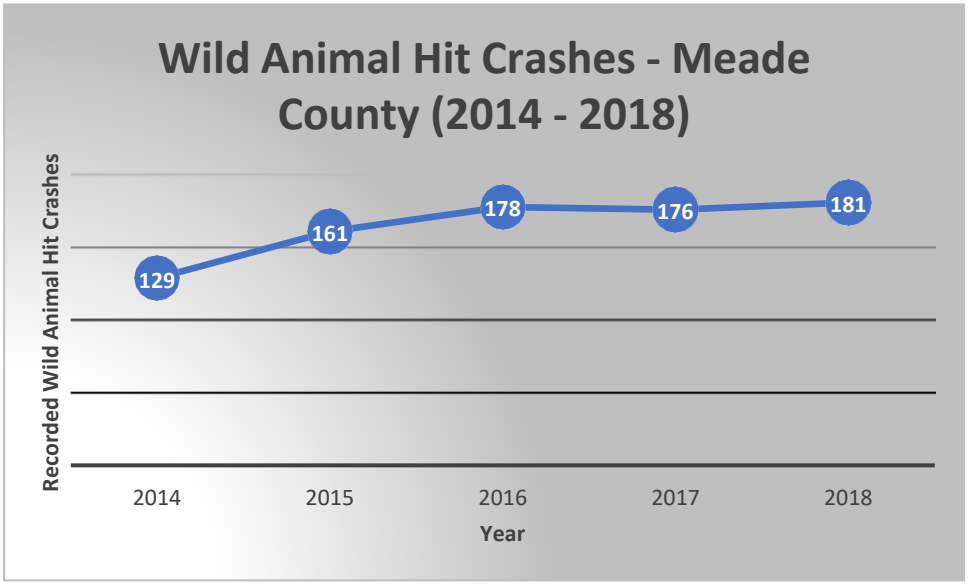

Figure 2. Upward trend of WVCs in Mead County, 2014-2018 (SD-DPS,2019).

Methods to reduce WVCs

There are three general ways to reduce WVCs: Modify wildlife behavior, modify driver behavior, and/or reduce wildlife populations (Hedlund et al., 2003). Of these options, we seek to evaluate the possible effect of modifying wildlife behavior using wildlife fencing and wildlife crossings (WCs), specifically wildlife underpasses. Other WVC mitigation efforts such as signing and fencing have been employed within the state of South Dakota in the past but there was no method identified to assess the effort's effectiveness.

Nation-wide, properly designed and maintained fencing coupled with appropriately located WCs has beenshown to be one of the most effective measures to reduce WVCs (Hedlund et al., 2003; Cramer and Hamlin, 2016). Other research indicates the effectiveness of the WC is highly dependent on the crossing's locationin addition to a properly designed and maintained fence (Huijser et al., 2007).

Selection of the wildlife crossing location is an important consideration that will affect the success of the crossing. A WC should be designed on a project-level or landscape-level approach. Crossing location analysis should consider aerial photos, land cover vegetation maps, topo maps, plat maps, wildlife habitatmaps, wildlife movement studies, road-kill data, and road network data (Clevenger and Huijser, 2011). Inaddition, a properly located wildlife crossing will increase connectivity between wildlife populations thereby reducing the barrier effect that roads create.

The design of a WC crossing is dependent on the type of wildlife intended to use it. For large ungulates, bridges have been shown to have lower repellency, and higher usage rates than culverts. When using culverts, they should be designed to be as high and wide as possible (Cramer and Hamlin, 2017). Structurelength distance should also be as short as possible. Kintsch and Cramer (2011) recommend a structure beless than 120' long and a minimum of 10' and 20' wide.

The more natural a WC fits into the surrounding landscape, the more likely animals will use it. Wildlife crossings should have vegetation leading up to the approach with trees and shrubs to offer animals cover.Human debris should be minimized and crossing bottoms should resemble the area on either side of the structure (Rudeiger and DiGiorgio, 2007).

Proper fencing in conjunction with a WC has been shown to be effective in reducing WVCs (Hedlund et al.,2003). The fencing used to direct animals into the crossing should be high enough they can't jump over (8') and long enough to discourage wildlife from detouring around the edge of the fence. If the fence is not long enough and animals begin to end around, WVC could increase as a result of a funneling effect (Clevenger et al., 2001). If an animal becomes trapped within the fenced roadway, escape routes such asanimal jump-outs need to be utilized so that animals have a way to exit the fenced area. Consideration should be given to the fencing material, as some fencing such as chain-link would be difficult to repair if an area were damaged.

To assess the success of wildlife crossings, a monitoring protocol should be developed prior to construction activities. It is necessary to set a baseline which to compare post-construction activities to pre-construction

conditions for a meaningful analysis. Although wildlife collision data can be used as a measure of performance, this metric does not consider change in wildlife populations with time (Clevenger et al., 2007). Cramer and Hamlin (2017) successfully used camera traps to document animal movements pre and *post-construction of wildlife crossings in Montana's Bitterroot valley showing varying levels of WVC* success. They were also able to document repellency and parallel movement to the structures giving wildlife managers and designers valuable insight into what works.

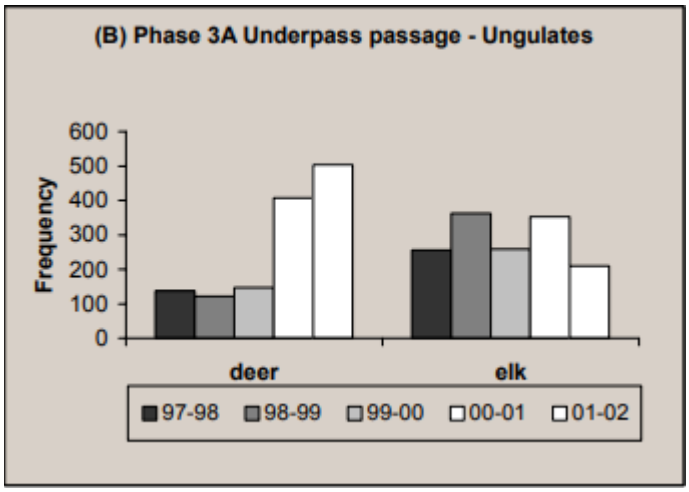

Figure 3. Ungulate use of road underpass in Central Canadian Rocky Mountains (Clevenger and Waltho, 2003).

Wildlife crossing performance should be monitored long enough after the crossing installation to consider changing animal behavior (Clevenger, 2005). Clevenger (2003) documented an increase over time for both carnivore and ungulate species of wildlife. Observations of deer usage on multiple crossings in Canada increased over a five-year period with no recorded plateau. This research suggests that wildlife take timeto adapt to using new structures and long-term continuous monitoring is needed to properly evaluate thewildlife crossing success.

Appendix B: WVC Mitigation Agency Contacts 2020

Contact Name	Resource Agency	Affiliation	Email
Nathan Baker	SDGFP Region 2	Terrestrial Resource Supervisor	nathan.baker@state.sd.us
Brian Serpan	SDGFP Region 2	Wildlife Program Manager	brian.serpan@state.sd.us
Paul Coughlin	SDGFP	Wildlife Habitat Program Administer	paul.couglin@state.sd.us
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Kimberly Zerr	SDDOT	GIS Coordinator	kimberly.zerr@state.sd.us
Jason Humphrey	SDDOT Pierre Region	Region Engineer	jason.humphrey@state.sd.us
Joanne Hight	SDDOT	Environmental Manager	joanne.hight@state.sd.us

Mark King	SDDOT Operations	Maintenance and Construction Management	mark.king@state.sd.us
Andy Vandel	SDDOT	Statewide Safety Engineer (analyzes WVC crash data for project scopes)	andy.vandel@state.sd.us
Joel Gengler	SDDOT	ROW Program Manager	joel.gengler@state.sd.us
Steve Wiege	SDDOT Rapid City Area	Administers Area carcass contract	steve.wiege@state.sd.us
Dave Madden	SDDOT	Bridge Design Engineer Manager	dave.madden@state.sd.us
Mark Leiferman	SDDOT	Scoping Program Manager	mark.leiferman@state.sd.us
Craig Olawsky	SDDOT	Wildlife Biologist	craig.olawsky@state.sd.us
Craig Smith	SDDOT	Director of Operations	craig.smith@state.sd.us
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Jenny Serbousek	SDDPS	Senior Statistician, Accident Records	jenny.serbousek@state.sd.us
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Chip Kimball	BLM	SD Field Office Field Manager	lkimball@blm.gov
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Appendix C. WVC Survey

SDDOT Vehicle-Wildlife Collision Mitigation Survey

The South Dakota Department of Transportation (SDDOT) is investigating ways to prevent or mitigate wildlife-vehicle collisions. I am interested in your experience and viewpoints and in any management practices your organization has established.

If you have any question about this survey, please contact Kit Bramblee, SDDOT Environmental Scientist III, at 605.773.2428 or kit.bramblee@state.sd.us. Thank you for your help.

* 1. Please enter your contact information

Name	
Agency	
Job Description	
Email Address	
Phone Number	

* 2. What roles does your agency have in wildlife-vehicle mitigation? (Please check all that apply)

- ◯ my agency is not involved in mitigation of wildlife-vehicle collisions
- ◯ identifying locations needing mitigation
- ◯ designing mitigation treatments
- ◯ evaluating the effectiveness of mitigation treatments
- ◯ constructing mitigation treatments
- ◯ developing policies or procedures for mitigation of wildlife-vehicle collisions

Please describe any other roles your agency plays in mitigation of wildlife-vehicle collisions:

1

* 3. What roles have you personally played in wildlife-vehicle mitigation? (Please check all that apply)

- I have not personally participated in mitigation of wildlife-vehicle collisions
- identifying locations needing mitigation
- designing mitigation treatments
- evaluating the effectiveness of mitigation treatments
- constructing mitigation treatments
- developing policies or procedures for mitigation of wildlife-vehicle collisions

Please describe any other roles you have personally played in mitigation of wildlife-vehicle collisions:

* 4. What kinds of mitigation treatments or strategies have you or your agency used to mitigate wildlife-vehicle collisions? (Please check all that apply)

- My agency and I have not used any mitigation treatments
- Route relocation
- Wildlife overpasses
- Wildlife underpasses
- Fencing
- Vegetation management
- Static signing of wildlife crossings
- Active wildlife detection and warning systems
- Reflective wildlife deterrence

Please describe any other mitigation treatments you or your agency has used:

2

* 5. Please rate the usefulness of these methods for evaluating the effectiveness of wildlife-vehicle collision mitigation treatments:

	Not useful	Somewhat useful	Moderately useful	Essential	Don't Know
Comparing **numbers of crashes** before and after mitigation	○	○	○	○	○
Comparing **severity of crashes** before and after mitigation	○	○	○	○	○
Comparing **wildlife losses** before and after mitigation	○	○	○	○	○
Comparing **wildlife behavior** before and after mitigation	○	○	○	○	○

Please describe any other methods you feel would be useful for evaluating the effectiveness of wildlife-vehicle collision mitigation treatments:

* 6. Please rate the significance of obstacles to effective mitigation of wildlife-vehicle collisions:

	Not a barrier	Minor barrier	Moderate barrier	Major barrier	Don't Know
Identifying suitable locations for mitigation	○	○	○	○	○
Designing suitable mitigation treatments	○	○	○	○	○
Securing funding for mitigation treatments	○	○	○	○	○
Demonstrating the need for mitigation in my geographic area	○	○	○	○	○
Demonstrating the value of mitigation to my agency	○	○	○	○	○
Coordinating mitigation efforts among agencies	○	○	○	○	○

Please describe any other barriers to effective mitigation of wildlife-vehicle collisions:

7. Please provide any other comments you may have on the subject of mitigating wildlife-vehicle collisions:

3

Appendix D: SDDOT Wildlife and Roads Decision Guides

Appendix D: Part 1: SDDOT Wildlife and Roads Decision Guide Project Development

Wildlife and Roads Decision Guide

Project Development Environmental Design Construction

Scoping | Determine Mitigation Need | Environmental Review | Determine Mitigation Component | Design Mitigation | Construction | Monitor WVC Mitigation Effectiveness

Instructions for Project Development Scoping: Work through the below questions to assist in your determination of including wildlife-vehicle collision mitigation (WVC) review for a transportation project.

Yes	No	If all of the below questions are determined to be "No" WVC Mitigation is not recommended.
☐	☐	**Does scope of work include activities to incorporate WVC mitigation?**
		1R project includes fencing improvements or replacements
		2R, 3R, 4R projects continue below…
☐	☐	**Is there a large structure replacement occurring within the project?**
		• Bridge Replacement • Reinforced Concrete Box Culvert Replacement ≥10' x 10' x 1 Barrel • Other Large Structure Replacement • Large structure replacements offer the opportunity for review of wildlife movements through or under the structure. Environmental review of these projects for WVC Mitigation is automatically included in project scope.
☐	☐	**Is there a WVC hotspot identified near a large structure within the project limits?**
		Crash data indicates an area(s) illustrating a WVC cluster ≥10 collisions within 1 mile of a large structure, drainage, or other significant terrain feature. • Attach maps of identified location(s) within scope • Include a call out for review of WVC Mitigation with executive summary of scope • Verify identified location(s) of WVC with carcass collection GIS data.

Appendix D: Part 2: SDDOT Wildlife and Roads Decision Guide Environmental

Wildlife and Roads Decision Guide

Project Development | **Environmental** | Design | Construction

Scoping → Determine Mitigation Need → Environmental Review → Determine Mitigation Component → Design Mitigation → Construction → Monitor WVC Mitigation Effectiveness

Instructions for Administration Environmental Section: Work through the initial resource review documenting all applicable information to better understand the project corridor. Reference primary contact list for Wildlife Vehicle Collisions (WVC) to determine points of contact for wildlife biologists, area engineers and carcass collectors within project location. Utilize the questions to help guide you through the decision-making and data collection process.

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.
		WVC Review Area within 4-mile Radius of Highway Project
☐	☐	**Is the transportation improvement feasible to include WVC mitigation measures?**
		Review scope of work and potential area of project disturbance.
		• Grading and/or roadway widening, alignments, or new construction • Structure replacements • Erosion control at bridge structures (wildlife movement paths) • Fencing opportunities

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.
		NEPA agency coordination letters to include WVC mitigation language.
		• SD Game, Fish and Parks • US Fish and Wildlife Service • Tribal Wildlife Contacts (if located on or adjacent to tribal property) • Other agency contacts based on proximity to managed lands (USFS, BLM, etc...)
☐	☐	**Has a relevant wildlife species of greatest conservation need (SDGFP Wildlife Action Plan), Federal or State Threatened and Endangered Species or large ungulate been identified within the project location for mitigation measures?**
		Elk, Bighorn Sheep, Mule Deer, Whitetail Deer, additional species of greatest concern (this can be multiple species)
		• Crash Data (ArcGIS) • Carcass Collection Data (ArcGIS) • GFP Coordination • USFWS Coordination
☐	☐	**Are there any documented wildlife movements within the location or corridor of the transportation project?**
		Known migratory routes in public documentation found online
		Known Threatened and Endangered Species habitat and movement
		Initial Resource Review with Wildlife Species of Concern in Mind
		Desktop Review utilizing available resources

		• Vegetative Cover
		• Types of Habitat
		  • Forest, River Bottoms, Prairie, Agricultural, Urban, etc...
		• Human Development
		• Land Cover Maps (USGS Land Cover)
		  • (https://www.usgs.gov/media/images/conterminous-us-land-cover-data-map-state)
		• Topo Maps

		Property Ownership

		• Public
		  • Game Production Area, Parks and Recreation Area, School and Public Lands, National Forest, National Grasslands, The Nature Conservancy, BLM, Bureau of Reclamation, USACE, National Park Service, USFWS Wildlife Refuge, Waterfowl Production Area
		  • Contact adjacent property owner/manager POC to discuss options for WVC Mitigation.
		  • Property ownership can be determined from Area Office permission to survey found in HW07 ROW Parcel Inventory application or by contacting local Area Office.

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.

		• Private
		  • Contact adjacent landowners if WVC mitigation location(s) identified
		  • What is the landowner's future plans for adjacent property?
		  • Development, farming, haying, grazing, etc…

		Road Networks
		• Federal Highways, State Highways, County Roads, Residential Driveways • Paved, Gravel, Dirt
		Roadkill Data/Maps

		• SDDOT ArcGIS Carcass Collector Data (Data Hound)
		• WVC Data/Maps
		  • SDDOT Safety Engineer
		• SD Department of Public Safety – Accident Records
		  • Senior Statistician, Accident Records primary contact

		Wildlife Connectivity Features

		• Transportation Structures
		  • Pipe, Culvert or Bridge
		• Terrain Features
		  • Ridgelines, low lying riparian area, corridor of vegetation cover, lake, river, stream, canyon, draw (may require field visit)
		• Human/Manmade Obstacles or Interference
		  • Residential/Commercial/Industrial Areas
		  • Staging Areas for Equipment
		  • Access Roads
		  • Guardrail, Fencing, Jersey Barriers, Walls, etc…

☐	☐	**Is the transportation improvement feasible to include WVC mitigation measures?**
		If "No" determination complete
		SDDOT and Resource Agency Contacts
		Contact State and Federal Biologists within Project Location
		• SD GFP Regional Supervisor/Regional Terrestrial Biologist • Does this further any objectives of the State Wildlife Action Plan? • USFWS Biologist • USFS Biologist (if applicable) • BLM Biologist (if applicable) • U:\pd\Environmental\Wildlife\Wildlife Crossings\Resource Agency Contacts

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.
		Questions to ask local Biologist(s)

		• Has there been any wildlife movement corridors or landscape linkages identified within project location(s)?
		• Are there any documented migration corridors?
		• Are there any wildlife species of concern for your agency within the project location(s)?
		  • Mule deer, whitetail deer, elk, bighorn sheep, antelope, federal or state Threatened & Endangered Species, etc…
		• Are there properties of concern adjacent to project?
		  • Federal, state, archeological, tribal, conservation easements, willing/cooperative adjacent landowners, etc…

		Contact SDDOT Primary Points of Contact
		• Area Engineer & Local Maintenance Lead
		Questions to ask Area Engineer and/or Local Maintenance Lead

		• Is there known high probability WVC locations within the project location(s)?
		• What are the primary times of wildlife movements at these known locations?
		  • Seasonally
		  • Time of Day
		• What are any maintenance concerns with implementing WVC Mitigation measures?
		  • Annual Costs
		  • Additional staff time
		  • Clearing foreign obstacles, debris, inspections of mitigation measure
		  • Fencing maintenance & inspections
		• Does snow accumulation in low areas affect wildlife movement?
		• Are there any specialized maintenance plans and schedules?

		Contact Local Carcass Collector
		Questions to ask Local Carcass Collector

		• Is there known high probability WVC locations within the project location(s)?
		  • Identify location(s)
		• What are the primary wildlife species involved in these locations?
		  • Mule deer, whitetail deer, elk, bighorn sheep, antelope, federal or state Threatened & Endangered Species, etc…
		• Contact SDDOT Maintenance Support, Transportation Specialist I, Data Analyst

☐	☐	**Is the transportation improvement feasible to include WVC mitigation measures?**
		If "No" determination complete

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.
		Environmental Field Survey
☐	☐	**Is there currently wildlife using/crossing at identified locations within project corridor?**
		Trails, tracks, identified hotspots documented during field survey.
☐	☐	**Is there an opportunity to utilize field monitoring equipment to identify wildlife movements?**
		Wildlife Camera Traps
		What wildlife species, if any, appears to be utilizing potential mitigation locations?
		• Frequency of use • Time of year observation conducted • Structure present at location • Type of habitat within vicinity
☐	☐	**Is there pronounced topographic features?**
		Mountains, Hills, River Valley, Prairie, Wetland, etc…
		What is the predominate land cover(s) near identified crossing location(s)?
		Wetland, Barren, Cropland, Forest, Grassland, Open Water, Urban
		What is the predominate land use near identified crossing location(s)?
		Agricultural, Pasture, Hayed Grassland, Commercial, Residential, Recreational, Other
☐	☐	**Are there adjacent fences at identified crossing location(s)?**

		• **Fence Type?**
		  • Multi strand barb
		  • Chain link
		  • Woven wire
		  • Wildlife Fence

Yes	No	Answers the questions to the best of your ability utilizing the provided information as a guide.
☐	☐	**Are there existing structures within 1 mile of identified crossing location(s)?**

		• **Bridge**
		  • Type of Construction
		  • Structure Number
		  • Measurements (Length, Width)
		  • Vertical Clearances (Max., Existing Crossing Locations)
		  • Obstructions (Riprap, Berm, Fencing, etc…)
		  • Wetland/Waterway/Drainage Type (Wetland, Ephemeral, Intermittent, Perennial)
		  • Openness Ratio
		  • (Height x Width) / Length

		• **Culvert**
		  • Type of Construction
		  • Structure Number
		  • Measurements
		  • # Barrels
		  • Obstructions to wildlife travel (Riprap, Fencing, Apron, Concrete Bottom)
		  • Wetland/Waterway/Drainage Type (Wetland, Ephemeral, Intermittent, Perennial)
		  • Openness Ratio
		  • (Height x Width) / Length

☐	☐	**Are there existing barriers or obstacles near identified crossing location(s)?**
		Fencing, Structures, Guardrail, etc…
☐	☐	**Is the transportation improvement feasible to include WVC mitigation measures?**
		If "No" determination complete
		Benefit / Cost Determination
☐	☐	**Is there a positive preliminary benefit/cost analysis based on preferred WVC mitigation and WVC's documented in the project location?**
		WVC Costs vs. Approx. Cost of potential mitigation measures to support previous determination. (Signing, Fencing, Structures, Structure Enhancements, etc…) • U:\pd\Environmental\Wildlife\Wildlife Crossings\Benefit_Cost • Contact SDDOT Safety Engineer for WVC numbers near location(s)
		Determine approximate cost of mitigation measure and compare that with annual cost of collision damage within SD County project is within. • U:\pd\Environmental\Wildlife\Wildlife Crossings\Benefit_Cost

Appendix D: Part 3: SDDOT Wildlife and Roads Decision Guide Design

Wildlife and Roads Decision Guide

Project Development | Environmental | **Design** | Construction

Scoping → Determine Mitigation Need → Environmental Review → Determine Mitigation Component → Design Mitigation → Construction → Monitor WVC Mitigation Effectiveness

Instructions for Designer: Work with the assigned Environmental Coordinator to determine the mitigation measure to be utilized. Reference the guidance information below to choose the most appropriate design alternatives for mitigation of wildlife vehicle collisions. Additional design and/or mitigation measures may be implemented with appropriate Environmental staff.

		Design (Bridge, Road, Region)
		Identify needs to incorporate WVC Mitigation measure(s) into project design
		Design Engineers work with Environmental Coordinator to determine best mitigation measure.
		Determine Preliminary Wildlife Mitigation Strategy
		Wildlife Structures
		Things to take into consideration for underpass and overpass structures • Most "open" design feasible for structure designs over or under transportation feature preferred. • Conform to local topography as much as possible • Design so flooding doesn't occur on more than a 25-year event. • Run-off from highway directed away from designed underpass structures to minimize flows where possible • Natural bottom with vegetation and/or natural structure (rocks, logs, etc...) • Safety of traveling public • Benefit of WVC reduction / Cost of structure

		Wildlife Unperpass

		Types of Wildlife Underpass
		• Bridge
		  o Concrete Bridge Span
		  o Steel Beam Span
		• Arch
		  o Concrete Bottomless Arch
		  o Corrugated Steel Bottomless Arch
		• Culvert
		  o Precast Concrete
		  o Cast In-Place Concrete
		  o Counter sunk dirt bottom
		  o Grouted riprap if present or roughened surface
		  o Elliptical Multi-Plate Corrugated Steel Culvert

		General Size Guidelines for Design Consideration of Underpass
		• Span
		  o Minimum 20'
		  o Recommended >40'
		• Height
		  o Minimum 10'
		  o Recommended >15'
		• Length
		  o Shortest possible.
		  o Design with open median under divided ROW if possible.

		Wildlife Overpass
		• **Types of Wildlife Overpass** o Buried Bridge

		• **General Size Guidelines for Design Consideration of Overpass**
		  o Width
		  ▪ Minimum 165'
		  ▪ Recommended 230'
		  o Length
		  ▪ Shortest possible

		Recommended Features

		• Mirror adjacent habitat and terrain, make it look natural
		• Microhabitat within structure (Logs, root wads, rock piles, boulders)
		• Native soils within structure bottoms ≥12"
		• Revegetate as much as possible
		• Limit noise from traffic as much as possible
		  o Structure coatings for noise reduction
		  o Maximize depth of structure below roadway.
		• Noise attenuating walls above entrance
		• Natural coloration to structure to mimic surroundings

		Fencing

		• Reference SDDOT Wildlife Fence Standard Plates
		• Reference SDDOT Wildlife Escape Ramps Standard Plates
		• Designed to guide wildlife to structure
		• Design as a barrier to crossing wildlife
		• Incorporate into existing terrain, natural barriers or man-made feature
		  o End of wildlife fence should be incorporated into natural or man-made barrier
		  ▪ Structure, Intersecting Road, Developed Location, Existing Fence, Hill Side, River, etc…
		• Fence end points should be signed (Wildlife Crossing)

		Signing

		Warning Signs
		  o Wildlife Crossing
		  o Specialty Wildlife Warning Signs
		  ▪ Bighorn Sheep Crossing
		  ▪ Elk Crossing
		  ▪ Wildlife Fencing Ends
		  o Speed Reductions
		• Interactive Warning Signs/Systems

		Vegetation Management
		• Reduce shrub and tree growth within ROW to maximize visibility • Reseed roadside with unpalatable species for wildlife • Low growing vegetation as to not obscure wildlife from motorists o Consider vegetation management activities to increase visibility and/or reduce wildlife presence along transportation systems.
		Preliminary Plans
		Secondary Benefit-Cost Analysis
		• WVC Damage Costs vs. Approx. Cost of Potential Mitigation Measures to support investigation. (Signing, Fencing, Structures, Existing Structure Enhancement, etc…) • Average $3,875 property damage/collision (Insurance Institute for Highway Safety) o Will the mitigation measure pay for itself during its standard life expectancy based on crash data?
		Public Meeting
		Incorporate Environmental data, field survey information and design alternatives into public meeting for comment and consideration.

