



# Environment and Natural Resources Trust Fund

2024 Request for Proposal

## General Information

**Proposal ID:** 2024-215

**Proposal Title:** White-Tailed Deer Movement and Disease in Suburban Areas

## Project Manager Information

**Name:** Meggan Craft

**Organization:** U of MN - College of Biological Sciences

**Office Telephone:** (612) 625-5713

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## Project Basic Information

**Project Summary:** Our project aims to better understand white-tailed deer movement, habitat use, and disease dynamics at the suburban/agricultural interface to inform more efficient deer management and disease control.

**Funds Requested:** \$699,000

**Proposed Project Completion:** June 30, 2027

**LCCMR Funding Category:** Foundational Natural Resource Data and Information (A)

## Project Location

**What is the best scale for describing where your work will take place?**

Region(s): Metro

**What is the best scale to describe the area impacted by your work?**

Statewide

**When will the work impact occur?**

During the Project and In the Future

## Narrative

### **Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

White-tailed deer are an important natural resource to the state of Minnesota. Yet we know little about basic deer biology (e.g., movement, habitat use) at the suburban/agricultural interface. Deer studies typically occur in rural landscapes. Better understanding of movement and habitat use can help target management of the deer population and reduce human-wildlife conflict (e.g., deer-vehicle collisions). White-tailed deer in Minnesota are also hosts for diseases that threaten deer, humans, and pets. For example, Chronic Wasting Disease (CWD) has spread to deer populations in proximity of the Twin Cities, yet applying what is known of deer ecology in rural settings may not be appropriate in making accurate predictions of CWD spread in suburban/urban areas. Also, white-tailed deer are competent hosts for SARS-CoV-2 and could be a source of new viral strains to humans, yet we do not understand how and where deer are exposed to, and spread, the virus. Finally, deer movements facilitate the spread of tick-borne diseases across landscapes (e.g., Lyme disease), with negative implications for humans and our pets. We know little about how diseases like these spread through white-tailed deer populations because we lack information on basic deer biology in suburban areas.

### **What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.**

To better understand white-tailed deer movement, habitat use, and disease dynamics at the suburban/agricultural interface, we will leverage initial successes of a USDA-funded pilot study on SARS-CoV-2 in deer. This pilot study occurred over the winter of 2022/2023 at Elm Creek Park Reserve where: 1) 36% of hunter-harvested white-tailed deer had antibodies to SARS-CoV-2; 2) 40 GPS-collars (that record deer location data every 30 minutes for two years) were placed on deer using efficient helicopter capture; and 3) biological samples were stored for future testing. We seek LCCMR funding to expand this study to a new area (Carver Park Reserve) to collect and analyze movement and disease data via GPS-collars, camera traps, and biological sampling to model connectivity and disease spread. We aim to: 1) Describe deer movement and disease status at an interface between white-tailed deer and humans (and our pets) through GPS collaring and disease sampling white-tailed deer for SARS-CoV-2, CWD, Lyme and other diseases; 2) Use movement and camera trap data to better understand habitat use, local deer density, and group size, with implications for deer management; and 3) Use movement data to create mathematical models to predict disease transmission hotspots in deer populations.

### **What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?**

Better understanding of white-tailed deer biology at the suburban/agricultural interface can help us provide much needed information to managers. This information will help managers more efficiently manage deer populations and reduce human-wildlife conflict (e.g., deer-vehicle collisions). Second, we will engage the public through creation of an iNaturalist site and through education at nature centers. Finally, understanding deer disease status (in combination with deer movement and habitat use) can help us better predict how various diseases would spread among deer at the high-density interfaces between deer, humans, and our pets, with implications for how to target disease control.

## Activities and Milestones

### Activity 1: Quantify deer movement and disease status at the suburban/agricultural interface

**Activity Budget:** \$344,918

**Activity Description:**

Preliminary results from our USDA study suggest that white-tailed deer occur in high densities in Elm Creek Park Reserve, have overlapping space use relevant for transmission of diseases through both direct (i.e., deer-to-deer) and indirect routes (i.e., through ticks, insect vectors, or the environment), and frequently spend time in the neighborhoods around the Park Reserve (Figures 1 and 2a). Here the goal is to gather additional data on deer movements and disease status; the current study is only 40 deer in one “green patch” (i.e., the park). Studying additional “green patches” will give us the ability to make generalizable insights into how deer move and contact each other within and between green patches, as well as at the interface of the green patches, agricultural lands, and neighborhoods.

