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# New Hampshire Fish and Game Department

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Glenn Normandeau  
Executive Director

February 27, 2014

Her Excellency, Governor Margaret Wood Hassan  
and the Honorable Council  
State House  
Concord, New Hampshire 03301

*Sole Source*

## REQUESTED ACTION

Authorize the New Hampshire Fish and Game Department to enter into a Sole Source Cooperative Project Agreement with the University of New Hampshire (Vendor No. 177867) to conduct a research project in support of deer management in the amount of \$50,000 from the date of Governor and Executive Council approval through December 30, 2015. 100% Federal Funds.

Funding is available in account, Game Management, with authority to adjust encumbrances in each of the state fiscal years through the Budget Office if needed and justified:

03 75 75 751520-21580000 - Wildlife Program Management Program - Game Management

20-75000-21580000-304-500841 Research and Management

FY14	FY15	FY16*
\$11,000	\$29,000	\$10,000

\*Pending State Budget Approval

## EXPLANATION

Given the biological, cultural and economic importance of white-tailed deer in New Hampshire, management of their population is a priority for state wildlife managers. In New Hampshire, winter weather and habitat are considered the limiting factors of the deer population. Specifically, annual survival is related to winter severity, measured temporally by days of deep snow and cold. Consequently the availability of suitable wintering habitat, or deer wintering areas (DWAs), is vitally important to mitigate the effects of snow depth on mobility and forage resources. Despite efforts to monitor, manage and protect DWAs, the amount and condition of suitable DWA habitat remains in flux as a consequence of both human activity and ecological processes.

In light of the critical importance of DWAs to deer survival, the Fish and Game Department has monitored, to varying degrees, the location, condition, and level of use of DWAs for ~40 years. Beginning in the 1970s, state wildlife biologists began mapping DWAs; many of these maps have been digitized and are used as part of a publicly available GIS layer for conservation planning. More recently (~15 years), regional wildlife biologists have conducted annual winter surveys at known or suspected DWAs to document use. A variety of metrics including snow depth, availability and use of browse, bark stripping, mortality, estimated number of deer, new development and forestry operations, and any other noteworthy findings (e.g.,

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evidence of supplemental feeding) are recorded. These data provide continual information about use and condition to help identify trends and fate of DWAs. However, no summary document of these data exists for use by either the department or conservation planning.

This project will provide the Department with up-to-date information on the location and status of known deer wintering areas in New Hampshire. Additionally, a deer wintering area habitat model will be developed using the vegetative and physical characteristics of known DWAs and used to delineate potential DWAs regionally throughout the state. The impact of deer winter feeding on the location, use and structure of DWAs will also be evaluated. This information will be provided in documented GIS layers for use by the department in managing New Hampshire's deer population and winter habitat as well as made available to foresters, land managers, town planning boards and conservation commissions, and others interested in managing or protecting deer wintering areas in New Hampshire.

Respectfully submitted,



Glenn Normandeau  
Executive Director



Kathy Ann LaBonte  
Chief, Business Division

**COOPERATIVE PROJECT AGREEMENT**  
between the  
**STATE OF NEW HAMPSHIRE, Fish and Game**  
and the

**University of New Hampshire** of the UNIVERSITY SYSTEM OF NEW HAMPSHIRE

- A. This Cooperative Project Agreement (hereinafter "Project Agreement") is entered into by the State of New Hampshire, **Fish and Game**, (hereinafter "State"), and the University System of New Hampshire, acting through **University of New Hampshire**, (hereinafter "Campus"), for the purpose of undertaking a project of mutual interest. This Cooperative Project shall be carried out under the terms and conditions of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, except as may be modified herein.
- B. This Project Agreement and all obligations of the parties hereunder shall become effective on the date the Governor and Executive Council of the State of New Hampshire approve this Project Agreement ("Effective date") and shall end on **12/30/15**. If the provision of services by Campus precedes the Effective date, all services performed by Campus shall be performed at the sole risk of Campus and in the event that this Project Agreement does not become effective, State shall be under no obligation to pay Campus for costs incurred or services performed; however, if this Project Agreement becomes effective, all costs incurred prior to the Effective date that would otherwise be allowable shall be paid under the terms of this Project Agreement.
- C. The work to be performed under the terms of this Project Agreement is described in the proposal identified below and attached to this document as Exhibit A, the content of which is incorporated herein as a part of this Project Agreement.

Project Title: **Assessing the Status of Deer Wintering Areas in New Hampshire**

- D. The Following Individuals are designated as Project Administrators. These Project Administrators shall be responsible for the business aspects of this Project Agreement and all invoices, payments, project amendments and related correspondence shall be directed to the individuals so designated.

**State Project Administrator**

Name: Kathy Ann Labonte  
Address: NH Fish and Game Department  
Business Division  
11 Hazen Drive  
Concord, NH 03222  
Phone: 603-271-2741

**Campus Project Administrator**

Name: Dianne Hall  
Address: University of New Hampshire  
Sponsored Programs Administration  
51 College Rd. Rm 116  
Durham, NH 03824  
Phone: 603-862-1942

- E. The Following Individuals are designated as Project Directors. These Project Directors shall be responsible for the technical leadership and conduct of the project. All progress reports, completion reports and related correspondence shall be directed to the individuals so designated.