Appendix E: Results of Surveys and Meetings with Tribal Representatives

SD DEPARTMENT OF PUBLIC SAFETY - ACCIDENT RECORDS SECTION
01/01/2020 THRU 12/31/2020
WILDLIFE COLLISIONS

County	Total	Fatal	Injury	PDO	Fatalities	Injuries
AURORA	45	0	1	44	0	1
BEADLE	54	0	1	53	0	1
BENNETT	8	0	0	8	0	0
BON HOMME	18	0	1	17	0	1
BROOKINGS	150	1	2	147	1	2
BROWN	189	0	0	189	0	0
BRULE	35	0	0	35	0	0
BUFFALO	5	0	0	5	0	0
BUTTE	84	0	0	84	0	0
CAMPBELL	3	0	0	3	0	0
CHARLES MIX	49	0	0	49	0	0
CLARK	81	0	0	81	0	0
CLAY	60	0	1	59	0	2
CODINGTON	118	0	1	117	0	1
CORSON	35	0	1	34	0	1
CUSTER	107	0	3	104	0	3
DAVISON	118	0	2	116	0	2
DAY	4	0	0	4	0	0
DEUEL	63	0	0	63	0	0
DEWEY	7	0	0	7	0	0
DOUGLAS	6	0	0	6	0	0
EDMUNDS	50	1	1	48	1	1
FALL RIVER	31	0	0	31	0	0
FAULK	40	0	0	40	0	0
GRANT	7	0	0	7	0	0
GREGORY	13	0	0	13	0	0
HAAKON	34	0	0	34	0	0
HAMLIN	105	0	0	105	0	0
HAND	51	0	0	51	0	0
HANSON	54	0	0	54	0	0
HARDING	3	0	0	3	0	0
HUGHES	50	0	1	49	0	1
HUTCHINSON	51	0	0	51	0	0
HYDE	1	0	0	1	0	0
JACKSON	53	0	0	53	0	0
JERAULD	18	0	0	18	0	0
JONES	41	1	1	39	1	1
KINGSBURY	114	0	0	114	0	0
LAKE	126	0	1	125	0	2
LAWRENCE	230	0	3	227	0	5
LINCOLN	222	0	3	219	0	4
LYMAN	92	0	0	92	0	0
MARSHALL	41	0	0	41	0	0
MCCOOK	96	0	1	95	0	2
MCPHERSON	38	0	1	37	0	1
MEADE	155	0	7	148	0	10
MELLETTE	14	0	0	14	0	0
MINER	60	0	0	60	0	0
MINNEHAHA	518	0	4	514	0	4
MOODY	114	0	0	114	0	0
PENNINGTON	329	0	14	315	0	16
PERKINS	30	0	1	29	0	1
POTTER	23	0	1	22	0	1
ROBERTS	60	0	0	60	0	0
SANBORN	66	0	0	66	0	0
SHANNON	11	0	1	10	0	1
SPINK	97	0	1	96	0	2
STANLEY	63	0	0	63	0	0
SULLY	18	0	0	18	0	0
TODD	7	0	0	7	0	0
TRIPP	62	0	0	62	0	0
TURNER	69	0	0	69	0	0
UNION	69	0	0	69	0	0
WALWORTH	31	0	0	31	0	0
YANKTON	68	0	0	68	0	0
ZIEBACH	6	0	0	6	0	0
TOTAL	**4670**	**3**	**54**	**4613**	**3**	**66**

Appendix F: Agency Coordination Letters

Appendix F: Part 1: SDGFP Coordination Letter Draft

Department of Transportation
Environmental Office
700 E Broadway Avenue
Pierre, South Dakota 57501-2558
605/773-4336

Month ##, 20##

Hilary Morey
SD Dept. of Game, Fish & Parks
523 E. Capitol Ave
Pierre, SD 57501

RE: Project #, PCN ####, _____ County
Location
Work Description

Dear Ms. Morey:

Attached is information on the above project. Please comment on any of the following topics that pertain to your agency:

1. Wetland Locations	6. Parks
2. Threatened or Endangered Species	7. Land & Water Conservation Funds
3. Refuges	8. Aquatic Invasive Species
4. SDGF&P Game Production Areas	9. Northern Long-eared Bat Hibernacula & Maternity Roosts
5. SDGF&P Recreation Areas	10. Wildlife Vehicle Collision Mitigation

This project is being reviewed for the incorporation of wildlife vehicle collision mitigation. As a cooperating wildlife management agency your input is very valuable. Please provide any additional comments from your agency that may be useful to our final decision to include a mitigation strategy within our final project design.

Please submit your comments as soon as possible, so that the project's environmental documentation can be completed, and the project can be let and constructed in a timely manner.

Sincerely,

Name
Title
605.773.####

Attachment

Department of Transportation
Environmental Office
700 E Broadway Avenue
Pierre, South Dakota 57501-2558
605/773-4336

Include item 9 in table and change color for projects in Custer, Lawrence, Meade, and Pennington counties.

Include Item 10 in table and change color for projects being reviewed for wildlife vehicle collision mitigation.

Cc: Randy Kittle [Cc: Randy if there is potential for 6(f) property being present.]

Cc: SDFGP Regional Terrestrial Biologists [Cc: If there is wildlife vehicle collision mitigation review.]

- Region 1: Trenton Haffley (Harding, Perkins, Meade, Ziebach, Lawrence, Pennington Haakon, Jackson, Custer, Fall River, Shannon, Bennett Counties)

- Region 2: Nathan Baker (Corson, Campbell, Dewey, Walworth, Potter, Sully, Stanley, Hughes, Hyde, Hand, Lyman, Jones, Buffalo, Brule, Mellette, Todd, Tripp, Gregory, Charles Mix, Douglas Counties)

- Region 3: Josh Delger (Beadle, Kingsbury, Brookings, Jerauld, Sanborn, Miner, Lake, Moody, Aurora, Davison, Hanson, McCook, Minnehaha, Hutchinson, Turner, Lincoln, Bon Homme, Yankton, Clay, Union)

- Region 4: Jacquie Ermer (McPherson, Brown, Marshall, Roberts, Edmunds, Day, Faulk, Spink, Clark, Codington, Grant, Hamlin, Deuel)

Cc: means another letter needs printed

Appendix F: Part 2: USFWS Coordination Letter Draft

USFWS TEMPLATE COORDINATION LETTER

NO EFFECT for all species

Use this FWS letter for project(s) with projects where:

- SDDOT Determination of **No Effect**.

Complete your project in IPaC to receive your Official Species List. If within your IPaC Regulatory Review there is a call out for WETLANDS, include the statement in red within the coordination letter, "This project may impact aquatic resources." Projects that include such work as Pipe Work, Structures, or Erosion Control will trigger this statement. If there are absolutely no aquatic resources (streams, wetlands) affected then leave out this statement.

Projects that contain Pipe Work include the project Pipe Report, if available, as attachment.

When a **No Effect** determination is reached in IPaC for the NLEB include a copy of the first page of the **Consistency Letter** as attachment.

Special Consideration: Threatened & Endangered Candidate species are also afforded special consideration because they can become listed as T or E and stop a project at any point during design or construction.

For your information

- Sentences shown in red text signify that project coordinator should either modify the sentence to suit project scope of work or delete if not applicable.
  CHANGE THE RED TEXT TO BLACK!
- Hidden text is shown in blue text. This is informational text cueing project coordinator to items to include or is a hyperlink to additional information to aid in coordination.
  - To turn Hidden text on go to **File** -> scroll down & select **Options** -> click on **Display** -> under 'Always show these formatting marks on the screen' select the check box for **Hidden Text**.

Department of Transportation
Environmental Office
700 E Broadway Avenue
Pierre, South Dakota 57501-2558
605/773-4336

Month ##, 20##

Scott Larson, Field Supervisor
U.S. Fish & Wildlife Service
420 Garfield - Suite 400
Pierre, SD 57501-5408

RE: Project #, PCN ####, _____ County
Location
Work Description

Dear Mr. Larson:

Attached is information on the above project for your review and comment. This project may impact aquatic resources.

According to the U.S. Fish & Wildlife Service (FWS) IPaC Information for Planning and Conservation system, the following species are known to occur in _____ County:
(Consultation code: _____).

Species	Status	SDDOT Determination	Comments
		No Effect	

The project will be reviewed for wetland impacts. The project will comply with all federal and state environmental regulations.

This project is being reviewed for the incorporation of wildlife vehicle collision mitigation. As a cooperating wildlife management agency your input is very valuable. Please provide any additional comments from your agency that may be useful to our final decision to include a mitigation strategy within our final project design.

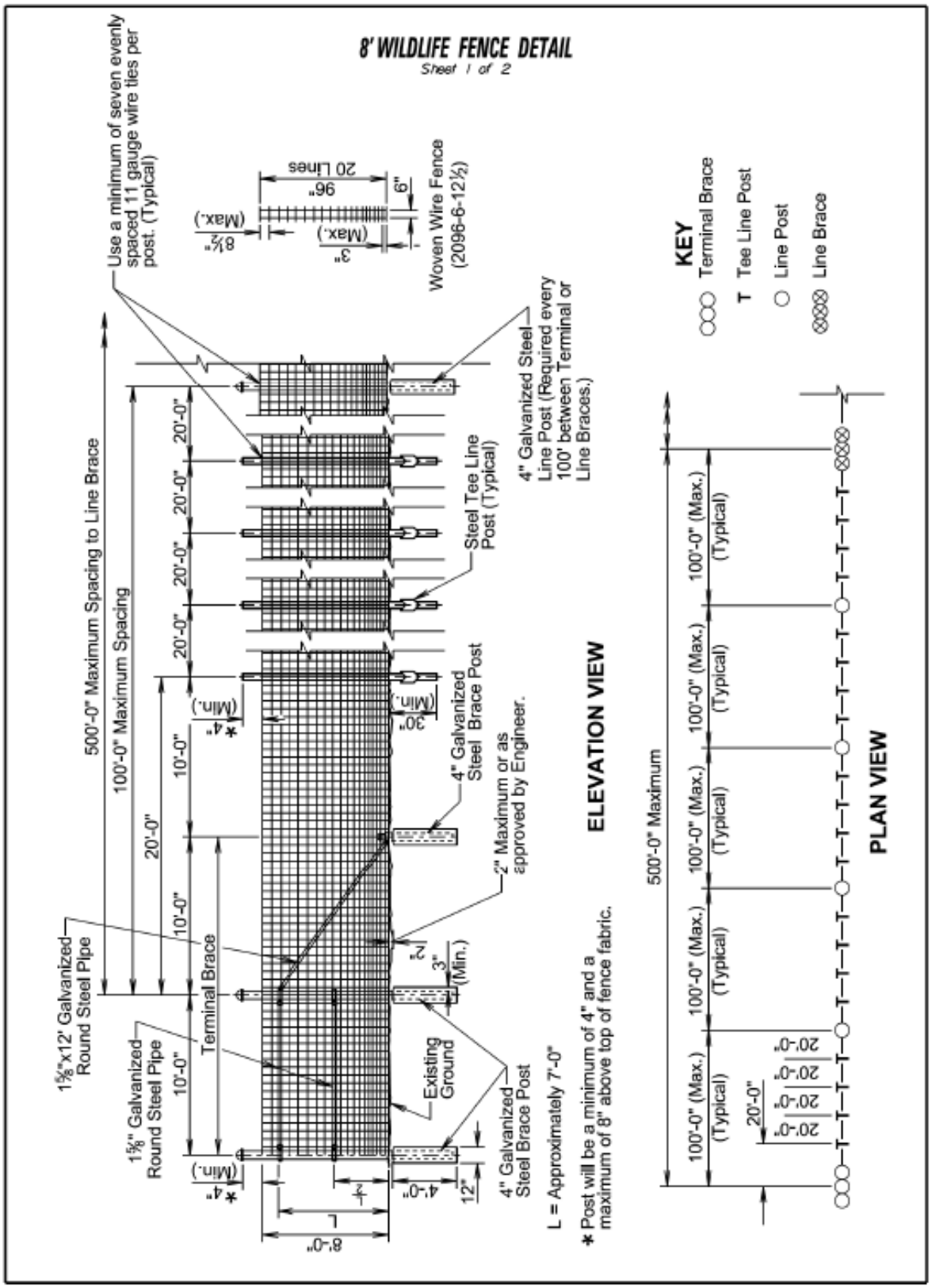
Please submit your comments as soon as possible, so that the project's environmental documentation can be completed, and the project can be let and constructed in a timely manner.

Sincerely,

Name {of NEPA Project Coordinator}
Title
605.773.####

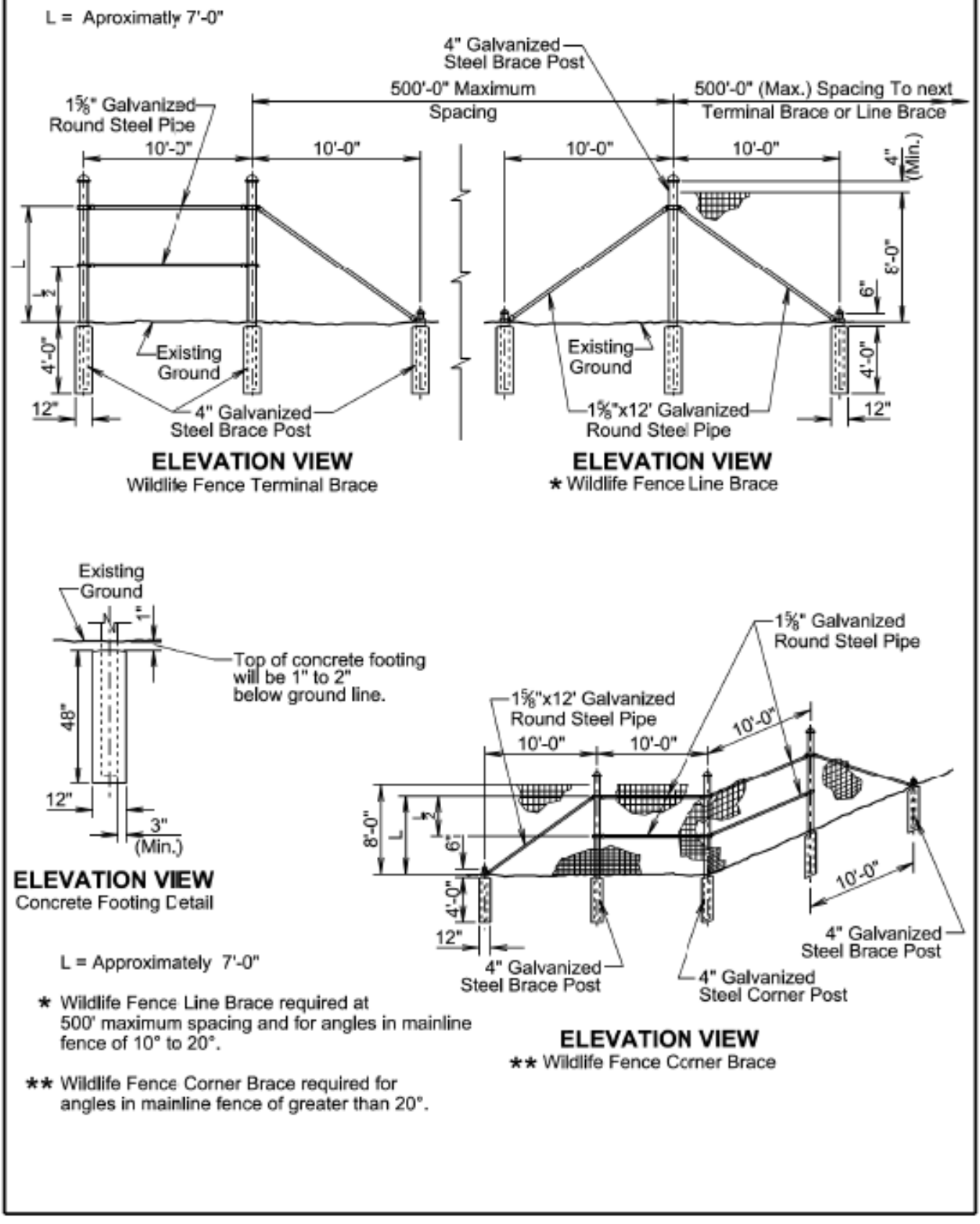
Attachments

Appendix H: SDDOT Wildlife Fencing Standard Plates



8' WILDLIFE FENCE DETAIL

Sheet 2 of 2

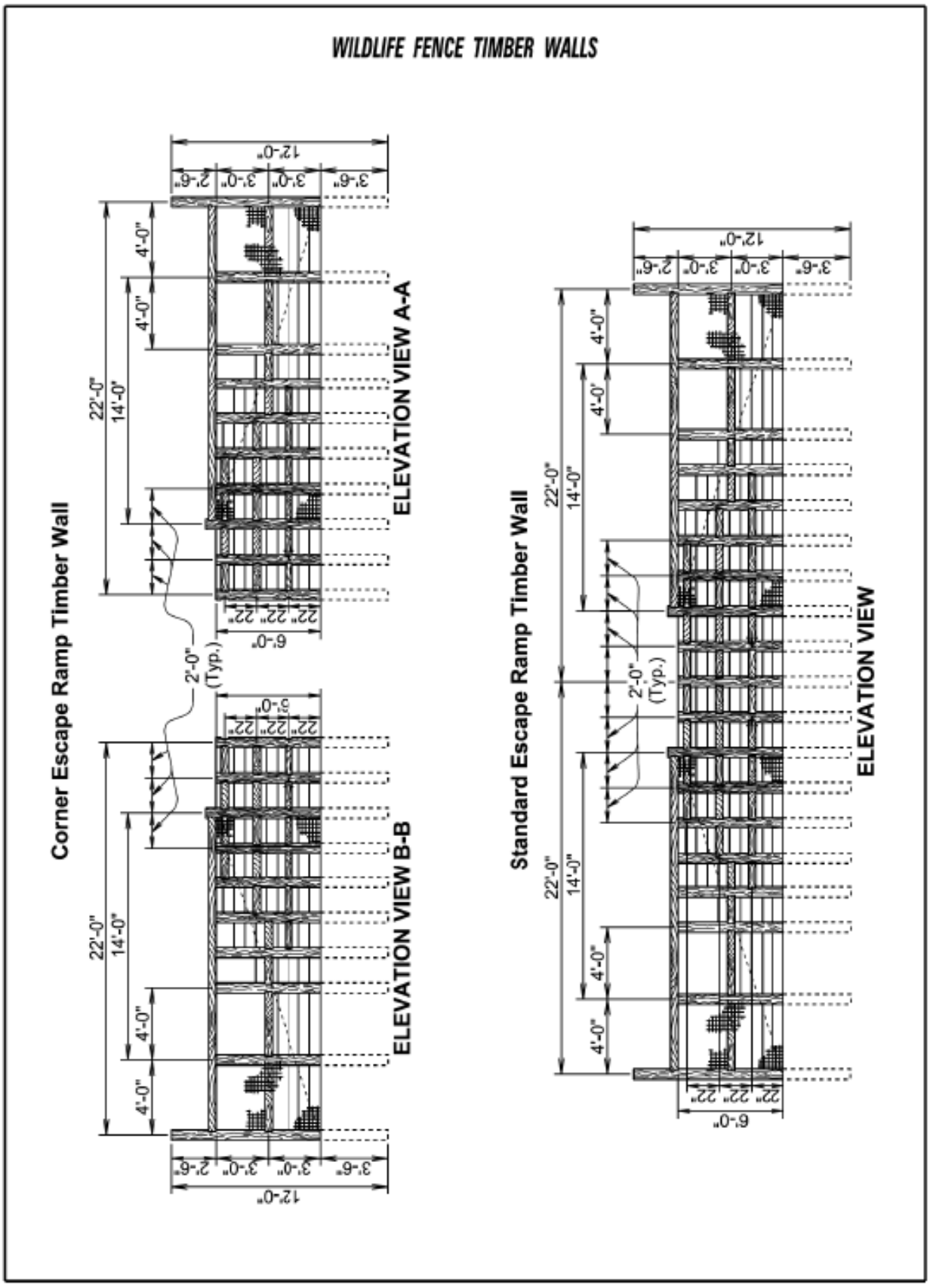


L = Approximately 7'-0"

* Wildlife Fence Line Brace required at 500' maximum spacing and for angles in mainline fence of 10° to 20°.

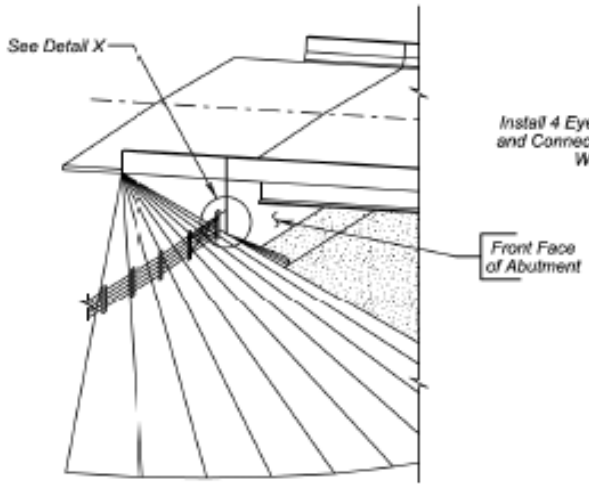
** Wildlife Fence Corner Brace required for angles in mainline fence of greater than 20°.

WILDLIFE FENCE TIMBER WALLS

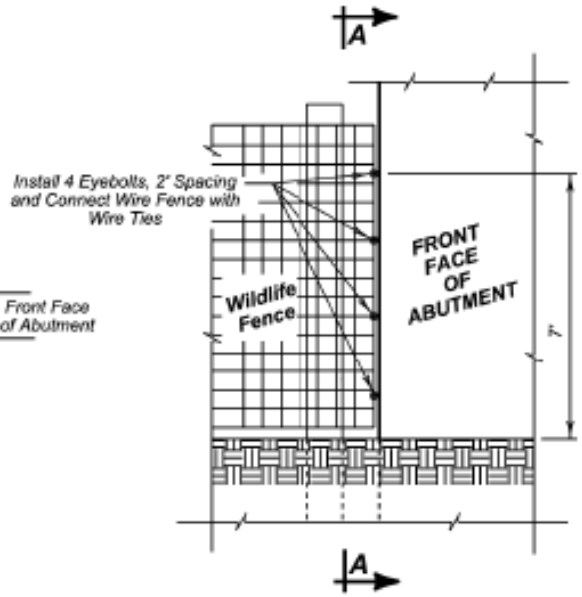


WILDLIFE FENCE AT STRUCTURES

Sheet 1 of 2



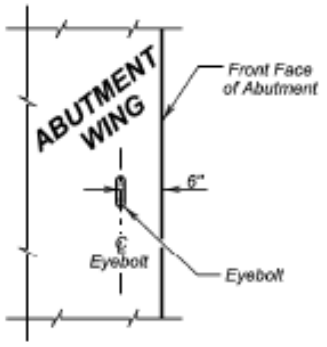
DETAILS FOR FENCE ANCHOR (SWEPT BACK WINGWALLS)



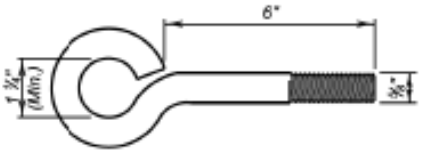
DETAIL "X"

GENERAL NOTES:

1. The fence and post details shown are for illustrative purpose only. The fence will be as specified elsewhere in the plans.
2. Eyebolts will be placed where they are needed to connect the fence to the strucuture. The Contractor will inspect the locations prior to preparing the bid to determine the quantity of eyebolts to be added.
3. Eyebolts will be ⅝ inch diameter and will conform to ASTM A307.
4. Eyebolts will be galvanized in accordance with AASHTO M232 (ASTM A153).
5. Eyebolts will be installed after abutment wings are backfilled and berm construction is complete. Drill-in and epoxy eyebolts into abutment such that the eye of the bolt is flush with the concrete surface.
6. The epoxy resin mixture will be of a type for bonding steel to hardened concrete and will conform to AASHTO M235 Type IV, Grade 3 (Equivalent to ASTM C881, Type IV, Grade 3).
7. The diameter of the drilled holes will not be less than ⅛ inch greater, nor more than ⅜ inch greater than the diameter of the eyebolts or as per Manufacturer's recommendations. The drilled holes will be blown out with compressed air using a device that will reach the back of the hole to be sure that all debris or loose material has been removed prior to epoxy injection.
8. Mix epoxy resin as recommended by the Manufacturer and apply by an injection method as approved by the Engineer. Beginning at the back of the drilled holes, fill the holes ⅓ to ½ full of epoxy, or as recommended by the Manufacturer, prior to insertion of the eyebolts. Care will be taken to prevent epoxy from flowing out of the horizontal holes prior to eyebolt insertion. Rotate the eyebolt during installation to eliminate voids and ensure complete bonding of the bolt. Insertion of the eyebolts by the dipping or painting method will not be allowed.
9. Loads will not be applied to the epoxy grouted eyebolts until the epoxy resin has had sufficient time to cure as specified by the epoxy resin manufacturer.
10. The cost for furnishing and installing the eyebolts will be incidental to various contract items.