We propose to: 1) Use helicopter capture to deploy GPS-collars to 40 white-tailed deer at Carver Park Reserve; and 2) Study deer for SARS-CoV-2, CWD, Lyme, and other pathogens (e.g., Powassan virus).

Specific outcomes will include: 1) Locations of 40 deer every 30 minutes at Carver Park for two years; and 2) Disease status from a variety of pathogens of importance to deer, human, and domestic animal health.

**Activity Milestones:**

Description	Approximate Completion Date
Obtain permits, order and acquire GPS collars, hire helicopter company	December 31, 2024
Place GPS collars on 40 white-tailed deer at Carver Park Reserve; collect biological samples	March 31, 2025
Obtain results of diagnostic testing for pathogens from Carver and banked samples from Elm Creek	July 31, 2025
Conduct pathogen risk factor analyses and summarize disease results for final report	January 31, 2026
Collect movement data for collared deer over two years for Activities 2 and 3	March 31, 2027

### Activity 2: Use movement and camera trap data to better understand deer habitat use, density and group size, through a management lens

**Activity Budget:** \$184,663

**Activity Description:**

The goal of this aim is to better understand deer habitat use, deer density, group size, and dispersal to better manage deer at the suburban/agricultural interface and reduce deer-human conflict. We will supplement Activity 1’s data with a camera trap study at Elm Creek and Carver Park and a website for public engagement (iNaturalist) where citizens can report collared deer and their group sizes. Our current Elm Creek movement study is a cooperative agreement where we share deer location data with USDA for a national analysis; however USDA funds do not cover local analyses of the movement data. Therefore we will hire a postdoctoral associate (or graduate student) and undergraduates to deploy the camera traps, monitor the iNaturalist site, and conduct the following analyses (Figure 2): 1) Use GPS and camera data to determine which habitats deer use daily and seasonally; 2) Use camera and iNaturalist data to determine how deer group sizes and local densities change seasonally; and 3) Use GPS data to quantify dispersal events away from the park reserves. Outcomes will include: deer home ranges; drivers of deer movement, grouping, and dispersal; as well as interactive discourse with managers about implications for management and public education.

**Activity Milestones:**

Description	Approximate Completion Date
Create iNaturalist site and deploy cameras at Elm Creek (Year 1) and Carver (Year 2)	June 30, 2026
Analyze camera trap and movement data from Elm Creek (Year 2) and Carver (Year 3)	January 31, 2027
Compare results between sites and determine generalizable conclusions; submit manuscript for publication	June 30, 2027
Continually work with managers to interpret results for management and public education	June 30, 2027

### Activity 3: Use movement data to create mathematical models to predict transmission hotspots in deer populations at the suburban/agricultural interface

**Activity Budget:** \$169,419

#### Activity Description:

The goal is to use a new tool that links animal movement to animal contacts (i.e., “movement-driven modeling of spatio-temporal infection risk”: MoveSTIR; Wilber et al., Ecology Letters, 2022) to predict deer-to-deer contact relevant for disease transmission. This mathematical approach leverages movement data to predict transmission hotspots (see Figure 3). Next, we can determine environmental drivers of contact, allowing us to predict hotspots of transmission in novel landscapes. We will hire a postdoctoral associate to use the deer movement data (Activity 1) to predict where and when contact hotspots occur for diseases transmitted by direct contact (e.g., SARS-CoV-2), indirect contact (e.g., Lyme), or both modes of transmission (e.g., CWD). Outcomes from this activity will include: 1) a map of transmission risk for Elm Creek and Carver for a variety of diseases with different transmission modes; 2) determination of environmental drivers of contact for each disease (e.g., season and/or specific habitat type); and 3) a regional risk map for the greater metro region for the spread of directly and indirectly transmitted pathogens. Knowing predicted hotspots can help target disease surveillance and control.