VIEW A - A

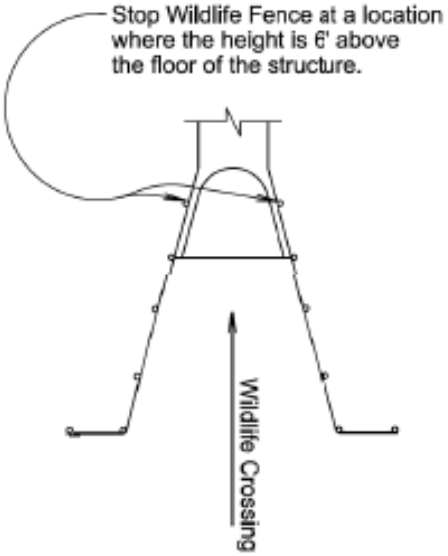


EYEBOLT DETAILS

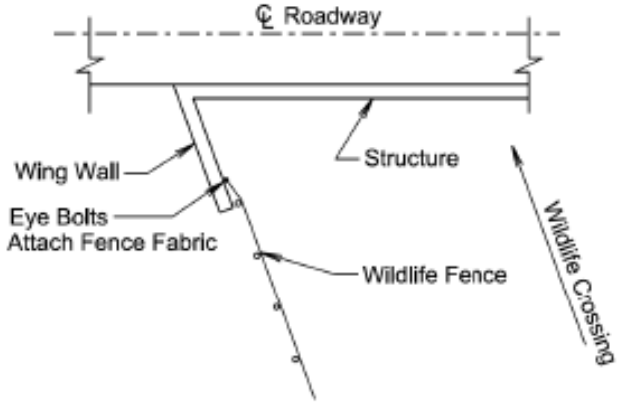
WILDLIFE FENCE AT STRUCTURES

Sheet 2 of 2

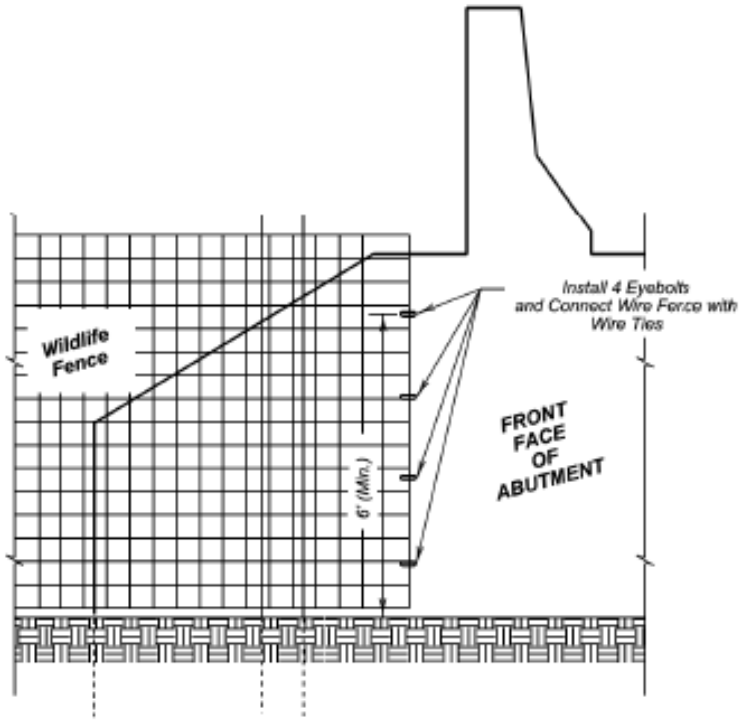
WILDLIFE JUMPOUTS

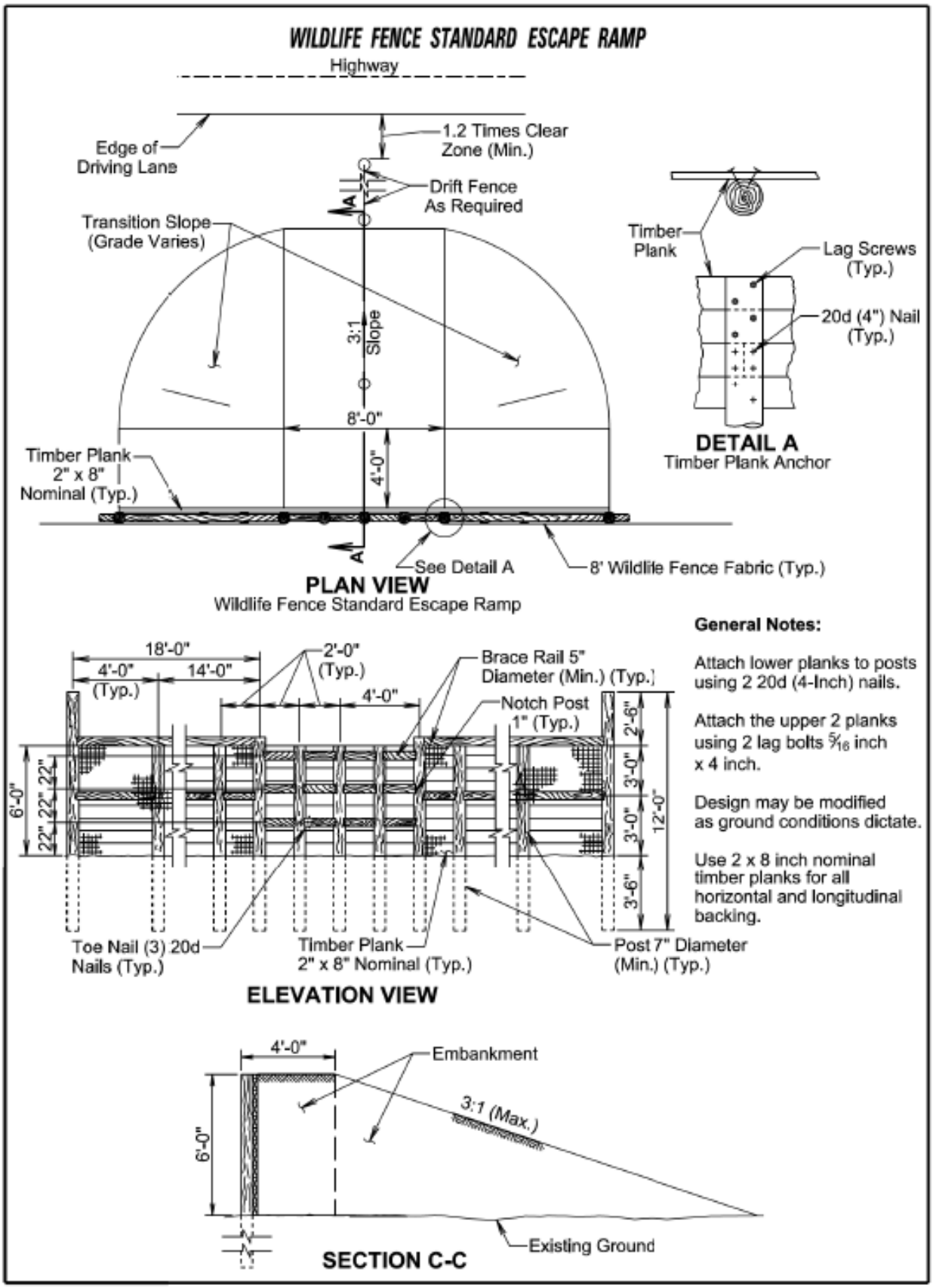


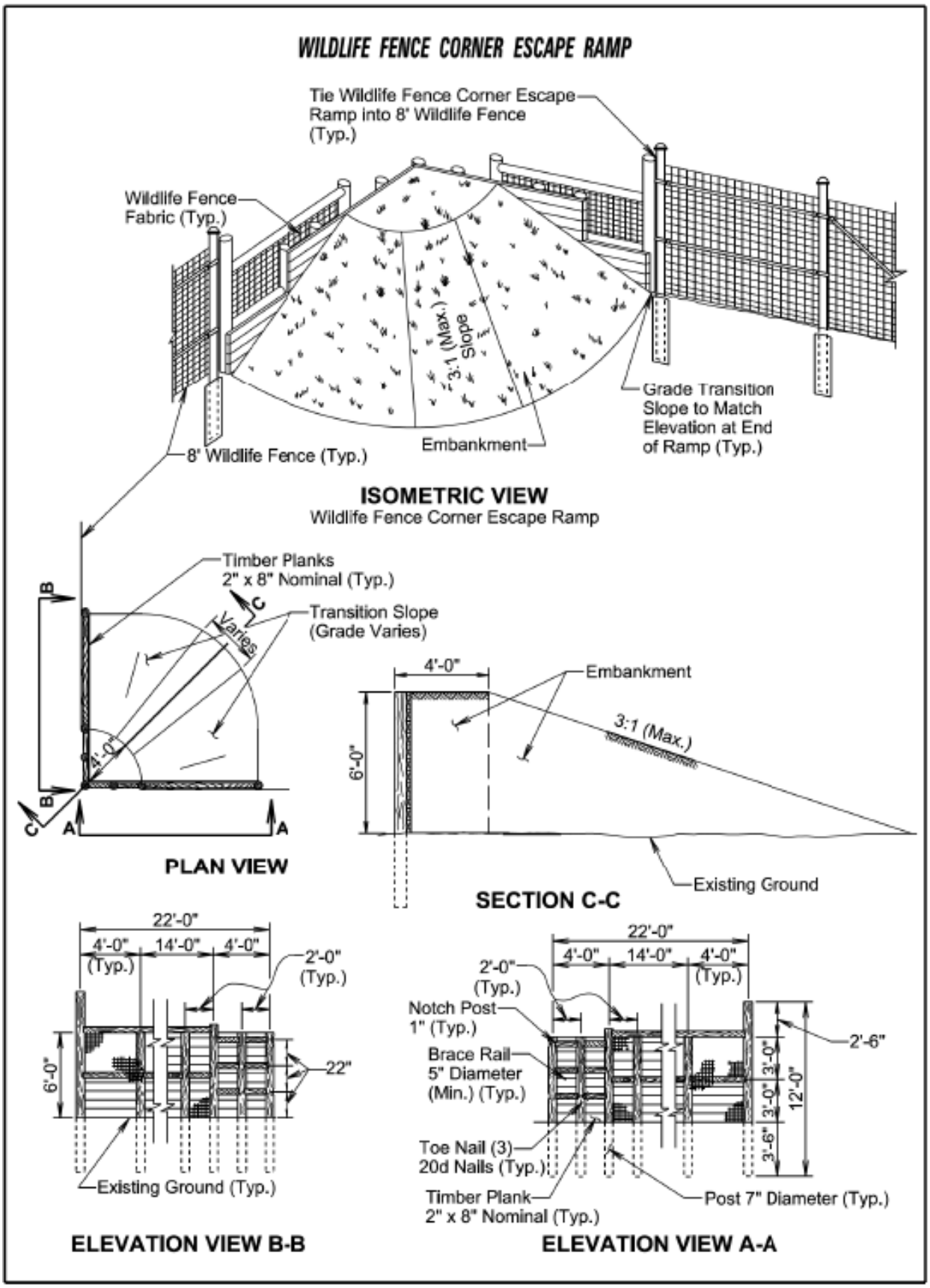
ATTACHING TO BRIDGE



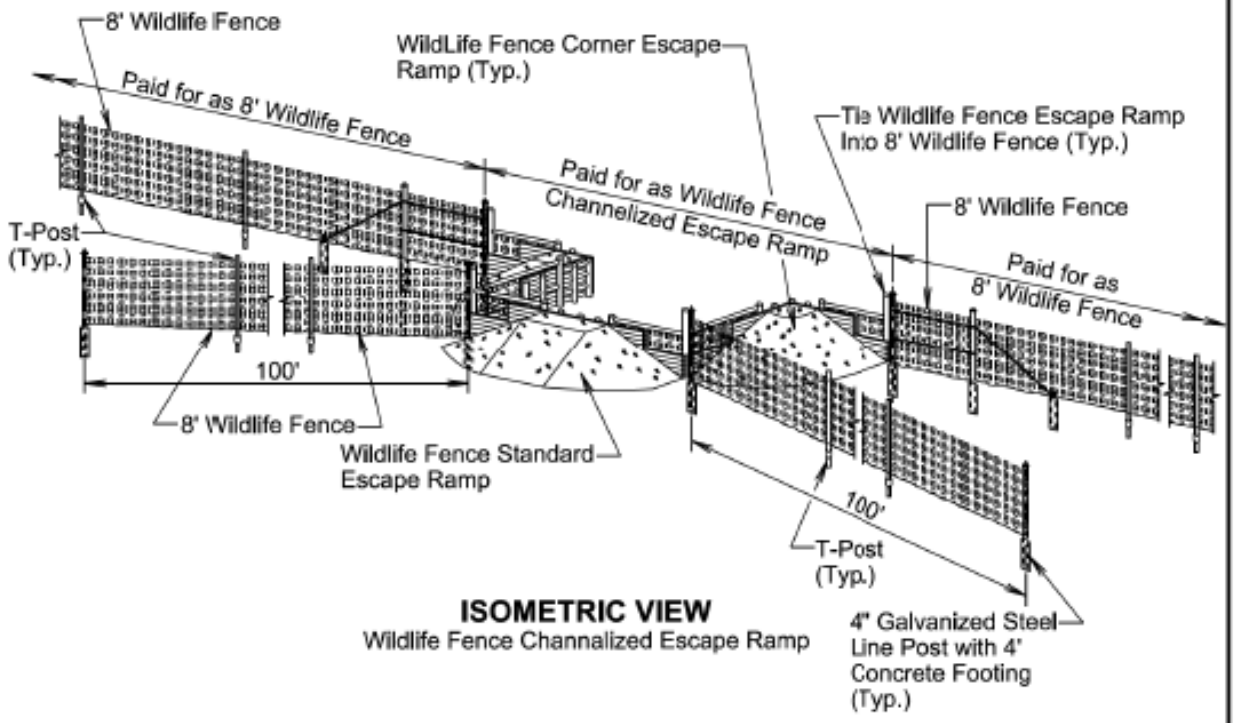
DETAILS FOR FENCE ANCHOR (STANDARD WINGWALL)



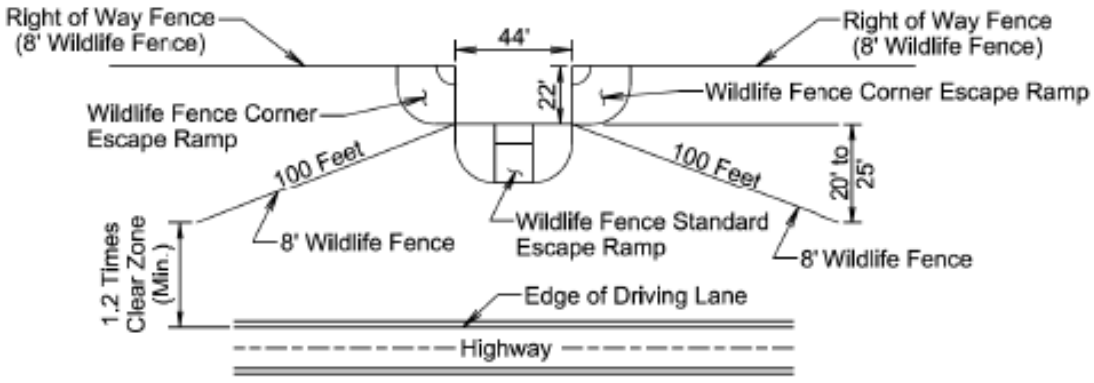

WILDLIFE FENCE STANDARD ESCAPE RAMP
Highway
Edge of Driving Lane
1.2 Times Clear Zone (Min.)
Drift Fence As Required
Transition Slope (Grade Varies)
3:1 Slope
8'-0"
4'-0"
Timber Plank 2" x 8" Nominal (Typ.)
See Detail A
8' Wildlife Fence Fabric (Typ.)
PLAN VIEW
Wildlife Fence Standard Escape Ramp
Timber Plank
Lag Screws (Typ.)
20d (4") Nail (Typ.)
DETAIL A
Timber Plank Anchor
18'-0"
4'-0" (Typ.)
14'-0"
2'-0" (Typ.)
4'-0"
Brace Rail 5" Diameter (Min.) (Typ.)
Notch Post 1" (Typ.)
6'-0"
22" 22" 22"
2'-6"
3'-0"
3'-0"
3'-6"
12'-0"
Toe Nail (3) 20d Nails (Typ.)
Timber Plank 2" x 8" Nominal (Typ.)
Post 7" Diameter (Min.) (Typ.)
ELEVATION VIEW
General Notes:
Attach lower planks to posts using 2 20d (4-Inch) nails.
Attach the upper 2 planks using 2 lag bolts 5/16 inch x 4 inch.
Design may be modified as ground conditions dictate.
Use 2 x 8 inch nominal timber planks for all horizontal and longitudinal backing.
4'-0"
Embankment
3:1 (Max.)
6'-0"
Existing Ground
SECTION C-C


WILDLIFE FENCE CORNER ESCAPE RAMP
Tie Wildlife Fence Corner Escape Ramp into 8' Wildlife Fence (Typ.)
Wildlife Fence Fabric (Typ.)
3:1 (Max.) Slope
Grade Transition Slope to Match Elevation at End of Ramp (Typ.)
Embankment
8' Wildlife Fence (Typ.)
ISOMETRIC VIEW
Wildlife Fence Corner Escape Ramp
Timber Planks 2" x 8" Nominal (Typ.)
Transition Slope (Grade Varies)
Varies
4'-0"
B
C
A
PLAN VIEW
4'-0"
Embankment
3:1 (Max.)
6'-0"
Existing Ground
SECTION C-C
22'-0"
4'-0" (Typ.)
14'-0"
4'-0"
2'-0" (Typ.)
6'-0"
22"
Existing Ground (Typ.)
ELEVATION VIEW B-B
22'-0"
4'-0"
14'-0"
4'-0" (Typ.)
2'-0" (Typ.)
Notch Post 1" (Typ.)
Brace Rail 5" Diameter (Min.) (Typ.)
2'-6"
3'-0"
3'-0"
3'-6"
12'-0"
Toe Nail (3) 20d Nails (Typ.)
Timber Plank 2" x 8" Nominal (Typ.)
Post 7" Diameter (Typ.)
ELEVATION VIEW A-A

WILDLIFE FENCE CHANNELIZED ESCAPE RAMP



ISOMETRIC VIEW
Wildlife Fence Channalized Escape Ramp



PLAN VIEW

GENERAL NOTES:

Payment for the wildlife fence channelized escape ramp includes two wildlife fence corner escape ramps and one wildlife fence standard escape ramp. No separate payment will be made for the corner and standard escape ramps when used with the channelized escape ramp.

Match post type of wing fence (8' Wildlife Fence) in combination

See 8' wildlife fence details for right of way fence design.

Appendix I: WVC Survey Results

SDDOT Vehicle-Wildlife Collision Mitigation Survey

Q1 Please enter your contact information

Answered: 18 Skipped: 0

ANSWER CHOICES	RESPONSES	
First and Last Name	100.00%	18
Agency	100.00%	18
Job Description	100.00%	18
Address 2	0.00%	0
City/Town	0.00%	0
State/Province	0.00%	0
ZIP/Postal Code	0.00%	0
Country	0.00%	0
Email Address	100.00%	18
Phone Number	100.00%	18

#	FIRST AND LAST NAME	DATE
1	[redacted]	7/2/2020 3:10 PM
2	[redacted]	6/30/2020 8:18 AM
3	[redacted]	6/29/2020 8:39 AM
4	[redacted]	6/24/2020 1:16 PM
5	[redacted]	6/24/2020 8:41 AM
6	[redacted]	6/19/2020 11:21 AM
7	[redacted]	6/19/2020 10:32 AM
8	[redacted]	6/19/2020 9:27 AM
9	[redacted]	6/18/2020 3:06 PM
10	[redacted]	6/18/2020 7:34 AM
11	[redacted]	6/17/2020 9:59 PM
12	[redacted]	6/17/2020 4:23 PM
13	[redacted]	6/17/2020 8:56 AM
14	[redacted]	6/17/2020 8:18 AM
15	[redacted]	6/16/2020 8:28 PM
16	[redacted]	6/16/2020 4:55 PM
17	[redacted]	6/16/2020 4:49 PM
18	[redacted]	6/16/2020 4:37 PM

1 / 15

SDDOT Vehicle-Wildlife Collision Mitigation Survey

#	AGENCY	DATE
1	SD Department of Game, Fish and Parks	7/2/2020 3:10 PM
2	SDDOT	6/30/2020 8:18 AM
3	U.S. Fish and Wildlife Service	6/29/2020 8:39 AM
4	GFP	6/24/2020 1:16 PM
5	Game, Fish and Parks	6/24/2020 8:41 AM
6	GFP	6/19/2020 11:21 AM
7	USDA Forest Service	6/19/2020 10:32 AM
8	SD Game, Fish and Parks	6/19/2020 9:27 AM
9	DPS - HIGHWAY SAFETY/ACCIDENT RECORDS	6/18/2020 3:06 PM
10	SDDOT	6/18/2020 7:34 AM
11	SDGFP	6/17/2020 9:59 PM
12	Transportation	6/17/2020 4:23 PM
13	SDGFP	6/17/2020 8:56 AM
14	SDDOT	6/17/2020 8:18 AM
15	SDGFP	6/16/2020 8:28 PM
16	Game, Fish & Parks	6/16/2020 4:55 PM
17	SDDOT	6/16/2020 4:49 PM
18	SDDOT	6/16/2020 4:37 PM

#	JOB DESCRIPTION	DATE
1	[redacted]	7/2/2020 3:10 PM
2	[redacted]	6/30/2020 8:18 AM
3	[redacted]	6/29/2020 8:39 AM
4	[redacted]	6/24/2020 1:16 PM
5	[redacted]	6/24/2020 8:41 AM
6	[redacted]	6/19/2020 11:21 AM
7	[redacted]	6/19/2020 10:32 AM
8	[redacted]	6/19/2020 9:27 AM
9	[redacted]	6/18/2020 3:06 PM
10	[redacted]	6/18/2020 7:34 AM
11	[redacted]	6/17/2020 9:59 PM
12	[redacted]	6/17/2020 4:23 PM
13	[redacted]	6/17/2020 8:56 AM
14	[redacted]	6/17/2020 8:18 AM
15	[redacted]	6/16/2020 8:28 PM
16	[redacted]	6/16/2020 4:55 PM
17	[redacted]	6/16/2020 4:49 PM
18	[redacted]	6/16/2020 4:37 PM

2 / 15

#	ADDRESS 2	DATE
	There are no responses.	

#	CITY/TOWN	DATE
	There are no responses.	

#	STATE/PROVINCE	DATE
	There are no responses.	

#	ZIP/POSTAL CODE	DATE
	There are no responses.	

#	COUNTRY	DATE
	There are no responses.	

#	EMAIL ADDRESS	DATE
1	[redacted]	7/2/2020 3:10 PM
2	[redacted]	6/30/2020 8:18 AM
3	[redacted]	6/29/2020 8:39 AM
4	[redacted]	6/24/2020 1:16 PM
5	[redacted]	6/24/2020 8:41 AM
6	[redacted]	6/19/2020 11:21 AM
7	[redacted]	6/19/2020 10:32 AM
8	[redacted]	6/19/2020 9:27 AM
9	[redacted]	6/18/2020 3:06 PM
10	[redacted]	6/18/2020 7:34 AM
11	[redacted]	6/17/2020 9:59 PM
12	[redacted]	6/17/2020 4:23 PM
13	[redacted]	6/17/2020 8:56 AM
14	[redacted]	6/17/2020 8:18 AM
15	[redacted]	6/16/2020 8:28 PM
16	[redacted]	6/16/2020 4:55 PM
17	[redacted]	6/16/2020 4:49 PM
18	[redacted]	6/16/2020 4:37 PM

SDDOT Vehicle-Wildlife Collision Mitigation Survey

#	PHONE NUMBER	DATE
1	[redacted]	7/2/2020 3:10 PM
2	[redacted]	6/30/2020 8:18 AM
3	[redacted]	6/29/2020 8:39 AM
4	[redacted]	6/24/2020 1:16 PM
5	[redacted]	6/24/2020 8:41 AM
6	[redacted]	6/19/2020 11:21 AM
7	[redacted]	6/19/2020 10:32 AM
8	[redacted]	6/19/2020 9:27 AM
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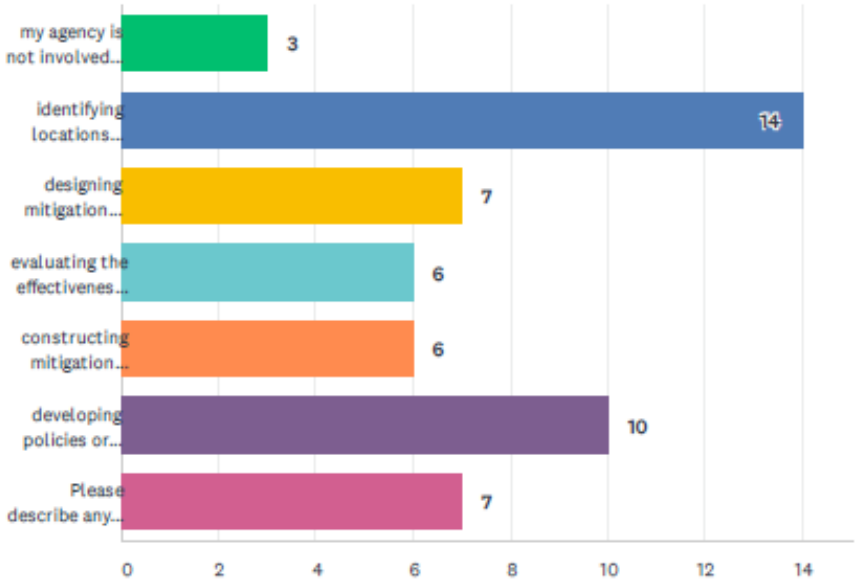
13	[redacted]	6/17/2020 8:56 AM
14	[redacted]	6/17/2020 8:18 AM
15	[redacted]	6/16/2020 8:28 PM
16	[redacted]	6/16/2020 4:55 PM
17	[redacted]	6/16/2020 4:49 PM
18	[redacted]	6/16/2020 4:37 PM

Q2 What roles does your agency have in wildlife-vehicle mitigation? (Please check all that apply)

Answered: 18 Skipped: 0



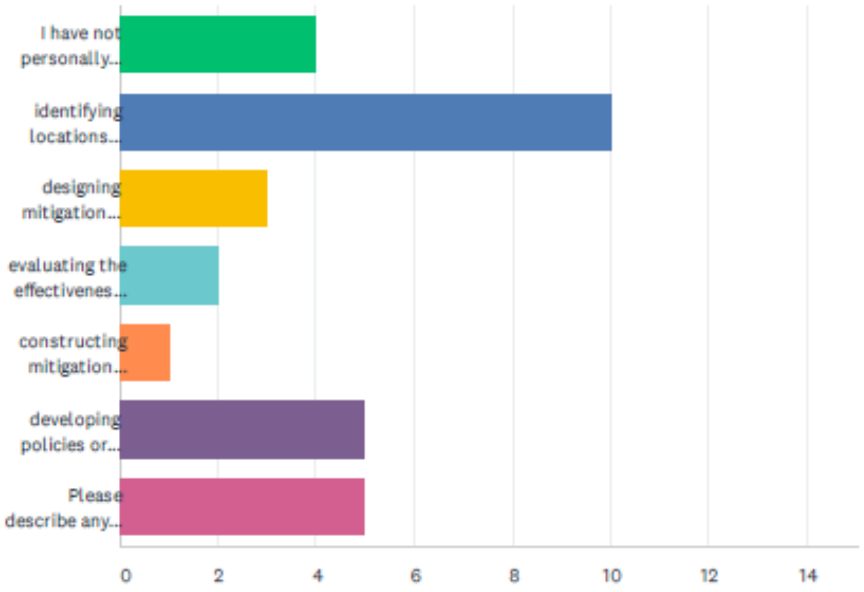
ANSWER CHOICES	RESPONSES	
my agency is not involved in mitigation of wildlife-vehicle collisions	16.67%	3
identifying locations needing mitigation	77.78%	14
designing mitigation treatments	38.89%	7
evaluating the effectiveness of mitigation treatments	33.33%	6
constructing mitigation treatments	33.33%	6
developing policies or procedures for mitigation of wildlife-vehicle collisions	55.56%	10
Please describe any other roles your agency plays in mitigation of wildlife-vehicle collisions:	38.89%	7
Total Respondents: 18		