#### Activity Milestones:

Description	Approximate Completion Date
Develop analytical workflow using preliminary movement data from Elm Creek	July 31, 2025
Analyze Elm Creek movement data using MoveSTIR, consider standalone publication	July 31, 2026
Analyze Carver movement data, and joint movement data with Elm Creek, using MoveSTIR	March 31, 2027
Submit joint movement manuscript for publication	June 30, 2027
Work with managers to devise disease control strategies from model results	June 30, 2027

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Tiffany Wolf	University of Minnesota, College of Veterinary Medicine	Co-PI / Provide guidance for the capture and disease sampling in Activity 1	Yes
James Forester	University of Minnesota, Twin Cities, College of Food, Agriculture and Natural Resource Science	Co-PI / Provide technical oversight for the camera trapping and movement analysis in Activity 2	Yes
John Moriarty	Three Rivers Park District	Collaborator / Provide access to Three Rivers Park District properties and facilities. Assist in the tracking and recovery of deer during the length of the study. Utilize results from this study for managing white-tailed deer on Three Rivers Park District properties.	No
Steven Hogg	Three Rivers Park District	Collaborator / Provide access to Three Rivers Park District properties and facilities. Assist in the tracking and recovery of deer during the length of the study. Utilize results from this study for managing white-tailed deer on Three Rivers Park District properties.	No

## Long-Term Implementation and Funding

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?**

Results pertaining to deer management and human-wildlife conflict will be directly implemented by Three Rivers Park District managers. Study findings will be disseminated to management and academic audiences through conference presentations (e.g., The Wildlife Society) and peer-reviewed publications, and translated for outreach and public engagement for the nature centers at Elm Creek and Carver Park Reserves. In expanding our existing project to encompass two suburban parks in the study of deer biology and disease dynamics, we will be well-positioned to submit a 4-5 year proposal to the National Science Foundation for additional funding to grow and enhance the study.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Mapping Habitat Use and Disease of Urban Carnivores	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03g	\$500,000

## Project Manager and Organization Qualifications

**Project Manager Name:** Meggan Craft

**Job Title:** Associate Professor, University of Minnesota

**Provide description of the project manager's qualifications to manage the proposed project.**

Meggan Craft, PhD, is an infectious disease ecologist and associate professor at the University of Minnesota in the

Department of Ecology, Evolution and Behavior. Since 2011 she has led a lab aiming to understand infectious disease dynamics in animal populations. Craft is interested in asking: How do animal interactions and movement affect the spread of infectious disease? She is increasingly interested in the effects of urbanization on disease spread. Urbanization can create diverse wildlife-human-domestic animal interfaces, which can have important implications for cross-species transmission and the emergence of pathogens. Craft has published 99 peer-reviewed articles and has been the primary research advisor for a high school student, 3 masters students, 6 PhD students, and 7 post-doctoral fellows. She currently is the Principal Investigator on a cooperative agreement with USDA-APHIS to conduct targeted surveillance of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in white-tailed deer (*Odocoileus virginianus*) in Minnesota. This cooperative agreement is in collaboration with University of Minnesota faculty James Forester and Tiffany Wolf and in partnership with John Moriarty and Steven Hogg from Three Rivers Park District. For USDA, we are collecting white-tailed deer SARS-CoV-2 status and movement data via Global Positioning System (GPS) collars on 40 deer in Elm Creek Park Reserve (Hennepin County). Elm Creek Park Reserve is an area with high deer density (i.e., 30-35 deer/square mile) that interfaces with high densities of humans (and our associated pets) in residential areas (see Figure 1). For the purposes of this proposal, we will call areas with high densities of wildlife at the interface with high densities of people (and our pets) the “suburban/agricultural interface” or “suburban areas”.