SDDOT Vehicle-Wildlife Collision Mitigation Survey

#	PLEASE DESCRIBE ANY OTHER ROLES YOUR AGENCY PLAYS IN MITIGATION OF WILDLIFE-VEHICLE COLLISIONS:	DATE
1	I am not aware of anything specific that GFP does to mitigate collisions, but there could be efforts that I am not aware of.	7/2/2020 3:10 PM
2	We provide recommendations for wildlife-vehicle mitigation.	6/29/2020 8:39 AM
3	Wildlife management, which indirectly assists in mitigation of collisions. Occasional location identification and mitigation; however, these are generally in rare and emergent situations. Other roles might exist within the agency, but are outside of my purview.	6/24/2020 8:41 AM
4	Our office receives State Reportable Motor Vehicle/Wild Animal crashes that are compiled into our database.	6/18/2020 3:06 PM
5	Providing input to DOT officials	6/17/2020 9:59 PM
6	The DOT has worked on a variety of techniques and pilot projects in efforts to reduce wildlife-vehicle encounters.	6/17/2020 4:23 PM
7	SDGFP has provided DOT with some relevant information regarding high density crossing areas based on observation as well as radio collar data.	6/16/2020 4:55 PM

Q3 What roles have you personally played in wildlife-vehicle mitigation? (Please check all that apply)

Answered: 18 Skipped: 0



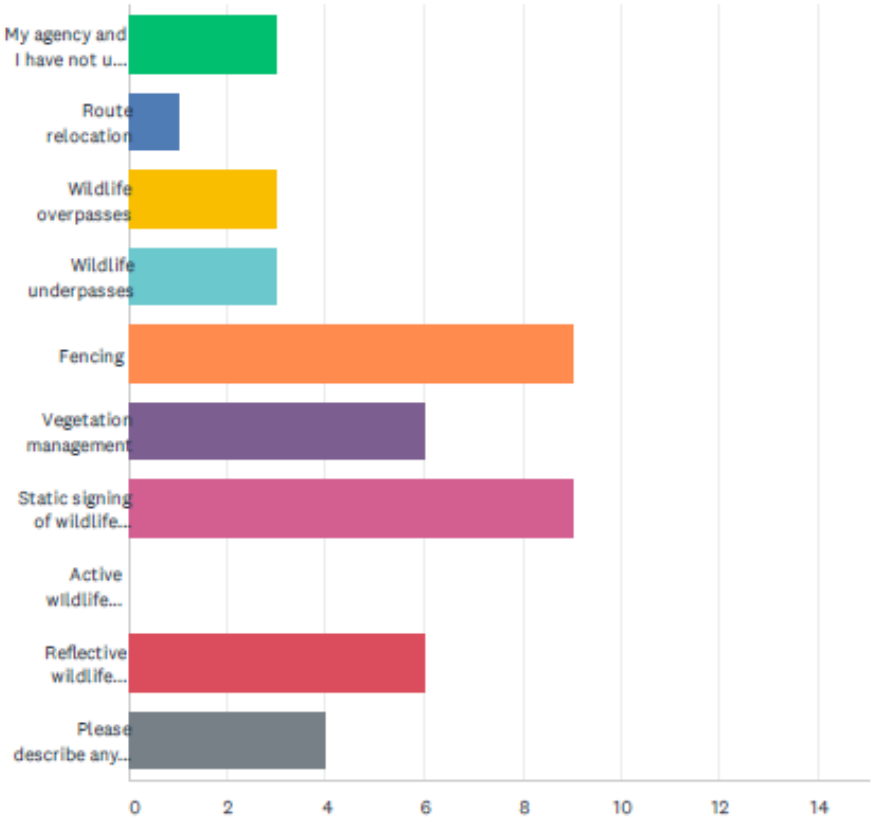
ANSWER CHOICES	RESPONSES	
I have not personally participated in mitigation of wildlife-vehicle collisions	22.22%	4
identifying locations needing mitigation	55.56%	10
designing mitigation treatments	16.67%	3
evaluating the effectiveness of mitigation treatments	11.11%	2
constructing mitigation treatments	5.56%	1
developing policies or procedures for mitigation of wildlife-vehicle collisions	27.78%	5
Please describe any other roles you have personally played in mitigation of wildlife-vehicle collisions:	27.78%	5
Total Respondents: 18		

SDDOT Vehicle-Wildlife Collision Mitigation Survey

#	PLEASE DESCRIBE ANY OTHER ROLES YOU HAVE PERSONALLY PLAYED IN MITIGATION OF WILDLIFE-VEHICLE COLLISIONS:	DATE
1	providing data on where river otters have been struck by vehicles	7/2/2020 3:10 PM
2	Contacting DOT for deer crossing signage	6/19/2020 11:21 AM
3	We are in the process of implementing a new software for the collection of state reportable crashes. This new software will be more detailed about the type of wild animal involved.	6/18/2020 3:06 PM
4	While in Road Design we used reflectors, fencing deterrent, vegetation in the highway right of way, and training for underpass/overpass.	6/17/2020 4:23 PM
5	I have not played a role with wildlife-vehicle collisions related to DOT. However I have provided mitigation measures for energy development projects to avoid wildlife-vehicle collisions (mostly reducing speed limits through project areas).	6/17/2020 8:56 AM

Q4 What kinds of mitigation treatments or strategies have you or your agency used to mitigate wildlife-vehicle collisions? (Please check all that apply)

Answered: 18 Skipped: 0



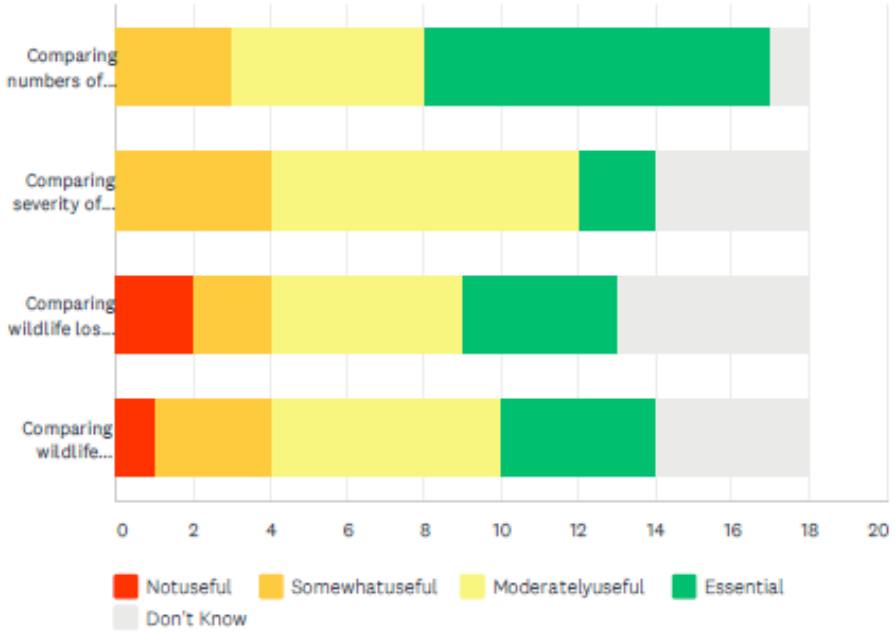
SDDOT Vehicle-Wildlife Collision Mitigation Survey

ANSWER CHOICES	RESPONSES	
My agency and I have not used any mitigation treatments	16.67%	3
Route relocation	5.56%	1
Wildlife overpasses	16.67%	3
Wildlife underpasses	16.67%	3
Fencing	50.00%	9
Vegetation management	33.33%	6
Static signing of wildlife crossings	50.00%	9
Active wildlife detection and warning systems	0.00%	0
Reflective wildlife deterrence	33.33%	6
Please describe any other mitigation treatments you or your agency has used:	22.22%	4
Total Respondents: 18		

#	PLEASE DESCRIBE ANY OTHER MITIGATION TREATMENTS YOU OR YOUR AGENCY HAS USED:	DATE
1	I am not aware of anything specific that GFP does to mitigate collisions, but there could be efforts that I am not aware of.	7/2/2020 3:10 PM
2	We provide recommendations for wildlife-vehicle mitigation.	6/29/2020 8:39 AM
3	not sure if our recommendations have ever actually been implemented that i have been involved with.	6/24/2020 1:16 PM
4	Intercept feeding to prevent wildlife from crossing road.	6/24/2020 8:41 AM

Q5 Please rate the usefulness of these methods for evaluating the effectiveness of wildlife-vehicle collision mitigation treatments:

Answered: 18 Skipped: 0



	NOTUSEFUL	SOMEWHATUSEFUL	MODERATELYUSEFUL	ESSENTIAL	DON'T KNOW	TOTAL	WEIGHTED AVERAGE
Comparing numbers of crashes before and after mitigation	0.00% 0	16.67% 3	27.78% 5	50.00% 9	5.56% 1	18	3.35
Comparing severity of crashes before and after mitigation	0.00% 0	22.22% 4	44.44% 8	11.11% 2	22.22% 4	18	2.86
Comparing wildlife losses before and after mitigation	11.11% 2	11.11% 2	27.78% 5	22.22% 4	27.78% 5	18	2.85
Comparing wildlife behavior before and after mitigation	5.56% 1	16.67% 3	33.33% 6	22.22% 4	22.22% 4	18	2.93

#	PLEASE DESCRIBE ANY OTHER METHODS YOU FEEL WOULD BE USEFUL FOR EVALUATING THE EFFECTIVENESS OF WILDLIFE-VEHICLE COLLISION MITIGATION TREATMENTS:	DATE
1	There could potentially be specific methods (which could be used in combination with the information above) to evaluate for each treatment. For example, if a wildlife crossing (under/overpass) was constructed, use of that treatment (more than just the behavior of the animal) would possibly be a helpful measurement.	6/24/2020 8:41 AM
2	Comparing Speed actual speed of vehicle at collision. Is route along a traditional migratory route? Is the habitat around the area have a higher probability of attracting wildlife (e.g., water source, agricultural crops)	6/19/2020 10:32 AM
3	For me the before and after crash data is the most useful. Understanding the wildlife behavior is also very valuable to see how mitigation strategies can be best applied in other areas. Some fencing will be used to funnel deer to an underpass while other fence will be used to keep deer from crossing the highway all together.	6/18/2020 7:34 AM
4	use of remote monitoring (e.g. game cameras combined with traffic counters) at high risk areas	6/17/2020 8:56 AM

Q6 Please rate the significance of obstacles to effective mitigation of wildlife-vehicle collisions:

Answered: 18 Skipped: 0

	NOT A BARRIER	MINORBARRIER	MODERATE BARRIER	MAJORBARRIER	DON'T KNOW	TOTAL	WEIGHTED AVERAGE
Identifying suitable locations for mitigation	22.22% 4	27.78% 5	27.78% 5	11.11% 2	11.11% 2	18	2.31
Designing suitable mitigation treatments	5.56% 1	11.11% 2	44.44% 8	22.22% 4	16.67% 3	18	3.00
Securing funding for mitigation treatments	0.00% 0	11.11% 2	33.33% 6	16.67% 3	38.89% 7	18	3.09
Demonstrating the need for mitigation in my geographic area	11.11% 2	33.33% 6	27.78% 5	5.56% 1	22.22% 4	18	2.36
Demonstrating the value of mitigation to my agency	27.78% 5	27.78% 5	27.78% 5	5.56% 1	11.11% 2	18	2.13
Coordinating mitigation efforts among agencies	16.67% 3	33.33% 6	22.22% 4	11.11% 2	16.67% 3	18	2.33

#	PLEASE DESCRIBE ANY OTHER BARRIERS TO EFFECTIVE MITIGATION OF WILDLIFE-VEHICLE COLLISIONS:	DATE
1	My agency is not usually involved during the planning stage of roads/highways authorized by the state or the FHA. NEPA documentation and required mitigation measures are rarely followed by design engineers and construction project managers. This is especially noticed due to damage to wetlands/waters of the United States. I am usually disappointed when implementation starts. Its like everything that was good was thrown out with the bath water. A hugh barrier is cost of the most appropriate mitigation and long term maintenance of the mitigation.	6/19/2020 10:32 AM
2	Finding the best locations to deploy mitigation treatments could be a struggle. We have limited experience with identifying all the ingredients that go into that perfect location but more experience will make this easier. We are defiantly moving in the right direction.	6/18/2020 7:34 AM

Q7 Please provide any other comments you may have on the subject of mitigating wildlife-vehicle collisions:

Answered: 6 Skipped: 12

#	RESPONSES	DATE
1	Mitigating wildlife - vehicle collisions can be important for the conservation of some rare species and should be done more in SD. Getting across a road is a major obstacle that is not overcome.	7/2/2020 3:10 PM
2	i believe there are some simple solutions to help mitigate wvc's, just need to actually implement.	6/24/2020 1:16 PM
3	South Dakota needs to really look at what other progressive states (Colorado) are doing to mitigate wildlife-vehicle collisions. We have a lot of wildlife and I hate when I hit something.. Insurance Costs to repair (let along medical bills) should be taken into account when figuring cost benefit ratios of a project. Save lives.	6/19/2020 10:32 AM
4	You're doing a great job with this.	6/18/2020 7:34 AM
5	I am no longer involved in this effort in my current role.	6/17/2020 4:23 PM
6	Many western states use identified migration corridors of big game species for planning of wildlife underpass/overpass or other mitigation measures. GFP currently does not have data about migration corridors (outside of the Black Hills) so identifying target areas may not take into account animal behavior. It's likely that wildlife collision data would do a good job predicting these areas, but there could be some underlying biological mechanism that we don't understand.	6/17/2020 8:56 AM

Appendix J: Study Advisory Team Meeting HDR Presentation

Objectives

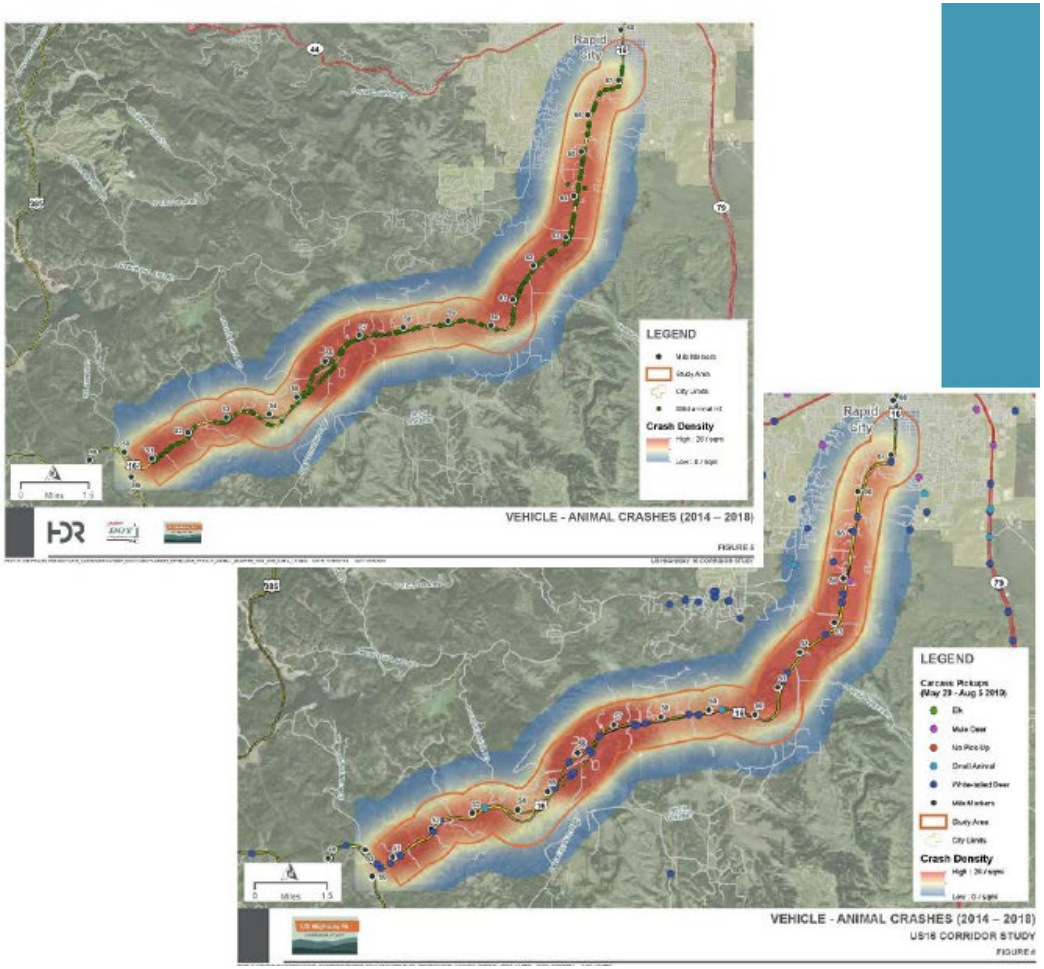
- Review SDDOT Wildlife and Roads Decision Guide
- Review wildlife vehicle collision findings
- Review white tail deer population information
  - Research to date
  - USFS and SDGFP meetings
- Present preliminary recommendations

SDDOT Wildlife and Road Decision Guide

- Environmental Checklist
- Field Review
- Findings:
  - US highway with several access points
  - Mixed land cover
  - Carcass data and WVC data obtained
  - BHNF protected area but interspersed with private development along US 16
  - White-tailed deer is the main species of concern (elk and bighorn sheep present but not an issue for collisions at this time)
  - No defined wildlife movement corridor – Meeting with SDGFP and USFS
  - SDGFP management goal is for maintaining current white-tailed deer population
  - Spring Creek is a natural wildlife connectivity feature; also an existing structure
  - Limited fences, some guardrail

Wildlife Collisions

- 280 vehicle-animal collisions were reported to authorities within the US16 Study Corridor between 2014-18 or 48% of the crashes
- This is supported by carcass data collected by SDDOT contractors, which show most collisions were white-tailed deer. No elk or bighorn sheep** collisions were reported.
- 75% of collisions are happening at night when animals are most active
- Most collisions are greatest November followed by June/Sept (May – Oct similar # of crashes) corresponding to breeding season/migration and summer when ADTs are higher

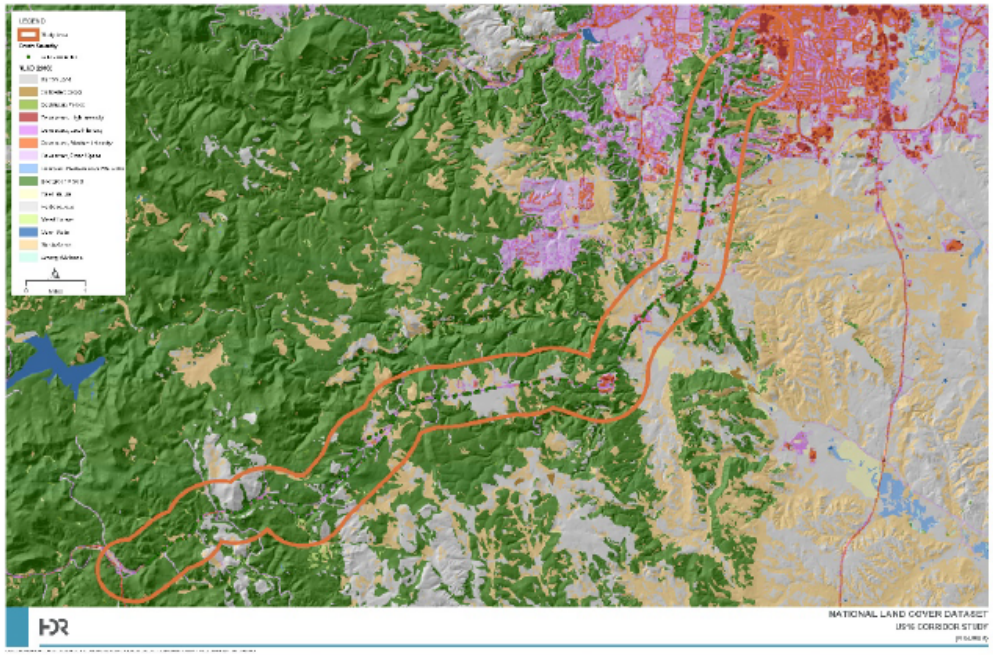


Wildlife Collisions

- Collisions are not concentrated in one location in the corridor
- Are some smaller concentrations

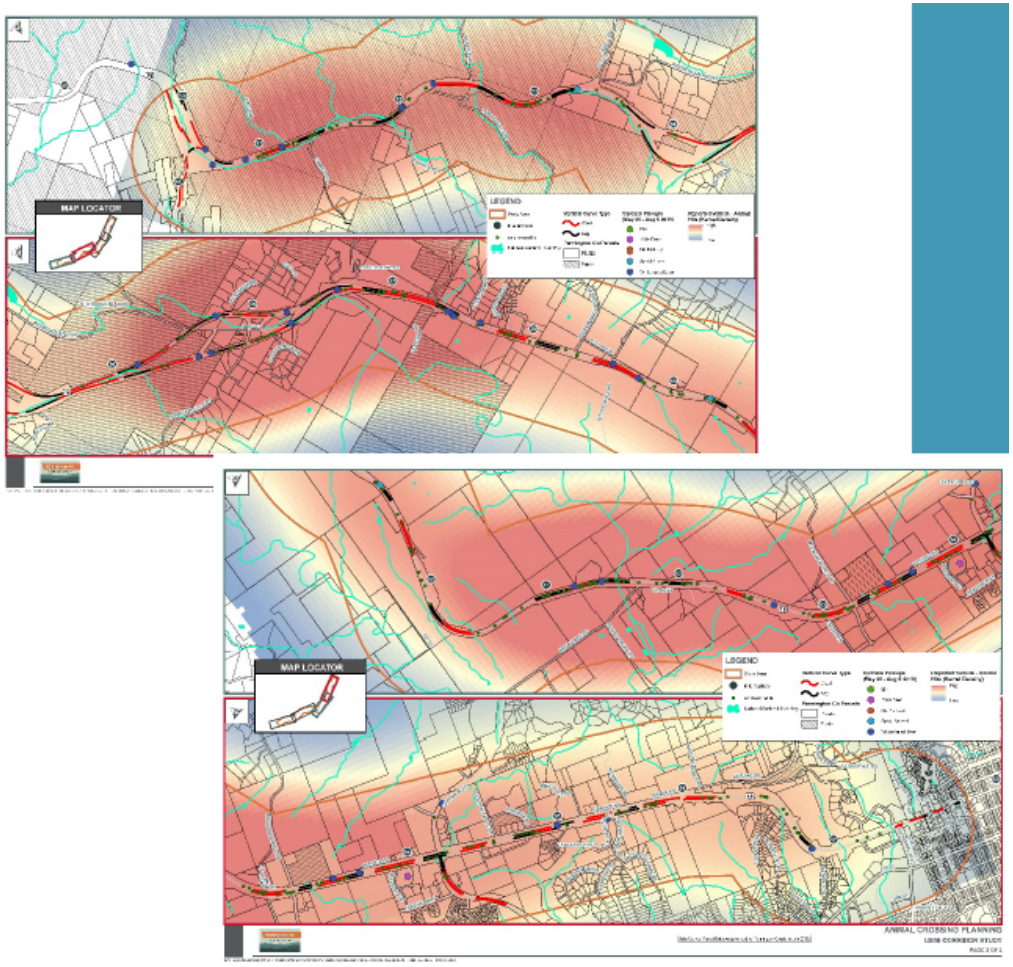
White-tailed population in the Black Hills

- Research has focused on mortality; winter/summer range;
- White-tailed population in the Black Hills is one of few migrating populations but there are no defined migration routes.
  - Migration occurs n-w in summer (3 weeks may); s-e in the winter (beginning Aug/Sept – Feb)
- Evidence of the deer crossing at Spring Creek
  - FS noted that will not cross during high flows which can send the individual deer over the road
- White-tailed forage (where easy)
  - Shrub and forb cover is important
  - Residential areas, along the road is first place to green/ last place to brown, and in burn areas (data inconsistent)
  - Limited hunting along some areas of US 16 (e.g. Reptile Gardens)



White-tailed population

- SDGFP mortality studies show the population is not being adversely affected by collisions
- SDFGP management goals (SD Wildlife Action Plan) – has been a growth area but shifting to maintain population goals
- USFS manages habitat with deer as an indicator species of forest health
- Not a lot of public commentary received about collisions from stakeholder to SDDOT, SDGFP, USFS
- USFS and SDGFP supportive of wildlife accommodations; not particularly interested in lots of fence



Types of Accommodations

- Underpasses
- Overpasses
- Fencing
- Warning Systems
- Speed limit reductions during certain times of year or day
- Education

So take aways for US 16?

- Collisions are primarily with white-tailed deer but are not causing a decline in the deer population
- At an annual average value of $17,343 per reported PDO crash, the total cost exceeds $107.9 million annually to the South Dakota public. In Oct 2019, SD ranked 4th highest in animal collisions.
- Migrating deer population but not a lot of research on movement patterns
- No clear migration routes or crossings on US 16 (except potentially at Spring Creek)
- Interspersed public / private property ownership
- Presence of the deer near rural residential development and this type of development is expected to continue growing along the corridor
- No hunting in many areas to control deer population
- Season variability in collisions

Preliminary Recommendations US 16?

- Additional research on movement patterns / major crossings on US 16
  - Partnership with USFS, SDGFP and universities
- Develop Animal Detection System (ADS) pilot project
  - Identify best ADS for US16 applications and study effectiveness
- Dynamic roadway warning signs and night/seasonal reduced speed limits
  - Identify most effective driver warning systems
  - Pair with educational programs and local partnerships (PSAs, websites, interviews)
- Enhance wildlife crossing at Spring if bridge is replaced or widened in the future
  - Design structure with wildlife movement in mind, may include fencing to guide wildlife to crossing
- Others
  - Maintenance at road edge
  - Coordination with landowner/SDGFP

Appendix K: SDDOT & SDGFP Wildlife Scoping Meeting Minutes

SD DOT & SD GFP Meeting Minutes for Wildlife Scoping

Meeting Location: SD GFP's Outdoor Campus – West in Rapid City and I-90 Site Visit

Date: February 22nd, 2019 (Fri) 9:00 am to 2:00 pm

Projects Discussed:

1) PCN #06Y4 – Rapid City Region Wildlife Fence (Bid 2021)
2) PCN #021G – I-90 EBL Exit 32 (Sturgis) to N of Exit 40 (Tilford) Mainline (Bid 2022)
3) PCN #06DN – I-90 EBL Exit 32 (Sturgis) to N of Exit 40 (Tilford) Structures (Bid 2024)

Attendees: Name	Agency	Phone	Email
Trenton Haffley	SD GFP – Rapid City	605-394-2394	trenton.haffley@state.sd.us
Andy Vandel	SD DOT – Pierre	605-773-4421	andy.vandel@state.sd.us
Sonia Downs	SD DOT – Pierre	605-892-2872	sonia.downs@state.sd.us
Kit Bramblee	SD DOT – Pierre	605-773-2428	kit.bramblee@state.sd.us
Greg Boness	SD DOT – Sturgis	605-347-1978	gregory.boness@state.sd.us
Tom Horan	SD DOT – Rapid City	605-394-1631	tom.horan@state.sd.us
Matt Rippentrop	SD DOT – Custer	605-673-9016	matt.rippentrop@state.sd.us

Items Discussed:

1) Introductions

2) Sonia and Andy explained how the SD DOT's STIP and scoping works. Discussed the SD DOT's two upcoming projects I-90 from Tilford to Sturgis exits and Rapid City Region Wildlife Fence. The Interstate's fence is owned by the SD DOT, where State highways fence are owned by the adjoining private landowner.

3) Discussed information to review for a potential wildlife fencing/crossing project:
   a) Wildlife vehicle collisions crash reports. Other states have found the number of crashes reported to take that times 5.25 or up as high as times 10 for the real number of wildlife vehicle collisions, because not all of them are reported as crashes. For example, on Hwy 18 between Hot Springs and Edgemont in 3 years there was 33 elk hit by vehicles, only 3 elk hits were reported as crashes, and only 11 elk hits were picked up by the carcass collector.
   b) Wildlife carcass hot spots picked up by the carcass collector using SD GFP/DOT's new App, which was started just over 6 months ago. By July 1, 2019, when the SD carcass collectors sign their new contracts all of them will be using the new App.
   c) Wildlife GPS collar data. There was no collar data for the areas available. If there is a concerned area, other States will only collar 10 animals using the drop net method to see their movements prior to a project's scoping.
   d) Wildlife harvest data. SD GFP's provided 2014, 2015, and 2018 elk harvest heat maps.
   e) Maps showing public land, private land ownership, and ROW areas.

4) Reviewed attached maps of the SD DOT's wildlife vehicle collisions, crashes reported, and SD GFP's elk harvest heat maps. The I-90 Tilford to Sturgis structures are located at MRMs 34.32, 37.40, and 39.45. Only the structures at MRMs 34.32 and 37.40 are being replaced. The railroad tracks that parallel I-90, typically two trains travel/day.

5) Discussed as a group about the elk crossing on I-90 by the Tilford exit. Trenton discussed in the early 2000s SD GFP decreased the elk population with hunting pressure, which pushed the elk from the Black Hills elk unit #7 to the Prairie elk unit #9 and I-90 divides the units. Greg agreed with Trenton what moves the elk and that he use to see around 75-100 elk in the early 2000s and now he sees 5-10 elk in the same area. Trenton said the local elk do not have a migration route and there is suitable habitat on both sides of I-90. Rip asked if the local landowners and SD GFP approved, could this area have 8' tall wildlife fence continual through this three-mile area using the two structures for crossings vs installing a half mile of wildlife fence each way of the three structures. Trenton said the local landowners would need to be met with for any of their concerns and SD GFP would potentially be open to the idea if the wildlife fence could reduce vehicle collisions.

6) Tom discussed the cost to benefit ratio should show that the 8' tall wildlife fence would be beneficial. Rip showed an example from a Utah DOT project that was on the I-70 and showed it's cost to benefit ratio (attached). Tom and Andy both agreed this was a good example of how it should be shown that any wildlife fence should or should not be considered.

7) Rip asked if anyone had a preference between 6' tall chain-link fence or 8' tall wildlife fence. Greg said chain-link fence is not easy to repair and he thought the 8' tall wildlife fence would be easier to repair. Rip said the wildlife fence is typically 8' tall, because the deer can still jump the 6' tall fence. Also the 8' tall wildlife fence cost half of what the 6' tall chain-link fence does.

8) Tom and Greg both asked about how much maintenance did the 8' tall wildlife fence take. Rip said he was told the first year it's about 3-5 days/year to find the holes that the wildlife found. Then after the first year, it's about 1-2 days/year of maintenance. Idaho just started a program called Adopt-A-Fence program with their conservation groups, which is like Adopt-A-Highway program with volunteers picking trash up on the highways. Idaho gives the volunteers the tools and supplies needed to maintain the fence. Any big repairs, like a tree falling on the fence, the DOT's maintenance crew repairs it.

9) Other States stressed to involve the public on the wildlife fence/crossing projects. Invite the local FHWA, Municipalities, County Planner, Conservation Groups, NRCS, USFS, BLM, news media, etc. The conservation groups typically help fund the wildlife fencing projects, which helps take ownership.

10) Other States said they would more than glad to give us (SD) any information of their plans, standard templates, specs, previous bids, type of fencing materials, etc. that they use.

11) Ways to measure success on a wildlife fencing project, which can take 1-4 years before the wildlife consistently uses them to see a potential 80% to 90% reduction in vehicle collisions:
    a) Use trail cameras to compare how many wildlife crossings went through the structure using fencing before and after the project.
    b) Compare the number of wildlife vehicle collisions before and after the project.
    c) Compare the number of wildlife carcasses picked up before and after the project.
    d) Compare the wildlife's estimated population before and after the project.

12) Kit asked if "Wildlife Fence/Crossing" signs should be installed to warn the vehicles entering the areas. Other States do install these types of signs.

13) Greg said the SD DOT maintenance staff would like to be able to use the new Carcass Collector App in reverse by marking the carcass on their cell phone for the Collector to pick up. Trenton said this would be nice for the SD GFP game wardens as well. We would need to make sure the carcasses weren't recorded twice. Trenton and Kit said they would look into this further. Rip discussed currently how elk are rarely and bighorn sheep are not ever recorded in the Carcass Collector App, because the elk and bighorn sheep are typically picked up by SD GFP's game wardens. However, there is an Excel spreadsheet that has been logging them and is attached.

14) Rip showed some pictures of what North Dakota did under an I-90 bridge by placing a 10' wide dirt path on top of the new riprap for no additional cost. In the six months after the project was completed, 1,200 wildlife crossing occurred with no wildlife fence installed.

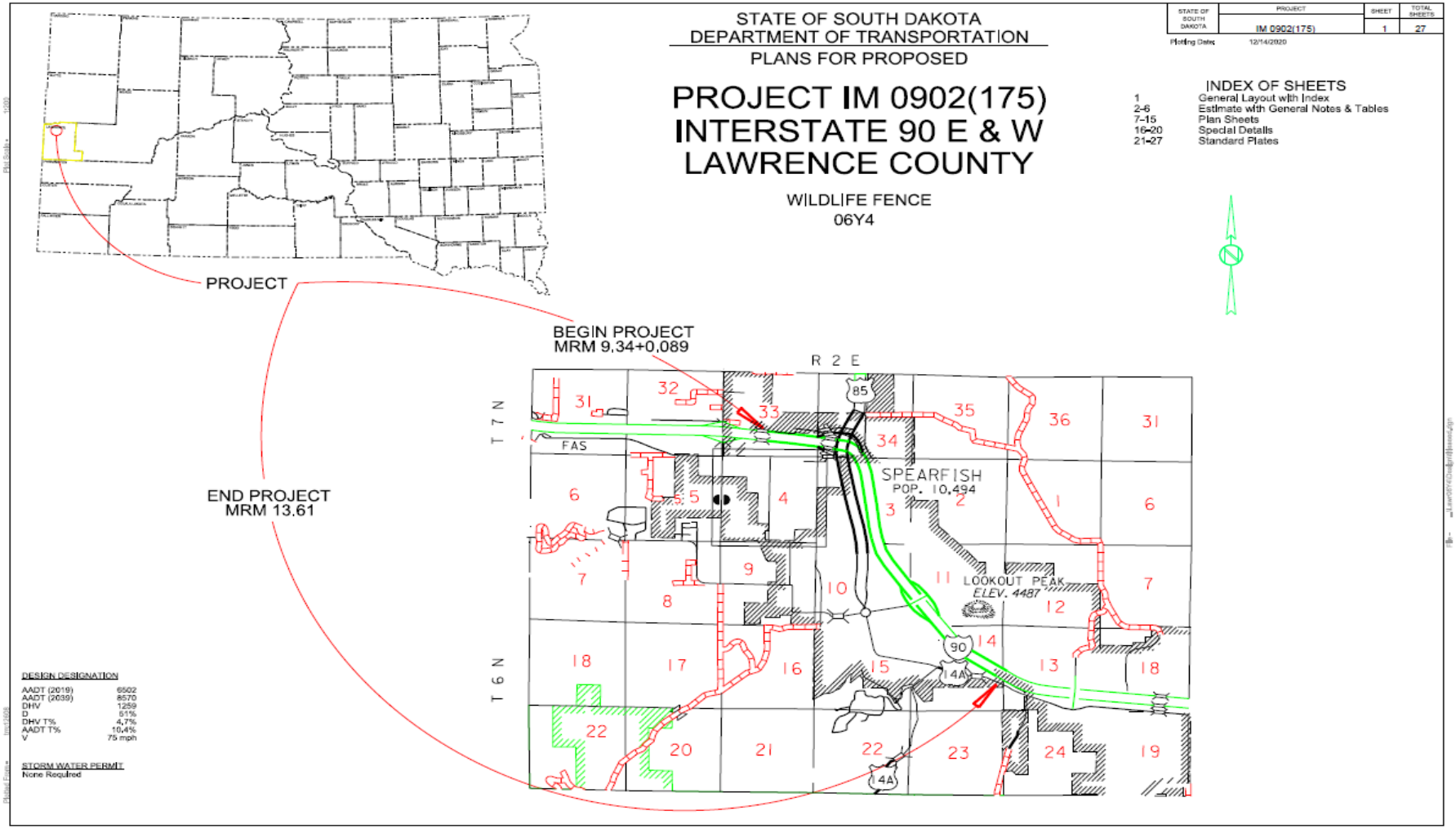
15) The group went on a field trip to see these locations discussed. Rip asked if at the I-90 Spearfish location from MRM 9.40 to 10.30, with potential approval of adjoining landowners can this area be fenced continual vs leaving an opening under the bridges at MRM 10.08 for a crossing. Tom said a flood event would need to be considered. Trenton said the SD GFP would be open to the idea of fencing it off vs leaving an opening under the bridges, because there are no migration routes and it might help keep deer out of the City of Spearfish. It was also discussed to possibly to some dirt work underneath the five bridges at MRM 10.08 and improve this potential crossing for wildlife.

16) Tom Horan showed the group Steve Wiege's five maps (attached) with notes for PCN #06Y4 – Rapid City Region Wildlife Fencing project. The top two areas of concern were on I-90 at Spearfish from MRM 9.4 to 10.3 and the west side of Rapid City on I-90 from MRM 55.8 to 57.1.

17) The two options of wildlife fencing that is being considered for both projects:
    a) 8' tall wildlife fence placed roughly a half mile each way of the structure using the lands natural topography.
    b) 8' tall wildlife fence place continual through the concerned area except at the structures to allow the wildlife to cross through the structures. In addition, potentially using double cattle guards installed at the exits so the wildlife can't enter the Interstate. If the fence was continual, escape ramps would be utilized.

Appendix L: Project IM 0902(175), Lawrence County, PCN 06Y4

Interstate 90 E & W, Wildlife Fence Plans



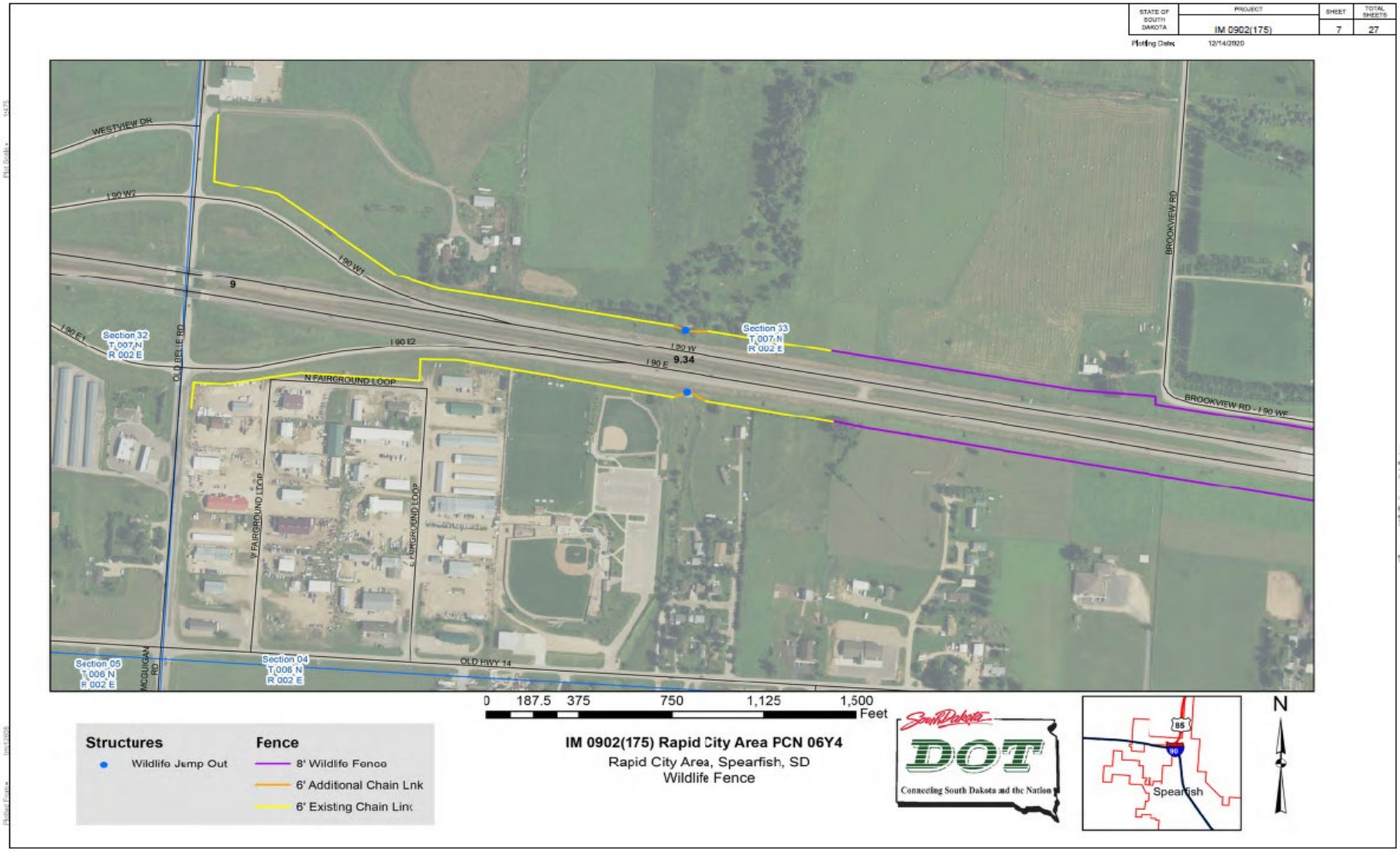
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS
	IM 0902(175)	6	27

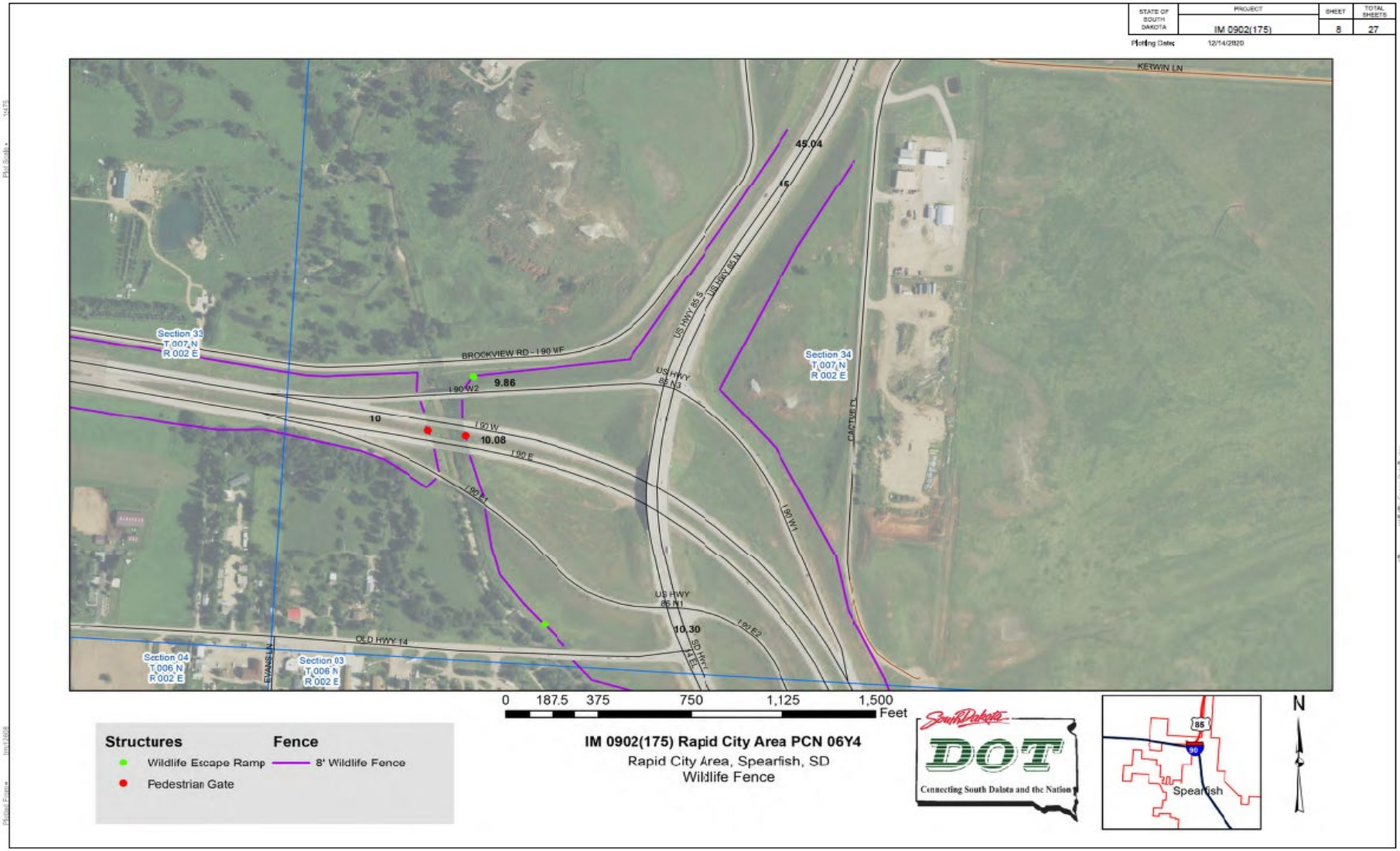
Table of Wildlife Fence

Route			Remove Fence (Ft)	2 Post Panel (Each)	6' Chain Link Fence with Tension Wired Top (Ft)	8' Wildlife Fence (Ft)	Wildlife Fence Terminal Brace (Each)	Wildlife Fence Line Brace (Each)	Wildlife Fence Corner Brace (Each)	Notes
I90 EB	MRM	MRM								
	8.95	9.34	2140	1	2336					
	9.51	10.04	3290			3290	2	6	3	
	10.04	10.04	60			60	2			Eastbound between mainline structures
	10.04	10.04	106			106	2			Eastbound Between off ramp and mainline structure
	10.08	10.08	75			75	2			Westbound between mainline structures
	10.08	10.23	872			872	2	1	2	
	10.80	11.36	2953			2953	2	8	1	
	12.03	12.03	20							To provide for jumpout
	12.73	13.61	4772			4772	2	8	3	
I90 WB	MRM	MRM								
	8.95	9.34	2280		2522					
	9.51	10.04	3280			3280	2	6	4	
	10.04	10.04	75			75	2			Westbound between mainline structures
	10.08	10.08	50			50	2			Westbound Between off ramp and mainline structure
	10.08	10.08	187			187	2			Eastbound Between off ramp and mainline structure
	9.86	10.17	455			455	2	1	1	
	10.30	12.85	11294			11294	2	14	15	
US 85 SB	MRM	MRM								
	44.28	44.64	2266			2266	2	2	10	
	44.89	44.95	851			851	2	1	3	
US 85 NB	MRM	MRM								
	44.89	44.95	851	2		851	2		3	
		Total	35877	3	4858	31437	32	47	45	

Table of Wildlife Escape Ramps

		6' Pedestrian Swing Gate (Each)	Wildlife Fence Standard Escape Ramp (Each)	Wildlife Fence Channelized Escape Ramp (Each)	Wildlife Fence Corner Escape Ramp (Each)	Type F Permanent Seed Mixture (Lb)	Fertilizing (Lb)	Fiber Mulching (Lb)	Notes
I90 EB	MRM								
	10.04	1							
	10.30			1		1	22	29	EB Off Ramp
	12.80		1			1	22	29	
I90 WB	MRM								
	9.86				1	1	22	29	WB On Ramp
	10.08	1							
	11.50		1			1	22	29	
	12.80		1			1	22	29	
		2	3	1	1	5	110	145	