**Organization:** U of MN - College of Biological Sciences

**Organization Description:**

The University of Minnesota, Twin Cities, is a public land-grant research university in the Twin Cities of Minneapolis and Saint Paul, Minnesota, United States.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Meggan Craft/ Associate Professor/ PI		Overall project management / Provide expertise and mentorship for disease modeling in Activity 3			26.9%	0.21		\$37,000
James Forester/ Associate Professor/ Co-PI		Provide technical expertise for the GPS collars (Activity 1) and mentorship for the camera trapping and movement analysis in Activity 2			26.9%	0.18		\$25,000
Tiffany Wolf/ Assistant Professor/ Co-PI		Dr. Wolf is a DVM/PhD and will lead the deer health component for the capture and disease sampling in Activity 1.			26.9%	0.18		\$21,000
Postdoctoral Associate		Lead for Activity 2 / Deploy the camera traps and conduct analysis of the camera and movement data			20.45%	2.5		\$210,000
Postdoctoral Associate		Lead for Activity 3 / Conduct the disease modeling			20.45%	2.5		\$211,000
							<b>Sub Total</b>	<b>\$504,000</b>
<b>Contracts and Services</b>								
HeliWild (Helicopter Wildlife Capture Services)	Professional or Technical Service Contract	Efficient and safe helicopter capture and sampling of 40 deer at Carver Park Reserve				0		\$50,000
							<b>Sub Total</b>	<b>\$50,000</b>
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	1) Trail cams, SD card, protective boxes and locks, lithium batteries; 2) Binoculars; 3) 40 GPS Collars (model G5-2D from Advanced Telemetry Systems, Isanti, MN); 4) Programmed release mechanisms for collars; 5) Supplies for capture and sampling of 40	1) Estimate group size and local densities of deer; 2) For resighting of collared individuals and visual observations of group size; 3) Track movements of 40 white-tailed deer; 4)					\$100,000

		deer (including write in field paper, pens, needles, syringes, tubes, swabs, darts, immobilization drugs, if needed)	For 40 GPS-collars to automatically 'drop off' after two years; 5) supplies for capture and sampling of 40 deer					
	Tools and Supplies	1) Diagnostic lab services; 2)Data Packages for collars based on at least 12 relocations a day for 24 months, flat rate at \$25/month per collar: Quantity 40 (*24 months),	1) Disease testing for pathogens including SARS-CoV-2, Lyme, CWD, Powassan Virus; 2) Data packages for GPS collars based on at least 12 relocations a day for 24 months,					\$40,000
							<b>Sub Total</b>	<b>\$140,000</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	5573 miles (camera trap checking, collar deployment, sampling and resighting) to and from field sites	Check camera traps, collaring and sampling deer, visual observations of collared deer					\$3,650
	Conference Registration Miles/ Meals/ Lodging	Formal presentation by postdoctoral associate or graduate student at state chapter Wildlife Society Meeting	Presenting at the Minnesota Chapter of The Wildlife Society will highlight the research in the state and serve an outreach function					\$500
							<b>Sub Total</b>	<b>\$4,150</b>
<b>Travel Outside Minnesota</b>								
	Conference Registration Miles/ Meals/ Lodging	Formal presentation by postdoctoral associate or graduate student at a professional society meeting	Formal presentation at a national level professional society research conference (e.g. The Wildlife Society)	X				\$850
							<b>Sub Total</b>	<b>\$850</b>
<b>Printing and Publication</b>								



							<b>Sub Total</b>	-
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$699,000</b>

## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<b>Travel Outside Minnesota</b>	Conference Registration Miles/Meals/Lodging	Formal presentation by postdoctoral associate or graduate student at a professional society meeting	The Wildlife Society annual meetings normally occur outside of Minnesota. This is a conference that will reach additional management audiences.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
In-Kind	University of Minnesota Indirect Costs	55% MTDC	Pending	\$384,000
			<b>Non State Sub Total</b>	<b>\$384,000</b>
			<b>Funds Total</b>	<b>\$384,000</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [31c0bfa6-f8c.pdf](#)

#### *Alternate Text for Visual Component*

Fig. 1. Locations of GPS-collared deer at Elm Creek Park Reserve with inset of collared deer.

Fig. 2. Collared deer routinely visit backyards. Camera traps and iNaturalist observations will estimate how group sizes change seasonally.

Fig. 3. High risk contact hotspots for disease transmission can be predicted by movement....

### Optional Attachments

#### *Support Letter, Photos, Media, Other*

Title	File
Support letter from Three Rivers Park District	<a href="#">a8728978-7a1.pdf</a>
Institutional Endorsement by University of Minnesota	<a href="#">8798c387-bb6.pdf</a>

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

**Does your project have potential for royalties, copyrights, patents, or sale of products and assets?**

No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**

N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**

N/A

**Does your project include original, hypothesis-driven research?**

Yes

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

**Does your project include the design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?**

No

**Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services, as defined in Minnesota Statutes section 299C.61 Subd.7?**

No