STATE OF SOUTH DAKOTA
PROJECT
IM 0902(175)
SHEET
7
TOTAL SHEETS
27
Plotting Date: 12/14/2020
WESTVIEW DR
I 90 W2
I 90 W1
I 90 E1
I 90 E2
I 90 W
I 90 E
9.34
9
Section 32
T 007 N
R 002 E
Section 33
T 007 N
R 002 E
OLD BIELLE RD
N FAIRGROUND LOOP
W FAIRGROUND LOOP
E FAIRGROUND LOOP
BROOKVIEW RD
BROOKVIEW RD - I 90 WB
MCGUIGAN RD
Section 05
T 006 N
R 002 E
Section 04
T 006 N
R 002 E
OLD HWY 14
0
187.5
375
750
1,125
1,500
Feet
Structures
Wildlife Jump Out
Fence
8' Wildlife Fence
6' Additional Chain Lnk
6' Existing Chain Linc
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
SouthDakota DOT
Connecting South Dakota and the Nation
Spearfish
N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PROJECT
IM 0902(175)
SHEET
8
TOTAL SHEETS
27
Plotting Date: 12/14/2020
KERWIN LN
45.04
15
US HWY 85 S
US HWY 85 N
Section 33
T 007 N
R 002 E
BROCKVIEW RD - I 90 WF
I 90 W2
9.86
10
I 90 W
10.08
I 90 E
I 90 E1
I 90 W1
Section 34
T 007 N
R 002 E
CARTER CT
US HWY 85 N1
10.30
I 90 E2
SD HWY 34 E
OLD HWY 14
EVANS LN
Section 04
T 006 N
R 002 E
Section 03
T 006 N
R 002 E
0
187.5
375
750
1,125
1,500
Feet
Structures
Wildlife Escape Ramp
Pedestrian Gate
Fence
8' Wildlife Fence
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
SouthDakota
DOT
Connecting South Dakota and the Nation
85
90
Spearfish
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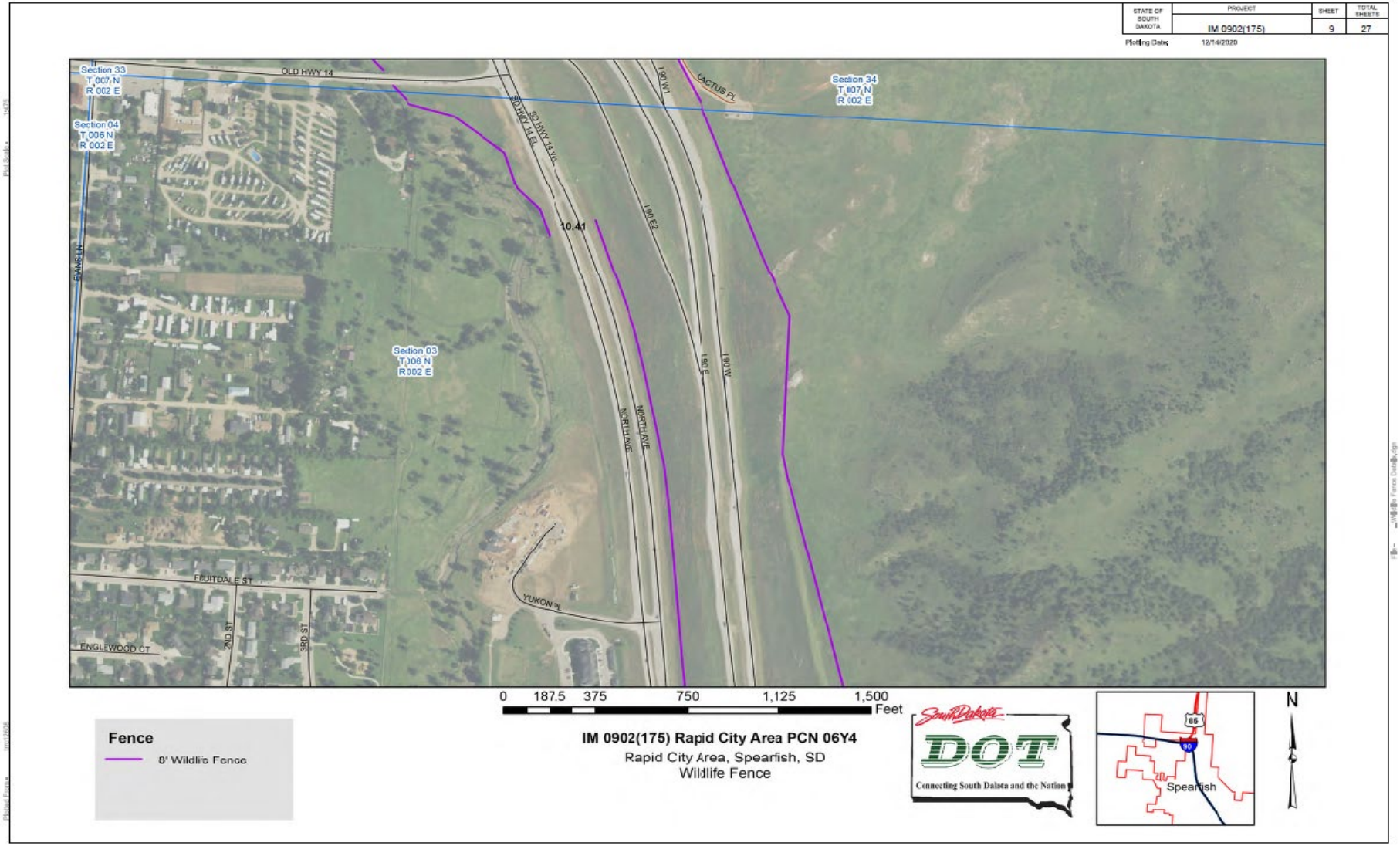
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PROJECT
IM 0902(175)
SHEET
9
TOTAL SHEETS
27
Plotting Date: 12/14/2020
Section 33
T 007 N
R 002 E
Section 04
T 006 N
R 002 E
Section 34
T 007 N
R 002 E
Section 03
T 006 N
R 002 E
OLD HWY 14
SD HWY 14 EB
SD HWY 14 WB
CACTUS PL
190 W1
190 E2
190 E1
190 W2
10.41
EVANS LN
NORTH AVE
FRUITDALE ST
YUKON PL
ENGLEWOOD CT
2ND ST
3RD ST
0
187.5
375
750
1,125
1,500
Feet
Fence
8' Wildlife Fence
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
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Spearfish
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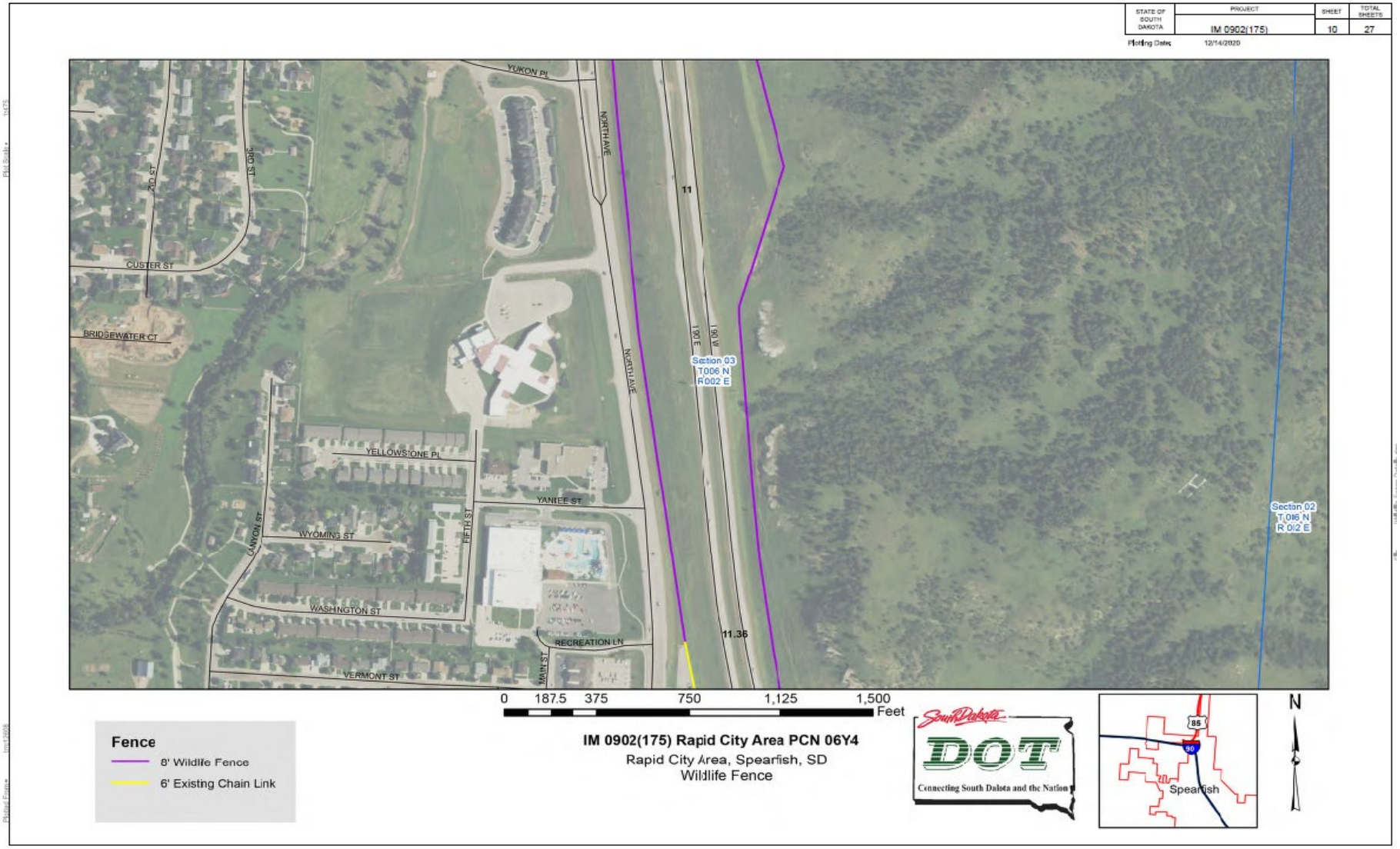
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SHEET
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TOTAL SHEETS
27
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NORTH AVE
11
CUSTER ST
BRIDGEWATER CT
Section 03
T006 N
R002 E
YELLOWSTONE PL
YANTEE ST
WYOMING ST
CANYON ST
FIFTH ST
WASHINGTON ST
RECREATION LN
MAIN ST
VERMONT ST
11.35
Section 02
T006 N
R002 E
0 187.5 375 750 1,125 1,500
Feet
Fence
8' Wildlife Fence
6' Existing Chain Link
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
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Spearfish
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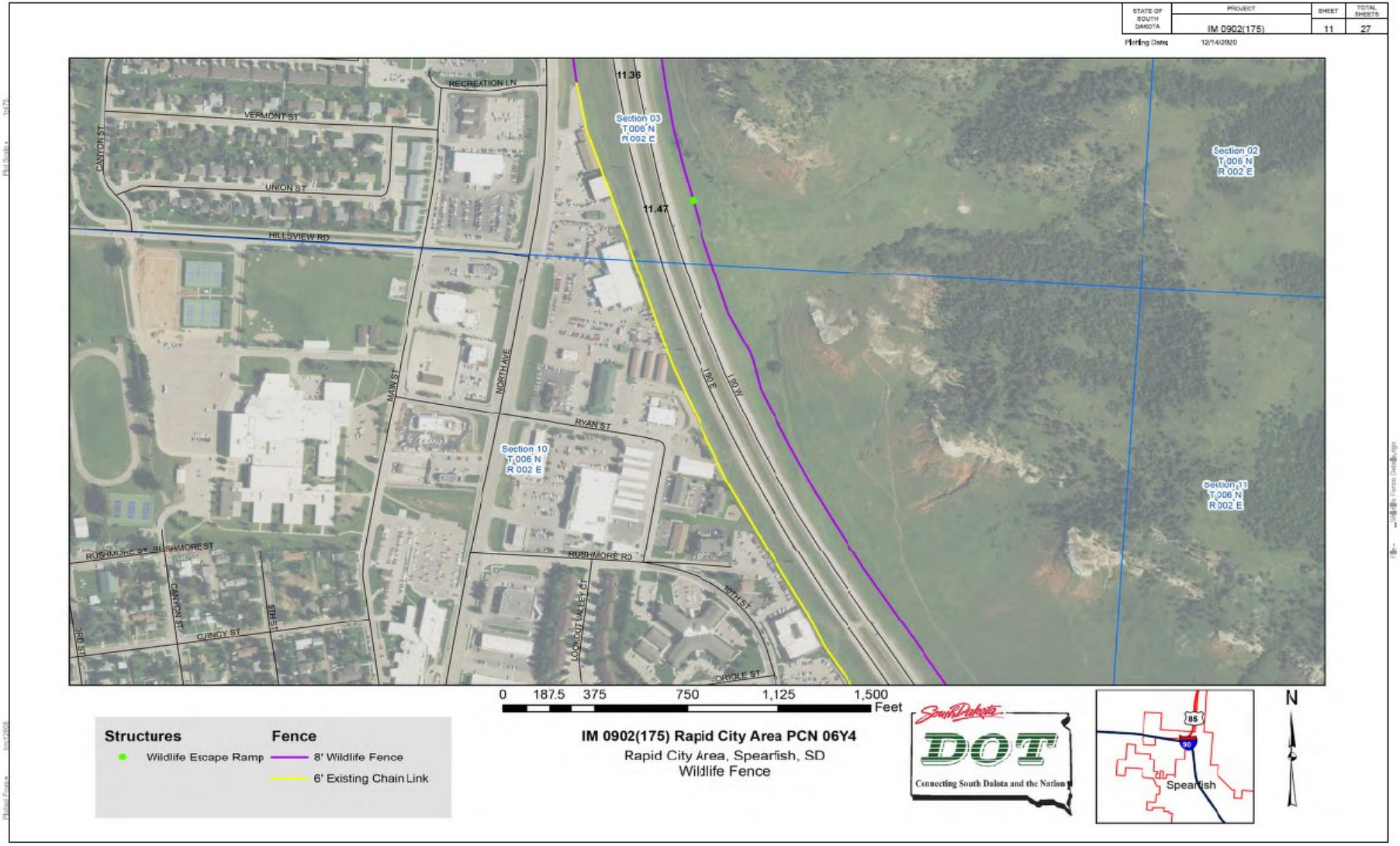
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SHEET
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VERMONT ST
CANYON ST
UNION ST
HILLSVIEW RD
MAIN ST
NORTH AVE
RYAN ST
RUSHMORE PL
RUSHMORE RD
CANYON ST
GUNCY ST
9TH ST
3RD ST
LOOKOUT VALLEY CT
11TH ST
ORIOLE ST
11.36
11.47
Section 03 T 006 N R 002 E
Section 02 T 006 N R 002 E
Section 10 T 006 N R 002 E
Section 11 T 006 N R 002 E
190E
190N
0 187.5 375 750 1,125 1,500 Feet
Structures
Wildlife Escape Ramp
Fence
8' Wildlife Fence
6' Existing Chain Link
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
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Spearfish
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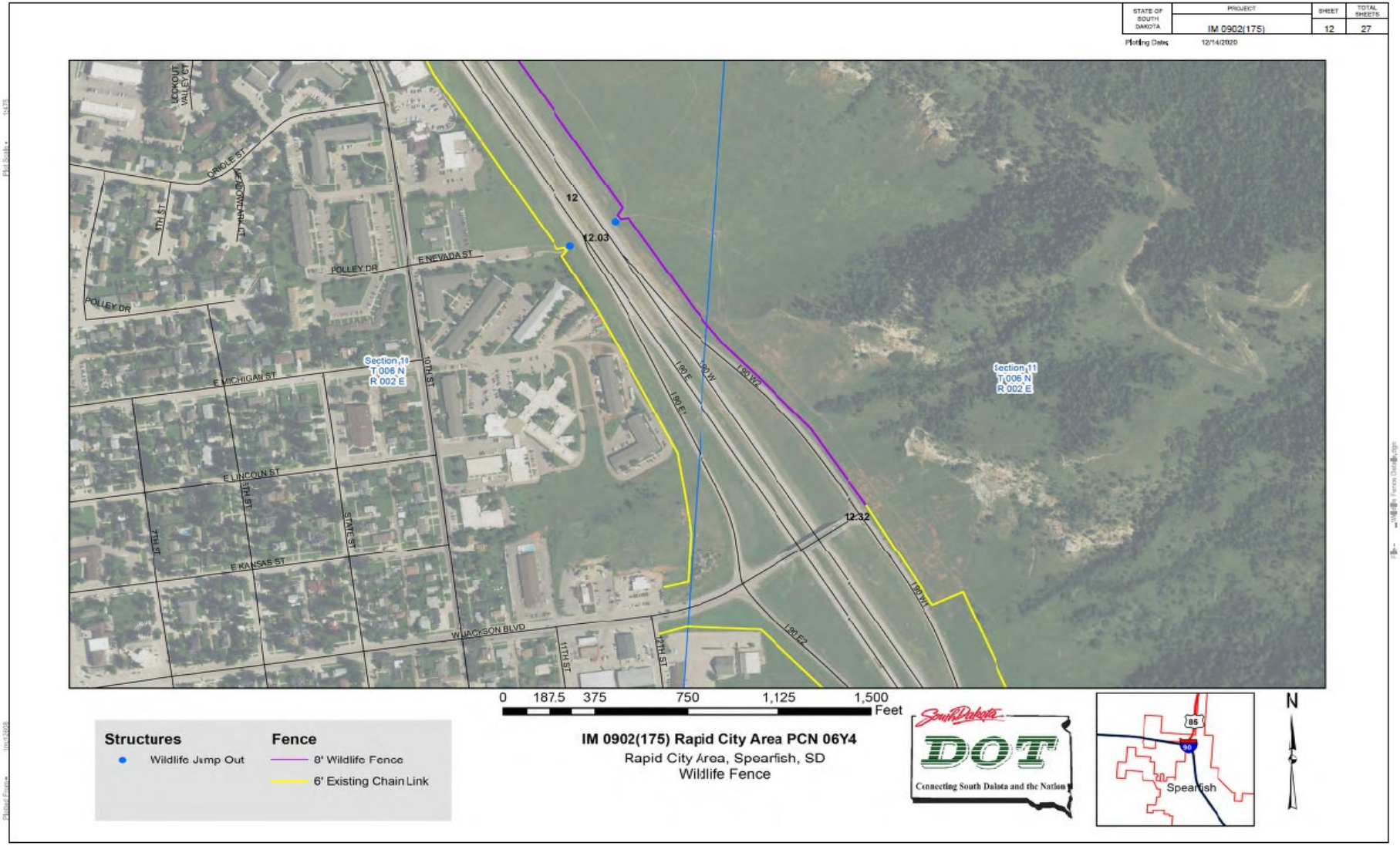
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IM 0902(175)
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Plotting Date: 12/14/2020
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ORIOLE ST
MEADOWLARK CT
7TH ST
POLLEY DR
E NEVADA ST
E MICHIGAN ST
E LINCOLN ST
E KANSAS ST
W JACKSON BLVD
10TH ST
11TH ST
12TH ST
STATE ST
Section 10 T 006 N R 002 E
Section 11 T 006 N R 002 E
12
12.03
12.32
180 E
180 W
180 E2
180 W2
0 187.5 375 750 1,125 1,500 Feet
Structures
Wildlife Jump Out
Fence
8' Wildlife Fence
6' Existing Chain Link
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
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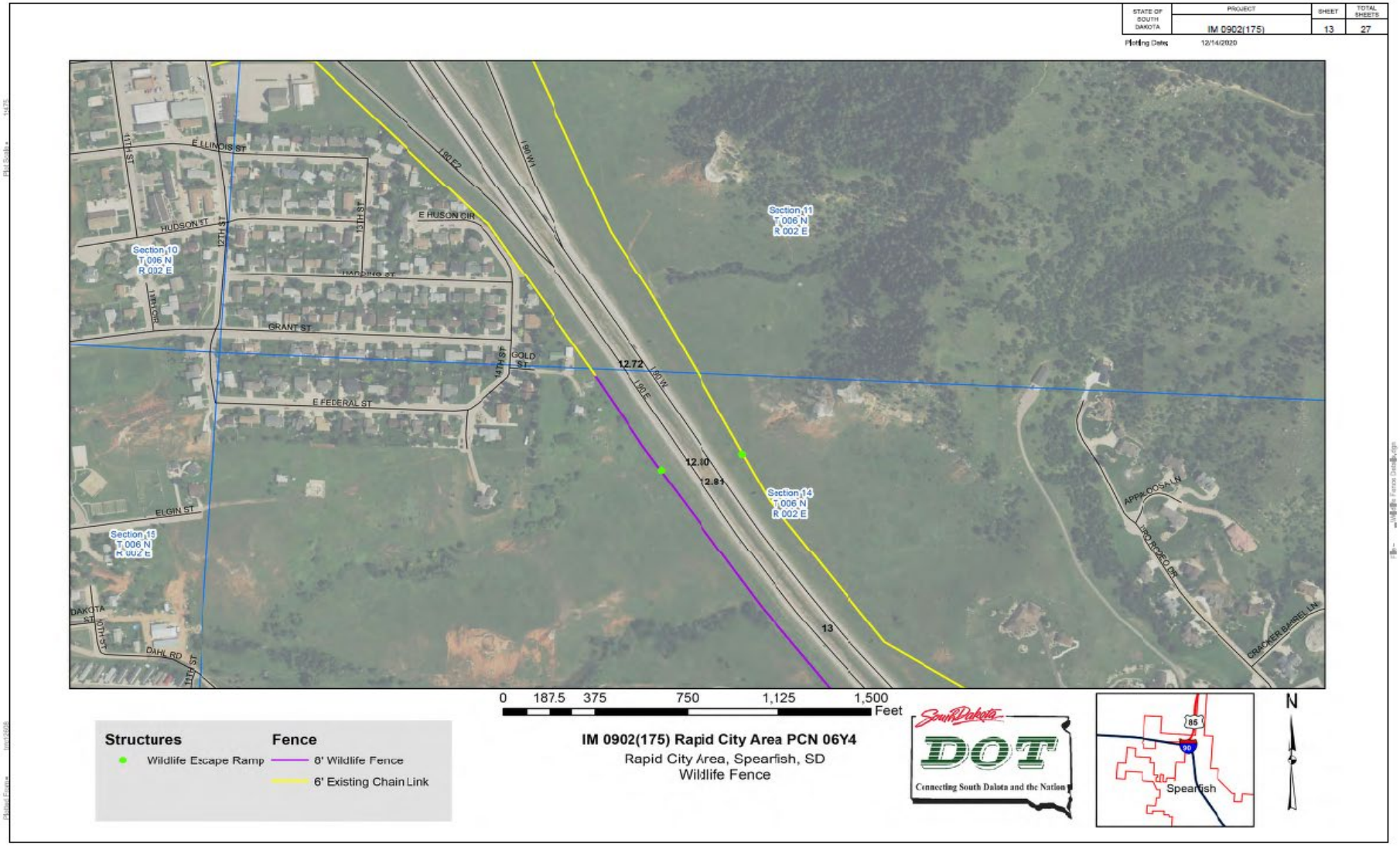
Spearfish
N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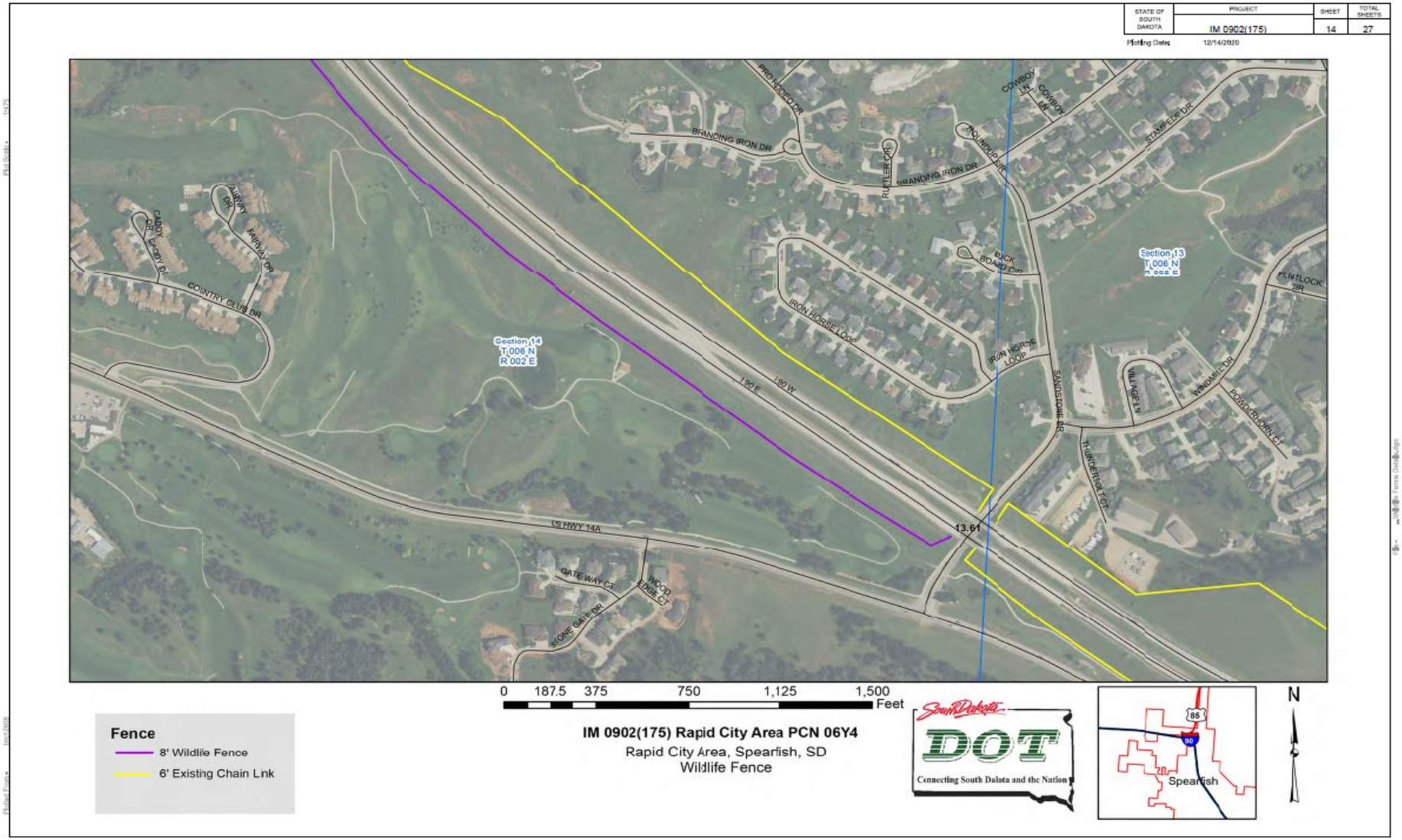
PROJECT
IM 0902(175)
SHEET
13
TOTAL SHEETS
27
Plotting Date: 12/14/2020
E ILLINOIS ST
HUDSON ST
E HUSON CIR
GRANT ST
GOLD ST
E FEDERAL ST
ELGIN ST
DAHL RD
DAKOTA ST
11TH ST
12TH ST
13TH ST
14TH ST
15TH ST
16TH ST
HARDING ST
190 E2
190 W1
190 W
190 E
Section 10 T 006 N R 002 E
Section 11 T 006 N R 002 E
Section 14 T 006 N R 002 E
Section 15 T 006 N R 002 E
12.72
12.10
12.81
13
APPALOOSA LN
LONGHORN DR
CRACKER BARREL LN
0 187.5 375 750 1,125 1,500 Feet
Structures
Wildlife Escape Ramp
Fence
8' Wildlife Fence
6' Existing Chain Link
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
Spearfish
N


STATE OF SOUTH DAKOTA
PROJECT
IM 0902(175)
SHEET
14
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Plotting Date: 12/14/2020
Section 14
T 006 N
R 002 E
Section 13
T 006 N
R 002 E
BRANDING IRON DR
PRO RODEO DR
RUNDLE CIR
COWBOY LN
STAMPEDE DR
ROUNDUP CIR
BUCK BOARD CIR
IRON HORSE LOOP
SANDSTONE DR
VILLAGE LN
WINDMILL DR
FLINTLOCK CIR
BOBBIE HORN CT
THUNDERBOLT CT
DADDY DR
LADDY DR
FAIRWAY DR
COUNTRY CLUB DR
180 E
180 W
US HWY 14A
13.61
GATE WAY CT
WOOD RIDGE CT
STONE GATE DR
0 187.5 375 750 1,125 1,500 Feet
Fence
8' Wildlife Fence
6' Existing Chain Lnk
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
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Spearfish
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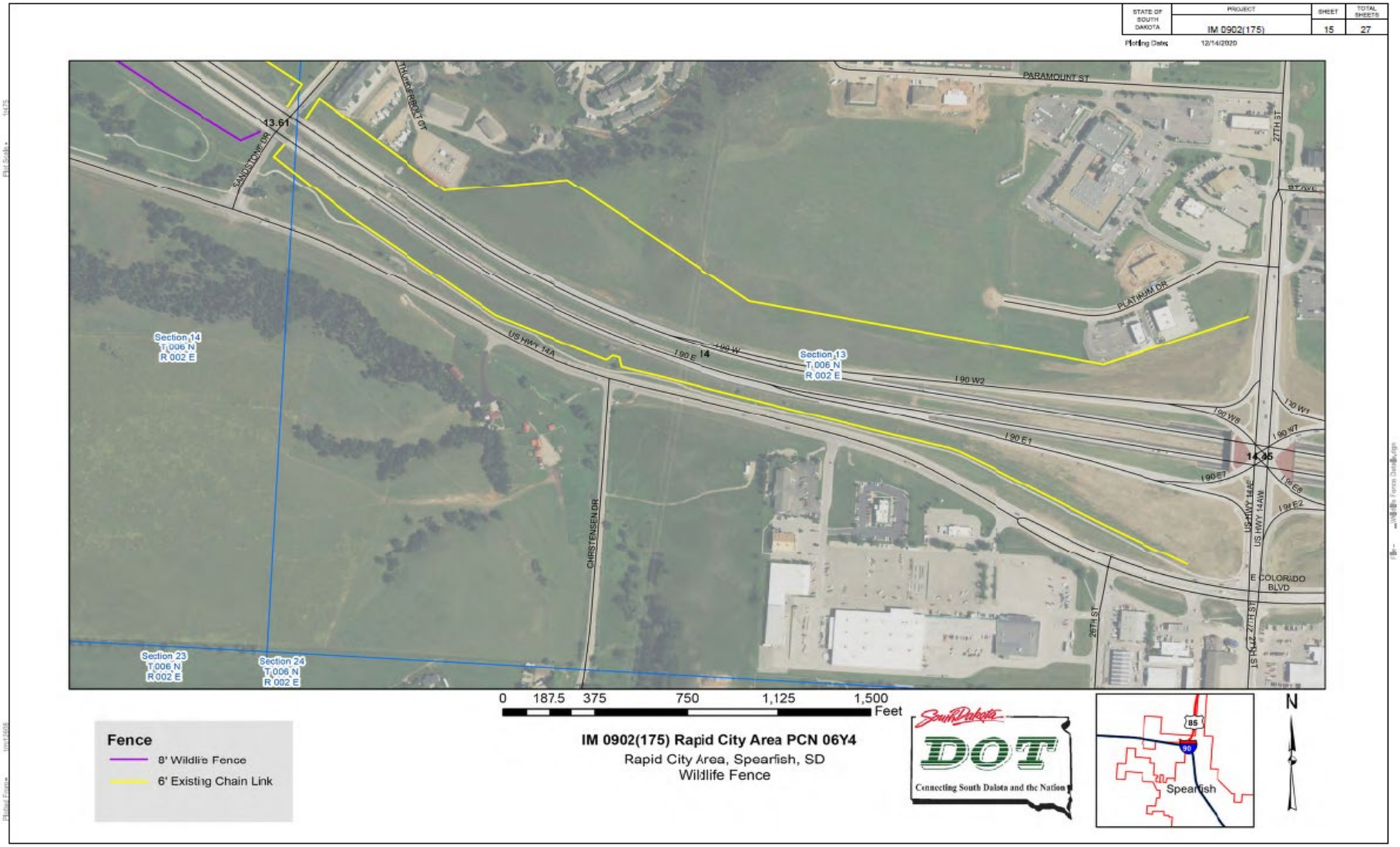
STATE OF SOUTH DAKOTA
PROJECT
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SHEET
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Plotting Date: 12/14/2020
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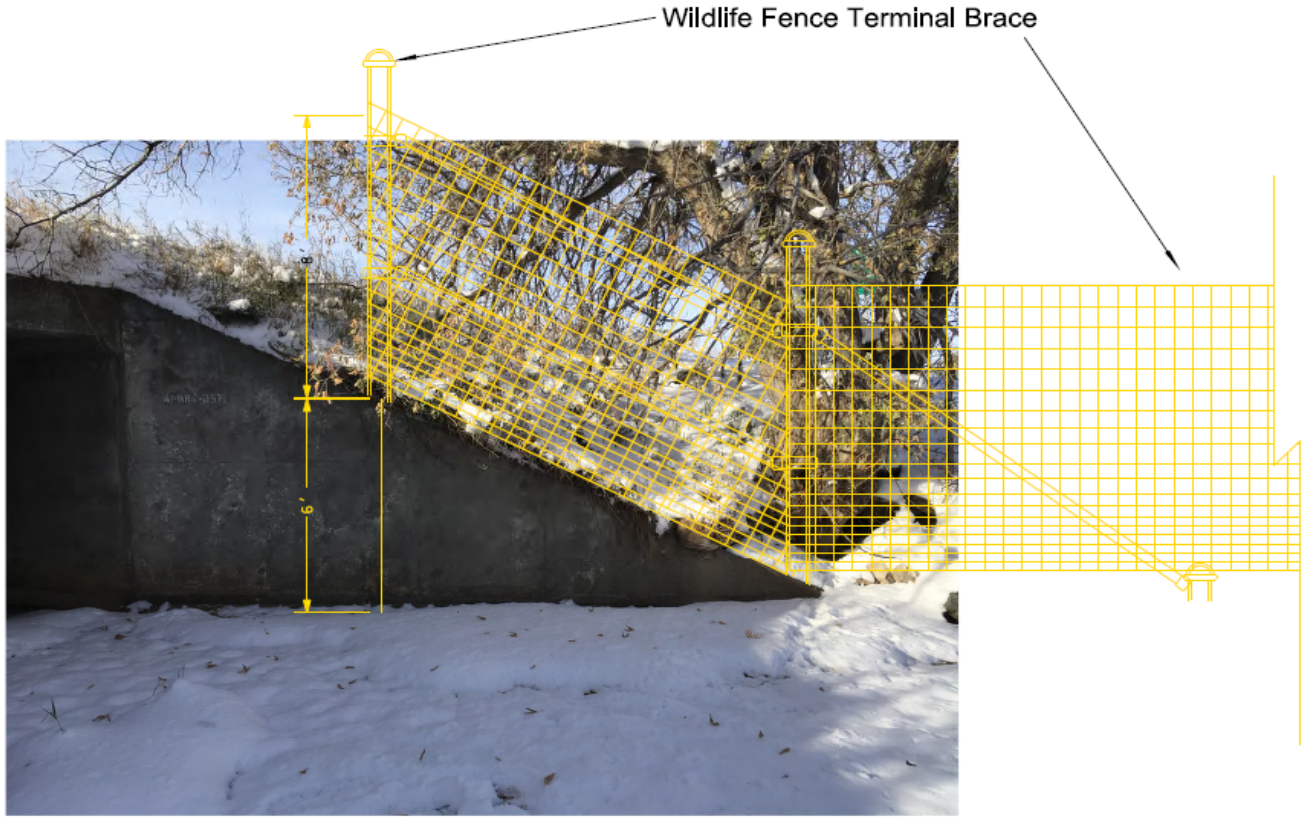
27TH ST
SANDSTONE DR
THUNDERBIRD DR
13.61
PLATINUM DR
Section 14
T 006 N
R 002 E
US HWY 14A
I 90 E
14
I 90 W
Section 13
T 006 N
R 002 E
I 90 W2
I 90 W1
I 90 W8
I 90 W7
I 90 E1
I 90 E7
I 90 E8
I 90 E2
14.35
US HWY 14AE
US HWY 14AW
E COLORADO BLVD
CHRISTENSEN DR
26TH ST
US HWY 212
Section 23
T 006 N
R 002 E
Section 24
T 006 N
R 002 E
0
187.5
375
750
1,125
1,500
Feet
Fence
8' Wildlife Fence
6' Existing Chain Link
IM 0902(175) Rapid City Area PCN 06Y4
Rapid City Area, Spearfish, SD
Wildlife Fence
South Dakota DOT
Connecting South Dakota and the Nation
85
90
Spearfish
N

WILDLIFE JUMPOUTS AT EXISTING STRUCTURES

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	IM 0902(175)	16	27

Plotting Date: 12/14/2020



Termination of wildlife fence will be at the point where the top of the wingwall is 6' above the floor of the box culvert as shown.

Appendix M: Project IM 0902(175), Lawrence County, PCN 06Y4

Interstate 90 E & W, Wildlife Fence Stakeholder Letter

Department of Transportation
Rapid City Area Office
2300 Eglin Street
P. O. Box 1970
Rapid City, SD 57709-1970
Phone: 605-394-2248
FAX: 605-394-1904
Web site: www.sddot.com and www.safetravelusa.com/sd

November 19, 2020

To Whom This May Concern,

The South Dakota Department of Transportation is proposing to install eight-foot wildlife fence adjacent to Interstate 90 from Exit 8 to Exit 14 near Spearfish, South Dakota. The intent of the project is to increase the safety for the travelling public by reducing wildlife vehicle collisions.

South Dakota Department of Transportation Safety Engineers reviewed the wildlife crash and roadkill carcass collection data and determined this location is one of South Dakota's top wildlife collision areas.

The South Dakota Department of Transportation's Research and Environmental Program studied the best locations to place escape ramps and underpass locations for wildlife to continue moving freely while avoiding collisions with vehicles. Consultation with other western transportation agencies, wildlife management agencies, and independent researchers was utilized to determine the most effective designs and plans to be applied.

The project's tentative bid letting date is for March/April 2021 and the construction completion date is October 1, 2021, prior to the increase in wildlife movement.

With the current COVID concerns, an in person public meeting will not be held. The enclosed draft plans have been distributed to adjacent landowners, conservation groups, and stakeholders for review. You are encouraged to reply with any questions or concerns you may have.

For more information or questions, contact Kit Bramblee with the South Dakota Department of Transportation's Environmental Office at 605-773-2428 or by email at kit.bramblee@state.sd.us.

Appendix N: Wildlife Camera Trap Data

Appendix N: Part 1: Wildlife Camera Trap Data Ft. Meade

Ft. Meade Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
05/19/2020				24				
05/20/2020				4				
05/21/2020				10				
05/22/2020			1	26				raccoon
05/23/2020				17				
05/24/2020				12				
05/25/2020				48				
05/26/2020				16				
05/27/2020				6				
05/28/2020				24				
05/29/2020				25		1		
05/30/2020				28				
05/31/2020	1		1	31		1	coyote approach and refusal, whiteail approach and refusal	
06/01/2020				21				
06/02/2020	2			18			whitetail approach and refusal	
06/03/2020				29				grackle
06/04/2020				16				
06/05/2020	1			14			WTD approach and refusal	
06/06/2020				30				
06/07/2020				34				
06/08/2020				7				
06/09/2020				22				
06/10/2020				5				
06/11/2020	5			26			WTD approach refusal	
06/12/2020				29				
06/13/2020	1			55			WTD approach refusal	
06/14/2020				33				
06/15/2020	3			24			WTD approach refusal	
06/16/2020	5			9			WTD approach refusal	
06/17/2020	1			21			Approach	
06/18/2020	1			50			Approach	
06/19/2020				16				
06/20/2020				14				
06/21/2020	2			10			Approach x2	
06/22/2020	4			22			Approach / Parallel	
06/23/2020	1			27			Approach / Parallel	
06/24/2020				19				
06/25/2020	4			20			Approach / Parallel, Pass through	
06/26/2020				31				
06/27/2020	1			68			Approach	
06/28/2020				47				
06/29/2020	1			15			Approach	
06/30/2020				9				
07/01/2020				9				
07/02/2020				10				
07/03/2020				31				
07/04/2020	1			47			Approach	
07/05/2020				34				
07/06/2020				21				
07/07/2020				11				
07/08/2020				13				
07/09/2020				29				
07/10/2020	2			5				
07/11/2020				7				
07/12/2020	1			55				
07/13/2020				10				

Ft. Meade Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
07/14/2020				16				
07/15/2020	3			77				
07/16/2020				7				
07/17/2020				20				
07/18/2020				38				
07/19/2020				12				
07/20/2020				19				
07/21/2020	3			14			Approach	
07/22/2020				22				
07/23/2020				6				Camera Check
07/24/2020				19				
07/25/2020				25				
07/26/2020				31				
07/27/2020				22				
07/28/2020				14				
07/29/2020				0				
07/30/2020				5				
07/31/2020				10				
08/01/2020				31				
08/02/2020				35				
08/03/2020				7				
08/04/2020				32				
08/05/2020				14				
08/06/2020				18				
08/07/2020				4				
08/08/2020				16				
08/09/2020				28				
08/10/2020				7				
08/11/2020				14				
08/12/2020				3				
08/13/2020				11				Dirt Bike
08/14/2020				10				
08/15/2020	1			11				
08/16/2020	2			13				
08/17/2020				8				
08/18/2020	1			1				
08/19/2020	1			7				
08/20/2020				8				
08/21/2020				12				
08/22/2020				24				
08/23/2020	2			11				
08/24/2020				0				
08/25/2020				5				
08/26/2020				2				
08/27/2020				2				
08/28/2020				26				
08/29/2020	1			45			Approach, Over the top	
08/30/2020				35				
08/31/2020	1			23			Approach	
09/01/2020				14	20+			Cattle
09/02/2020					200+			Cattle
09/03/2020				3				
09/04/2020				4				
09/05/2020				5				
09/06/2020			2	5				
09/07/2020				2	20+			
09/08/2020				2				
09/09/2020					20+			
09/10/2020			1	1	200+			
09/11/2020				1	3			

Ft. Meade Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
09/12/2020					3			
09/13/2020					9			
09/14/2020				3				
09/15/2020			1	4				
09/16/2020			1	1				
09/17/2020					20+			
09/18/2020					20+			
09/19/2020					20+			
09/20/2020				5	20+			
09/21/2020			1	10	200+			
09/22/2020	1			3				
09/23/2020			2		3			Cattle
09/24/2020			2	12				
09/25/2020				3				
09/26/2020				5				
09/27/2020			4	7	20+			
09/28/2020				11	200+			Moving Cattle on horse back and retrieving equipment/panels
09/29/2020				17				Ranch Hands working on fence
09/30/2020			1					
10/01/2020								
10/02/2020				1				
10/03/2020				1				
10/04/2020				3				
10/05/2020				1				
10/06/2020			3					
10/07/2020								Camera Check
10/08/2020			3				racoons using structure	
10/09/2020								
10/10/2020			6	3	1		racoons using structure	
10/11/2020				1	1			
10/12/2020				4				
10/13/2020								
10/14/2020					1			
10/15/2020				1	1			
10/16/2020			1					
10/17/2020				2	cattle			
10/18/2020								
10/19/2020								
10/20/2020				1	1			
10/21/2020								
10/22/2020								
10/23/2020	2						may have used structure	
10/24/2020								
10/25/2020								
10/26/2020								
10/27/2020			1				Pass through	Camera Check
10/28/2020			1				Pass through	
10/29/2020			2				Pass through	
10/30/2020								
10/31/2020				1				
11/01/2020	1		1	6	1			
11/02/2020					1			
11/03/2020			3	2				
11/04/2020				8				Controlled Burn
11/05/2020				4				
11/06/2020	1						Approach	
11/07/2020	1			3	1		Approach	
11/08/2020			5	2				

Ft. Meade Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
11/09/2020								
11/10/2020								
11/11/2020				3				
11/12/2020								
11/13/2020				3				
11/14/2020			1					
11/15/2020	5			14				
11/16/2020								
11/17/2020			5	7				
11/18/2020				1				
11/19/2020			2					
11/20/2020				1				
11/21/2020	1			6			Pass by	
11/22/2020			2	8				
11/23/2020								
11/24/2020			7	6				
11/25/2020				1				
11/26/2020	1		3	4		1		Red Fox Squirrel
11/27/2020	3		3	14				
11/28/2020				15				
11/29/2020								
11/30/2020				2				Camera Check
12/01/2020								
12/02/2020				2				
12/03/2020								
12/04/2020				1				
12/05/2020				1				
12/06/2020			4	4	1			cat
12/07/2020				2				
12/08/2020				13				
12/09/2020	1			10				
12/10/2020								
12/11/2020								
12/12/2020								
12/13/2020				1				
12/14/2020				1				
12/15/2020				2				
12/16/2020								
12/17/2020				3				
12/18/2020								
12/19/2020			2	2				
12/20/2020			2	5				
12/21/2020				1				Camera Check
12/22/2020			1					
12/23/2020				1				
12/24/2020			1	2				
12/25/2020			1	2				
12/26/2020			1	28		1		red fox
12/27/2020				3				
12/28/2020				1				
12/29/2020						1		red fox
12/30/2020				1				
12/31/2020				2				
01/01/2021				13				
01/02/2021				13				
01/03/2021				17				
01/04/2021								
01/05/2021			2					
01/06/2021				2				
01/07/2021								

Ft. Meade Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
01/08/2021			1					
01/09/2021				3				
01/10/2021				1				
01/11/2021			5	7				
01/12/2021			2	3				
01/13/2021				5				
01/14/2021			3					
01/15/2021								
01/16/2021								
01/17/2021				8				
01/18/2021								
01/19/2021								
01/20/2021			2	4				
01/21/2021				2				
01/22/2021								
01/23/2021				4				
01/24/2021				5				
01/25/2021				1				
01/26/2021								camera check
Total	69	0	93	2537	27	5		

Appendix N: Part 2: Wildlife Camera Trap Data
Spearfish Golf Course

Spearfish Golf Course Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc	Movement Desc	Notes:
05/19/2020	5						Interstate Approach	
05/25/2020	2							
06/03/2020	1							
06/21/2020	1							
06/26/2020	1							
06/29/2020	1							
07/03/2020	2							
07/05/2020	2							
07/07/2020	3							
07/08/2020	1							
07/15/2020				1				
07/25/2020	1							
07/28/2020	1							
07/29/2020	1							
08/13/2020	1							
08/18/2020	3							
08/20/2020	2							
08/22/2020	7							
08/23/2020	1							
08/26/2020								Camera Checked
08/27/2020	3							
08/28/2020								
08/29/2020	2							
08/30/2020								
08/31/2020								
09/01/2020								
09/02/2020								
09/03/2020	4							
09/04/2020								
09/05/2020	2							
09/06/2020	1							
09/07/2020	2							
09/08/2020								
09/09/2020								
09/10/2020								
09/11/2020								
09/12/2020	4							
09/13/2020	1							
09/14/2020	1							
09/15/2020	4							
09/16/2020								
09/17/2020	2							
09/18/2020	1							
09/19/2020	7							
09/20/2020								
09/21/2020								
09/22/2020								
09/23/2020	2							
09/24/2020	5							
09/25/2020	2							
09/26/2020								
09/27/2020	4							
09/28/2020								
09/29/2020	2							
09/30/2020								
10/01/2020								
10/02/2020	4							
10/03/2020	4							
10/04/2020	1							
10/05/2020								
10/06/2020	2							

Spearfish Golf Course Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc	Movement Desc	Notes:
10/07/2020								Camera Check
10/08/2020	4							
10/09/2020								
10/10/2020	1							
10/11/2020								
10/12/2020								
10/13/2020								
10/14/2020	1							
10/15/2020								
10/16/2020								
10/17/2020								
10/18/2020								
10/19/2020								
10/20/2020								
10/21/2020								
10/22/2020								
10/23/2020								
10/24/2020								
10/25/2020								
10/26/2020								
10/27/2020	1							Camera Check
10/28/2020								
10/29/2020								
10/30/2020								
10/31/2020								
11/01/2020	2							
11/02/2020								
11/03/2020								
11/04/2020								
11/05/2020								
11/06/2020	1							
11/07/2020								
11/08/2020								
11/09/2020								
11/10/2020								
11/11/2020								
11/12/2020								
11/13/2020								
11/14/2020	1							
11/15/2020								
11/16/2020								
11/17/2020								Utility Work
11/18/2020								Utility Work
11/19/2020								Utility Work
11/20/2020	3							Utility Work
11/21/2020	1							Utility Work
11/22/2020	1							Utility Work
11/23/2020	3							Utility Work
11/24/2020	2							Utility Work
11/25/2020	4							Utility Work
11/26/2020								Utility Work
11/27/2020								Utility Work
11/28/2020	2							Utility Work
11/29/2020								Utility Work
11/30/2020								Utility Work
12/01/2020								Camera Check
12/02/2020								Utility Work
12/03/2020	2							Utility Work
12/04/2020								Utility Work
12/05/2020								Utility Work
12/06/2020								Utility Work

Spearfish Golf Course Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc	Movement Desc	Notes:
12/07/2020	2							Utility Work
12/08/2020	1							Utility Work
12/09/2020	2							Utility Work
12/10/2020								Utility Work
12/11/2020								Utility Work
12/12/2020								Utility Work
12/13/2020								Utility Work
12/14/2020	2							Utility Work
12/15/2020								Utility Work
12/16/2020								Utility Work
12/17/2020								Utility Work
12/18/2020								Utility Work
12/19/2020								Utility Work
12/20/2020								Utility Work
12/21/2020								Camera Check
12/22/2020								Utility Work
12/23/2020								Utility Work
12/24/2020								Utility Work
12/25/2020								Utility Work
12/26/2020								Utility Work
12/27/2020								Utility Work
12/28/2020								Utility Work
12/29/2020								Utility Work
12/30/2020								Utility Work
12/31/2020								Utility Work
01/01/2021								Utility Work
01/02/2021								
01/03/2021								
01/04/2021								
01/05/2021								
01/06/2021								
01/07/2021								
01/08/2021								
01/09/2021								
01/10/2021								
01/11/2021								
01/12/2021	1							
01/13/2021								
01/14/2021								
01/15/2021								
01/16/2021								
01/17/2021								
01/18/2021								
01/19/2021								
01/20/2021								
01/21/2021								
01/22/2021								
01/23/2021						1		Red Fox
01/24/2021	1							
01/25/2021								
01/26/2021								Camera Check
Total	134	0	0	1	0	1		

Appendix N: Part 3: Wildlife Camera Trap Data
Pleasant Valley

Pleasant Valley Camera Trap								
Date	WTD	MD	Raccoon	Skunk	Human	Domestic	Movement Desc	Notes:
05/18/2020						30+		Cattle using box culvert
05/19/2020						30+		Cattle using box culvert
05/20/2020					1			Rancher on four wheeler
05/21/2020						30+		Cattle using box culvert
05/22/2020						30+		Cattle using box culvert
05/23/2020						30+		Cattle using box culvert
05/25/2020						30+		Cattle using box culvert
05/26/2020					2	30+		Cattle using box culvert
05/27/2020						30+		Cattle using box culvert
05/28/2020						30+		Cattle using box culvert
05/29/2020					3	30+		Cattle using box culvert
05/31/2020	4							parallel
06/02/2020						30+		Cattle using box culvert
06/03/2020					2	30+		Cattle using box culvert
06/04/2020					1	30+		Cattle using box culvert
06/06/2020	4						Parallel	
06/08/2020	1				2	2		
06/11/2020				1				
06/15/2020					2	30+		cattle using box culvert
06/16/2020	1						Parallel	
06/18/2020	4						Approach	
06/20/2020			1				Pass Through	
06/21/2020	7						Approach x7	
06/24/2020				1				
06/25/2020	2						Parallel	
06/26/2020	1						Parallel	
06/29/2020	4						Approach	
07/02/2020	1						Pass Through	
07/03/2020	4						Parallel	
07/04/2020	3						Parallel	
07/05/2020	2						Approach	
07/07/2020	1						Parallel	
07/08/2020	1						Parallel	
07/09/2020	2		1				Parallel	
07/11/2020						10+		
07/13/2020					8			
07/15/2020					2			
07/16/2020	4						Parallel	
07/17/2020	3						Parallel	
07/21/2020					2			
07/30/2020	2						Parallel	
08/12/2020					2	30+		
08/14/2020						10+		
08/16/2020						30+		
08/17/2020						10+		
08/18/2020					1	10+		
08/19/2020					1			
08/20/2020	1						Parallel	
08/26/2020								Camera Checked / Camera Realigned with Structure
08/27/2020								
08/28/2020								
08/29/2020								
08/30/2020	2							
08/31/2020								
09/01/2020								
09/02/2020								
09/03/2020								
09/04/2020								

Pleasant Valley Camera Trap								
Date	WTD	MD	Raccoon	Skunk	Human	Domestic	Movement Desc	Notes:
09/05/2020								
09/06/2020	2							
09/07/2020								
09/08/2020								
09/09/2020								
09/10/2020								
09/11/2020								
09/12/2020								
09/13/2020								
09/14/2020	5							
09/15/2020								
09/16/2020								
09/17/2020	1							
09/18/2020								
09/19/2020								
09/20/2020								
09/21/2020								
09/22/2020								
09/23/2020								
09/24/2020								
09/25/2020								
09/26/2020	1							
09/27/2020								
09/28/2020	1							
09/29/2020								
09/30/2020								
10/01/2020	2							
10/02/2020								
10/03/2020					2	200+		cattle
10/04/2020								
10/05/2020								
10/06/2020								
10/07/2020								camera check
10/08/2020	2							
10/09/2020			3					racoons using structure
10/10/2020					2	1		humans installed panels across structure
10/11/2020								panel across structure
10/12/2020								panel across structure
10/13/2020								panel across structure
10/14/2020								panel across structure
10/15/2020						cattle		panel across structure
10/16/2020						cattle		panel across structure
10/17/2020						cattle		panel across structure
10/18/2020								panel across structure
10/19/2020								panel across structure
10/20/2020					1			panel across structure
10/21/2020								panel across structure
10/22/2020								panel across structure
10/23/2020								panel across structure
10/24/2020								panel across structure
10/25/2020								panel across structure
10/26/2020								panel across structure
10/27/2020						100+		panel across structure/camera check
10/28/2020								
10/29/2020								
10/30/2020	3							
10/31/2020								

Pleasant Valley Camera Trap								
Date	WTD	MD	Raccoon	Skunk	Human	Domestic	Movement Desc	Notes:
11/01/2020								
11/02/2020								
11/03/2020								
11/04/2020								
11/05/2020								
11/06/2020								
11/07/2020								
11/08/2020								
11/09/2020								
11/10/2020								
11/11/2020								
11/12/2020								
11/13/2020								
11/14/2020								
11/15/2020								
11/16/2020								
11/17/2020								
11/18/2020								
11/19/2020								
11/20/2020								
11/21/2020								
11/22/2020	1						Approach	
11/23/2020								
11/24/2020								
11/25/2020								
11/26/2020								
11/27/2020	3							
11/28/2020	2							
11/29/2020								
11/30/2020								Camera Check
12/01/2020								
12/02/2020								
12/03/2020								
12/04/2020								
12/05/2020								
12/06/2020								
12/07/2020								
12/08/2020								
12/09/2020								
12/10/2020								
12/11/2020								
12/12/2020								
12/13/2020	3							
12/14/2020								
12/15/2020								
12/16/2020								
12/17/2020								
12/18/2020								
12/19/2020								
12/20/2020								
12/21/2020								Camera Check
12/22/2020								snow
12/23/2020								
12/24/2020								
12/25/2020								
12/26/2020								
12/27/2020								
12/28/2020								
12/29/2020								

Pleasant Valley Camera Trap								
Date	WTD	MD	Raccoon	Skunk	Human	Domestic	Movement Desc	Notes:
12/30/2020								
12/31/2020								
01/01/2021								
01/02/2021	3							
01/03/2021								
01/04/2021								
01/05/2021								
01/06/2021								
01/07/2021								
01/08/2021								
01/09/2021								
01/10/2021								
01/11/2021								
01/12/2021					6	100+		cattle
01/13/2021								
01/14/2021					2			
01/15/2021								
01/16/2021								
01/17/2021								
01/18/2021								
01/19/2021								
01/20/2021								
01/21/2021								
01/22/2021								
01/23/2021								
01/24/2021								
01/25/2021								
01/26/2021								Camera Check
Total	83	0	5	2	42	3		

Appendix N: Part 4: Wildlife Camera Trap Data

Spearfish Creek East

Spearfish Creek East Camera Trap								
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Movement Desc	Notes:
05/19/2020	6							
05/20/2020	2							
05/23/2020	7							
05/24/2020	8							
05/25/2020	13							
05/26/2020	11							
05/27/2020	1			1				person sleeping under bridge
05/28/2020				2				fisherman
05/30/2020	7							
06/01/2020	3							
06/03/2020	3							
06/04/2020	2							
06/05/2020	2							
06/06/2020				1				fisherman
06/07/2020	9			1				
06/08/2020	2							
06/09/2020	2							fawn
06/10/2020	5							
06/11/2020	5			3				
06/12/2020	10							
06/13/2020	1							
06/14/2020	3							
06/15/2020	1			5				fisheman
06/16/2020	4							
06/17/2020	2			4				fisheman
06/18/2020	3							
06/19/2020	4							
06/20/2020	9							
06/21/2020	1			2				
06/22/2020	4							
06/23/2020	1							
06/24/2020	2							
06/25/2020	0							
06/26/2020	2							
06/27/2020	0							
06/28/2020	2							
06/29/2020	2							
06/30/2020	2							
07/01/2020	3							
07/02/2020	3							
07/03/2020	6							
07/04/2020	0							
07/05/2020	3							
07/06/2020	4							
07/07/2020	3							
07/08/2020	12							
07/09/2020	2							
07/10/2020	0							
07/11/2020	4							
07/12/2020	0							
07/13/2020	0							
07/14/2020	4							
07/15/2020	5							
07/16/2020	4							
07/17/2020	0							
07/18/2020	4							
07/19/2020	1							
07/20/2020	4							
07/21/2020	11					1		Dog
07/22/2020	3							
07/23/2020								Camera Check
07/24/2020	7							

Spearfish Creek East Camera Trap								
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Movement Desc	Notes:
07/25/2020	4							
07/26/2020				2				
07/27/2020				4				
07/28/2020	12							
07/29/2020	3							
07/30/2020								
07/31/2020	3			2				
08/01/2020	11							
08/02/2020								
08/03/2020	2							
08/04/2020	2							
08/05/2020	12							
08/06/2020	4							
08/07/2020	6							
08/08/2020	9							
08/09/2020	1			2				
08/10/2020	9							
08/11/2020	4							
08/12/2020	8							
08/13/2020	2							
08/14/2020	2							
08/15/2020	2							
08/16/2020	1							
08/17/2020	4							
08/18/2020								
08/19/2020	3			2				
08/20/2020	1			3				
08/21/2020	1			3				
08/22/2020				1				
08/23/2020	1			2				
08/24/2020	1							
08/25/2020	3							
08/26/2020				2				Camera Check
08/27/2020				1				
08/28/2020	1			2				
08/29/2020	4			1				
08/30/2020	2							
08/31/2020	4							
09/01/2020	7			2				
09/02/2020	2					1		cat
09/03/2020	7							
09/04/2020	5							
09/05/2020	6							
09/06/2020	3							
09/07/2020								
09/08/2020	2							
09/09/2020	9							
09/10/2020	1							
09/11/2020				1				
09/12/2020	1							
09/13/2020	1							
09/14/2020	1		1					
09/15/2020	3							
09/16/2020	6							
09/17/2020								
09/18/2020	3		1					
09/19/2020	5							
09/20/2020	5							
09/21/2020								
09/22/2020								
09/23/2020	4							
09/24/2020	2							

Spearfish Creek East Camera Trap								
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Movement Desc	Notes:
09/25/2020	1							
09/26/2020	1							
09/27/2020	3							
09/28/2020								
09/29/2020	7							
09/30/2020	4							
10/01/2020	14							
10/02/2020	8							
10/03/2020	1			1				
10/04/2020	1			1				
10/05/2020	5							
10/06/2020	5		1	1				
10/07/2020								Camera Check
10/08/2020	1			6				
10/09/2020	5							
10/10/2020	3			4				
10/11/2020	1							
10/12/2020	2							
10/13/2020	4							
10/14/2020								
10/15/2020	1							
10/16/2020	8							
10/17/2020								
10/18/2020	4							
10/19/2020	21							
10/20/2020	2							
10/21/2020	5			1				
10/22/2020	2							
10/23/2020								snow covered
10/24/2020								snow covered
10/25/2020								snow covered
10/26/2020								snow covered
10/27/2020								snow covered/camera check
10/28/2020	4							
10/29/2020	9							
10/30/2020	4							
10/31/2020	4							
11/01/2020	3							
11/02/2020	5							
11/03/2020	6							
11/04/2020	2			6				
11/05/2020	10							
11/06/2020	7							
11/07/2020	5							
11/08/2020	11							
11/09/2020	7							
11/10/2020	8							
11/11/2020	2							
11/12/2020	10							
11/13/2020	16							
11/14/2020	9							
11/15/2020	6							
11/16/2020	26							
11/17/2020	9							
11/18/2020	3							
11/19/2020	6							
11/20/2020	5							
11/21/2020	25			3		1		Cat
11/22/2020	10							
11/23/2020	8							Cat
11/24/2020	10					1		
11/25/2020	22			2				

Spearfish Creek East Camera Trap								
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Movement Desc	Notes:
11/26/2020	3					1		Cat
11/27/2020	8							
11/28/2020	18							
11/29/2020	6							
11/30/2020	9							Camera Check
12/01/2020	6							
12/02/2020	4							
12/03/2020	12							
12/04/2020	7							
12/05/2020	8							
12/06/2020	5							
12/07/2020	7							
12/08/2020	5							
12/09/2020	5							
12/10/2020	6							cat
12/11/2020	5							
12/12/2020	1							
12/13/2020	0							
12/14/2020	3							
12/15/2020	7							
12/16/2020	2							
12/17/2020	7							
12/18/2020	5			2				
12/19/2020	5			2				
12/20/2020	6							
12/21/2020	6							Camera Check
12/22/2020	1							
12/23/2020								Snow Covered Lense
12/24/2020	4							
12/25/2020	16			1		1		cat
12/26/2020	4			1				
12/27/2020	4							
12/28/2020	3							
12/29/2020	14							snow
12/30/2020	9							
12/31/2020	4							
01/01/2021	5							
01/02/2021	8							
01/03/2021	3			1		2		cat, dog
01/04/2021	2							
01/05/2021	2					1		cat
01/06/2021	5			1				
01/07/2021	7							
01/08/2021	0							snow
01/09/2021	1							snow
01/10/2021	1			1				
01/11/2021	3							
01/12/2021	3			1				
01/13/2021	0							
01/14/2021	0							
01/15/2021	5							
01/16/2021	1							Camera Tampered with by Human
01/17/2021								Camera Tampered with by Human
01/18/2021								Camera Tampered with by Human
01/19/2021								Camera Tampered with by Human
01/20/2021								Camera Tampered with by Human
01/21/2021								Camera Tampered with by Human
01/22/2021								Camera Tampered with by Human
01/23/2021								Camera Tampered with by Human
01/24/2021								Camera Tampered with by Human
01/26/2021								Camera Check
Total	1041	0	3	84	0	9		

Appendix N: Part 5: Wildlife Camera Trap Data
Spearfish Creek West

Spearfish Creek West Camera Trap									
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Misc.	Movement Desc	Notes:
05/18/2020	10							passing under structure	
05/19/2020	2							passing under structure	
05/21/2020	2							passing under structure	
05/22/2020	1							passing under structure	
05/23/2020	19							passing under structure	
05/24/2020	8							passing under structure	
05/25/2020	5							passing under structure	
05/26/2020	3				2			Canada geese walking under structure	
05/27/2020	1								
05/28/2020	1								Human occupying structure
05/29/2020				2					Fisherman/ Human occupying structure
05/30/2020	1			2					Fisherman/ Human occupying structure
05/31/2020	1			2	1				Fisherman
06/01/2020	3				1				
06/02/2020	3			3		1			Fisherman with dog
06/04/2020	2								
06/05/2020	4								
06/06/2020	7								
06/07/2020	5								
06/08/2020	11								
06/09/2020	4								
06/10/2020	10								
06/11/2020	15				2				
06/12/2020	5				1				
06/14/2020	5								
06/15/2020	9								
06/16/2020	10								
06/17/2020	6								
06/18/2020	4								
06/19/2020	3								
06/20/2020	11								
06/21/2020	0				2				
06/22/2020	0				1				
06/23/2020	3								
06/24/2020	0								
06/25/2020	3								
06/26/2020	1								
06/27/2020	0								
06/28/2020	2								
06/29/2020	2								
06/30/2020	2								
07/01/2020	2								
07/02/2020	1								
07/03/2020	1								
07/04/2020	0								
07/05/2020	4								
07/06/2020	0								
07/07/2020	0								
07/08/2020	4								
07/09/2020	0								
07/10/2020	1								
07/11/2020	0								
07/12/2020	0								
07/13/2020	0								
07/14/2020	1								
07/15/2020	4								
07/16/2020	0								
07/17/2020	1								
07/18/2020	0								
07/19/2020	0								
07/20/2020	3								
07/21/2020	0								
07/22/2020	3								
07/23/2020									Camera Checked
07/24/2020	1								
07/25/2020	1								

Spearfish Creek West Camera Trap									
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Misc.	Movement Desc	Notes:
07/26/2020	7								
07/27/2020	9								
07/28/2020	3								
07/29/2020	3								
07/30/2020	7								
07/31/2020	4				2				
08/01/2020	14				1				
08/02/2020									
08/03/2020	6				1				
08/04/2020	6								
08/05/2020	4								
08/06/2020									
08/07/2020	2								
08/08/2020	3								
08/09/2020	1				1				
08/10/2020	5								
08/11/2020	2								
08/12/2020	2								
08/13/2020	4								
08/14/2020	4								
08/15/2020	1				1				
08/16/2020	1				3				
08/17/2020	4				2				
08/18/2020	0				1				
08/19/2020	1				1				
08/20/2020	1				1				
08/21/2020	5								
08/22/2020	1								
08/23/2020									
08/24/2020					1				
08/25/2020	5								
08/26/2020									Camera Check
08/27/2020	1			1					
08/28/2020				3					highway patrol
08/29/2020	1								
08/30/2020	9								
08/31/2020	18								
09/01/2020	14			2					
09/02/2020	5					1			cat
09/03/2020	14								
09/04/2020	17					1			
09/05/2020	11								
09/06/2020	7								
09/07/2020	2								
09/08/2020	6								
09/09/2020	21					1			
09/10/2020	21								
09/11/2020	7								
09/12/2020	21			1					
09/13/2020	24			1					
09/14/2020	6								
09/15/2020	19								
09/16/2020	19								
09/17/2020	17								
09/18/2020	8								
09/19/2020	13								
09/20/2020	24		6			1			
09/21/2020	11								
09/22/2020	13								
09/23/2020	19								
09/24/2020	10								
09/25/2020	2								
09/26/2020	8					1			cat lives under bridge
09/27/2020	15					1			
09/28/2020	9					1			
09/29/2020	12					1			
09/30/2020	3					1	1		cat and mouse
10/01/2020	1								
10/02/2020	1								

Spearfish Creek West Camera Trap									
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Misc.	Movement Desc	Notes:
10/03/2020	8			1					
10/04/2020	13					1			
10/05/2020				6					
10/06/2020	6								
10/07/2020	4								camera check
10/08/2020	15					1			
10/09/2020	8								
10/10/2020	12			2					
10/11/2020	3								
10/12/2020	6								
10/13/2020	8					1			
10/14/2020									
10/15/2020	3								
10/16/2020	2								
10/17/2020	1								
10/18/2020	8								
10/19/2020	10								
10/20/2020	2								
10/21/2020	5								
10/22/2020			4						
10/23/2020	2			1					
10/24/2020	1								
10/25/2020	9								
10/26/2020	4								
10/27/2020	2								camera check
10/28/2020	5		1						
10/29/2020	5								
10/30/2020									
10/31/2020	2								
11/01/2020									
11/02/2020	3								
11/03/2020	4								
11/04/2020									
11/05/2020	4								
11/06/2020	8								
11/07/2020	4								
11/08/2020									
11/09/2020	8								
11/10/2020	4								
11/11/2020									
11/12/2020	2								
11/13/2020	5								
11/14/2020	2								
11/15/2020	8		1						
11/16/2020	2								
11/17/2020	11								
11/18/2020	2								
11/19/2020	4								
11/20/2020	7								
11/21/2020	5								
11/22/2020	9								
11/23/2020	3								
11/24/2020	12								
11/25/2020	8					1			Cat
11/26/2020	2								
11/27/2020	4								
11/28/2020	3				1				Rock Dove
11/29/2020	10								
11/30/2020	9								Camera Check
12/01/2020									
12/02/2020	14								
12/03/2020	7								
12/04/2020	9								
12/05/2020	12								
12/06/2020	7								
12/07/2020	4								
12/08/2020	3								
12/09/2020	5								
12/10/2020	3								

Spearfish Creek West Camera Trap									
Date	WTD	MD	Raccoon	Human	Birds	Domestic	Misc.	Movement Desc	Notes:
12/11/2020	8								
12/12/2020									
12/13/2020	7								
12/14/2020	5								
12/15/2020	9								
12/16/2020						2			Dog
12/17/2020	2								
12/18/2020	2								
12/19/2020	2								
12/20/2020									
12/21/2020	5								Camera Check
12/22/2020	2								
12/23/2020	1					1			dog
12/24/2020	5					1			dog
12/25/2020									
12/26/2020	1								
12/27/2020									
12/28/2020						1			dog
12/29/2020	2								
12/30/2020	3								
12/31/2020									
01/01/2021									
01/02/2021									
01/03/2021	8								
01/04/2021				1					SDDOT bridge inspection
01/05/2021						1			dog
01/06/2021	1								
01/07/2021									
01/08/2021									
01/09/2021									
01/10/2021	1								
01/11/2021	1								
01/12/2021									
01/13/2021									
01/14/2021	1								
01/15/2021	2								
01/16/2021									
01/17/2021									
01/18/2021									
01/19/2021									
01/20/2021									
01/21/2021									
01/22/2021									
01/23/2021									
01/24/2021	2					1			dog
01/25/2021									
01/26/2021									camera check
Total	1146	0	12	28	26	21	1		

Appendix N: Part 6: Wildlife Camera Trap Data
Spearfish Fence End

Spearfish Fence End Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
06/21/2020	1						Parallel to Fence	
06/29/2020				1				
07/09/2020	1							
07/27/2020	1							
07/29/2020	3							
08/21/2020	1							
08/24/2020	2			1				Man dumping waste in ROW, many gallons
08/26/2020	2							Camera Checked
08/27/2020								
08/28/2020								
08/29/2020								
08/30/2020								
08/31/2020								
09/01/2020								
09/02/2020								
09/03/2020								
09/04/2020								
09/05/2020								
09/06/2020								
09/07/2020								
09/08/2020								
09/09/2020								
09/10/2020								
09/11/2020								
09/12/2020								
09/13/2020								
09/14/2020								
09/15/2020								
09/16/2020								
09/17/2020	1							
09/18/2020	2							
09/19/2020	2							
09/20/2020								
09/21/2020	1							
09/22/2020	3							
09/23/2020								
09/24/2020								
09/25/2020								
09/26/2020								
09/27/2020								
09/28/2020								
09/29/2020								
09/30/2020								
10/01/2020								
10/02/2020	1							
10/03/2020	1							
10/04/2020								
10/05/2020	2							
10/06/2020								

Spearfish Fence End Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
10/07/2020	1						running to interstate	checked camera
10/08/2020		1						
10/09/2020	3							
10/10/2020								
10/11/2020								
10/12/2020	1	1						
10/13/2020		1		1				
10/14/2020								
10/15/2020								
10/16/2020		1						
10/17/2020								
10/18/2020								
10/19/2020								
10/20/2020								
10/21/2020								
10/22/2020								
10/23/2020				1				
10/24/2020								
10/25/2020								
10/26/2020								
10/27/2020								Camera Check
10/28/2020								
10/29/2020								
10/30/2020								
10/31/2020								
11/01/2020								
11/02/2020								
11/03/2020								
11/04/2020								
11/05/2020								
11/06/2020								
11/07/2020								
11/08/2020								
11/09/2020								
11/10/2020								
11/11/2020								
11/12/2020								
11/13/2020								
11/14/2020								
11/15/2020	2							
11/16/2020	1							
11/17/2020								
11/18/2020								
11/19/2020								
11/20/2020								
11/21/2020								
11/22/2020								
11/23/2020								
11/24/2020								
11/25/2020								

Spearfish Fence End Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
11/26/2020								
11/27/2020								
11/28/2020	1							
11/29/2020								
11/30/2020								Camera Check
12/01/2020								
12/02/2020								
12/03/2020								
12/04/2020								
12/05/2020								
12/06/2020								
12/07/2020								
12/08/2020								
12/09/2020								
12/10/2020								
12/11/2020								
12/12/2020								
12/13/2020								
12/14/2020								
12/15/2020								
12/16/2020								
12/17/2020								
12/18/2020								
12/19/2020								
12/20/2020								
12/21/2020								Camera Check
12/22/2020								
12/23/2020								
12/24/2020								
12/25/2020								
12/26/2020								
12/27/2020								
12/28/2020								
12/29/2020								
12/30/2020				1				Dumping Sediment
12/31/2020								
01/01/2021								
01/02/2021								
01/03/2021								
01/04/2021								
01/05/2021								
01/06/2021								
01/07/2021								
01/08/2021								
01/09/2021								
01/10/2021								
01/11/2021								
01/12/2021								
01/13/2021								
01/14/2021								
01/15/2021								

Spearfish Fence End Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
01/16/2021								
01/17/2021								
01/18/2021								
01/19/2021								
01/20/2021								
01/21/2021								
01/22/2021								
01/23/2021								
01/24/2021								
01/25/2021								
01/26/2021								Camera Check
Total	33	4	0	5	0	0		

Appendix N: Part 7: Wildlife Camera Trap Data
Tilford Railroad

Tilford Railroad Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
06/18/2020	3						Interstate Approach	
06/19/2020	1							
06/20/2020	1							
06/21/2020	3	4						
06/22/2020	3							
06/23/2020	3							
06/25/2020	4							
06/27/2020	1							
06/29/2020	1							
06/30/2020	3							
07/06/2020	3							
07/09/2020	3							
07/10/2020	2							
07/11/2020	4							
07/16/2020	3							
07/17/2020	1							
07/18/2020	1							
07/19/2020	1							
07/21/2020	3							
07/22/2020	1							
07/23/2020	2							
07/24/2020	5							
07/27/2020	1							
07/28/2020	5							
07/29/2020	1							
08/01/2020	5							
08/04/2020	1							
08/06/2020	1							
08/09/2020				3				Rally
08/10/2020	2							Rally
08/13/2020	1							Rally
08/16/2020	1							Rally
08/18/2020	3							
08/21/2020	2							
08/22/2020	2							
08/26/2020	1							Camera Checked
08/27/2020								
08/28/2020								
08/29/2020	1							
08/30/2020								
08/31/2020	1							
09/01/2020	2							
09/02/2020	2							
09/03/2020								
09/04/2020	6							
09/05/2020								
09/06/2020	1							
09/07/2020								
09/08/2020								
09/09/2020								
09/10/2020								
09/11/2020	1							
09/12/2020	2							

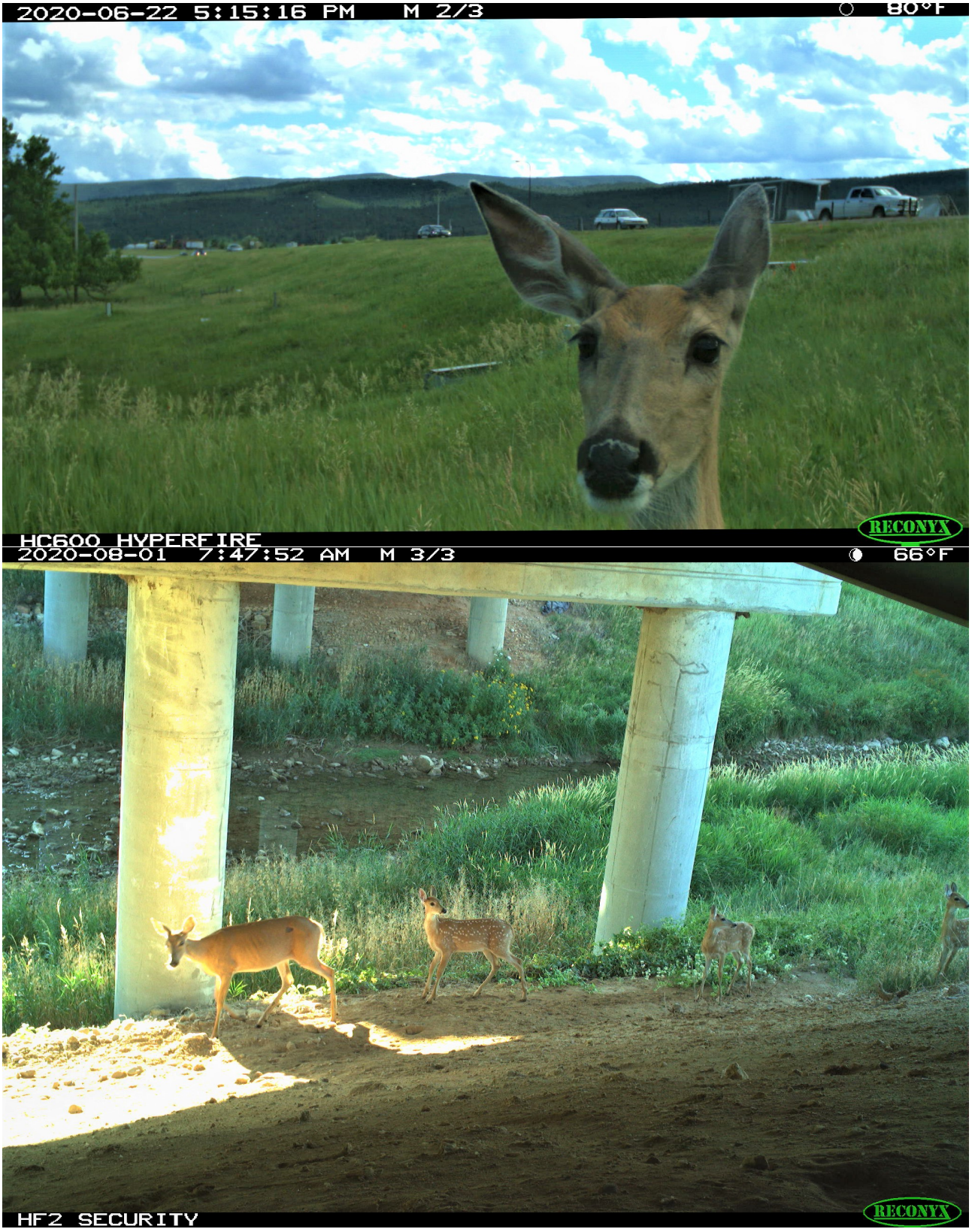
Tilford Railroad Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
09/13/2020	2							
09/14/2020								
09/15/2020								
09/16/2020								
09/17/2020								
09/18/2020	1							
09/19/2020	1							
09/20/2020								
09/21/2020	2							
09/22/2020	1							
09/23/2020								
09/24/2020								
09/25/2020								
09/26/2020								
09/27/2020								
09/28/2020								
09/29/2020								
09/30/2020								
10/01/2020								
10/02/2020								
10/03/2020								
10/04/2020								
10/05/2020								
10/06/2020								
10/07/2020								Camera checked
10/08/2020								increased train activity
10/09/2020								increased train activity
10/10/2020								increased train activity
10/11/2020								increased train activity
10/12/2020								increased train activity
10/13/2020								increased train activity
10/14/2020								increased train activity
10/15/2020								increased train activity
10/16/2020								increased train activity
10/17/2020								increased train activity
10/18/2020								increased train activity
10/19/2020								increased train activity
10/20/2020								increased train activity
10/21/2020								increased train activity
10/22/2020								increased train activity
10/23/2020								increased train activity
10/24/2020								increased train activity
10/25/2020								increased train activity
10/26/2020								increased train activity
10/27/2020								camera check
10/28/2020								
10/29/2020								
10/30/2020								
10/31/2020								
11/01/2020								
11/02/2020								
11/03/2020								
11/04/2020								

Tilford Railroad Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
11/05/2020	1							
11/06/2020								
11/07/2020								
11/08/2020								
11/09/2020								
11/10/2020								
11/11/2020								
11/12/2020								
11/13/2020								
11/14/2020								
11/15/2020								
11/16/2020								
11/17/2020								
11/18/2020								
11/19/2020								
11/20/2020								
11/21/2020								
11/22/2020								
11/23/2020								
11/24/2020								
11/25/2020								
11/26/2020	2							
11/27/2020								
11/28/2020								
11/29/2020								
11/30/2020								Camera Check
12/01/2020								
12/02/2020								
12/03/2020								
12/04/2020								
12/05/2020								
12/06/2020	1							
12/07/2020								
12/08/2020								
12/09/2020								
12/10/2020								
12/11/2020								
12/12/2020								
12/13/2020								
12/14/2020								
12/15/2020								
12/16/2020								
12/17/2020								
12/18/2020								
12/19/2020								
12/20/2020								
12/21/2020								Camera Check
12/22/2020								
12/23/2020								
12/24/2020								
12/25/2020								
12/26/2020								
12/27/2020								

Tilford Railroad Camera Trap								
Date	WTD	MD	Raccoon	Human	Domestic	Misc.	Movement Desc	Notes:
12/29/2020								
12/30/2020								
12/31/2020								
01/01/2021								
01/02/2021								
01/03/2021								
01/04/2021								
01/05/2021								
01/06/2021								
01/07/2021								
01/08/2021								
01/09/2021								
01/10/2021								
01/11/2021								
01/12/2021								
01/13/2021								
01/14/2021								
01/15/2021								
01/16/2021								
01/17/2021								
01/18/2021								
01/19/2021								
01/20/2021								
01/21/2021								
01/22/2021								
01/23/2021								
01/24/2021								
01/25/2021								
01/26/2021								Camera Check
Total	105	4	0	3	0	0		

Appendix N: Part 8: Wildlife Camera Trap Photo Examples


2020-06-21 9:51:13 PM M 2/3
68°F
HF2 SECURITY
2020-10-18 2:03:43 PM M 1/3
32°F
RECONYX
HF2 SECURITY
RECONYX


2020-06-22 5:15:16 PM M 2/3
80°F
RECONYX
HC600 HYPERFIRE
2020-08-01 7:47:52 AM M 3/3
66°F
HF2 SECURITY
RECONYX


2020-09-20 11:23:55 PM M 3/3
66°F
HF2 SECURITY
2020-08-04 6:44:36 AM M 1/3
59°F
RECONYX
HC600 HYPERFIRE
RECONYX


2020-07-24 4:42:11 AM M 3/3 65°F
HC600 HYPERFIRE
RECONYX
2020-07-28 4:27:42 AM M 3/3 59°F
HC600 HYPERFIRE
RECONYX


2020-06-19 8:47:40 PM M 3/3 59°F
HC600 HYPERFIRE
2020-05-26 8:48:18 PM M 1/3 69°F
RECONYX
HF2 SECURITY
RECONYX