**State Project Director**

Name: Kent A. Gustafson  
Address: NH Fish and Game Department  
Wildlife Division  
11 Hazen Drive  
Concord, NH 03222  
Phone: 603-271-2461

**Campus Project Director**

Name: Peter Pekins  
Address: University of New Hampshire  
Natural Resources  
James Hall Rm G05  
Durham, NH 03824  
Phone: 603-862-1017

F. Total State funds in the amount of \$50,000 have been allotted and are available for payment of allowable costs incurred under this Project Agreement. State will not reimburse Campus for costs exceeding the amount specified in this paragraph.

Check if applicable

Campus will cost-share 25 % of total costs during the term of this Project Agreement.

Federal funds paid to Campus under this Project Agreement are from Grant/Contract/Cooperative Agreement No. **W-106-R-1** from **US Fish and Wildlife Service** under CFDA# **15.611**. Federal regulations required to be passed through to Campus as part of this Project Agreement, and in accordance with the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, are attached to this document as Exhibit B, the content of which is incorporated herein as a part of this Project Agreement.

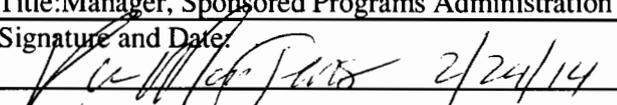
G. Check if applicable

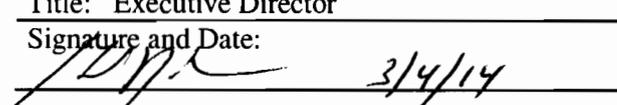
Article(s) of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002 is/are hereby amended to read:

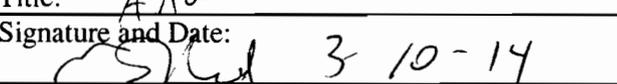
H.  State has chosen **not to take** possession of equipment purchased under this Project Agreement.  
 State has chosen **to take** possession of equipment purchased under this Project Agreement and will issue instructions for the disposition of such equipment within 90 days of the Project Agreement's end-date. Any expenses incurred by Campus in carrying out State's requested disposition will be fully reimbursed by State.

This Project Agreement and the Master Agreement constitute the entire agreement between State and Campus regarding this Cooperative Project, and supersede and replace any previously existing arrangements, oral or written; all changes herein must be made by written amendment and executed for the parties by their authorized officials.

IN WITNESS WHEREOF, the University System of New Hampshire, acting through the **University of New Hampshire** and the State of New Hampshire, **Fish and Game** have executed this Project Agreement.

**By An Authorized Official of:**  
**University of New Hampshire**  
Name: Karen M. Jensen  
Title: Manager, Sponsored Programs Administration  
Signature and Date:  2/24/14

**By An Authorized Official of:**  
**NH Fish and Game Department**  
Name: Glenn Normandeau  
Title: Executive Director  
Signature and Date:  3/4/14

**By An Authorized Official of:** the New Hampshire Office of the Attorney General  
Name: Evan Mulholland  
Title: AA  
Signature and Date:  3-10-14

**By An Authorized Official of:** the New Hampshire Governor & Executive Council  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
Signature and Date: \_\_\_\_\_

## EXHIBIT A

**A. Project Title:** Assessing the Status of Deer Wintering Areas in New Hampshire

**B. Project Period:** 04/01/14-12/30/15

**D. Objectives:**

This project expands upon efforts to better understand the effects of non-harvest factors on the New Hampshire deer population (NHFG W-89-R Project 1, Job 2) by assessing the status of deer wintering areas. Specific objectives are to:

- 1) assimilate data from annual deer wintering area (DWA) surveys (1999-2013) and historic DWA maps into GIS map layer available for use by resource professionals and land conservation decision makers,
- 2) determine necessary data inputs to develop and train a GIS model capable of predicting suitable DWA habitat by region throughout the state,
- 3) ground truth the GIS model by assessing predicted DWA habitat through physical site inspections to determine presence and level of use, and
- 4) evaluate supplemental feeding using stable isotope analysis to assess the influence of feeding sites on DWA location, age, and structure.

### STUDY AREA

The study area is the state of New Hampshire, divided regionally (North, Central, South) along WMU boundaries for purposes of GIS modeling and supplemental feeding analysis. Cover type and winter severity vary on a latitudinal gradient, with resultant differences in DWA structure and timing of use. Forest dominates New Hampshire, with the north region characterized by lowland spruce-fir and mixed conifer, the central by high elevation spruce-fir and mixed-conifer, and the south by hemlock-hardwood-pine. Winter severity is measured annually in each WMU using a winter severity index (WSI) that records days (1 Dec.-30 Apr.) with minimum temperature  $<0$  degrees F and/or snow levels  $\geq 18$ ", with a point assigned for each criteria met/day. Mean WSI values since 1949 are 72.6 in the north region (n=320), 52.6 in the central (n=448), and 27.6 in the south region (n=512).

### METHODS

#### Objective 1: DWA Mapping

The NHFG has an existing layer of historical DWAs already mapped using coordinates provided by annual DWA survey forms. The locations of newly identified DWAs will be mapped using ArcMap (ArcGIS version 10.1, ESRI). Historical DWAs will be evaluated using recent (2006-2012) land cover imagery to assess current structure and existence, and boundaries will be redrawn accordingly. The DWA layer will provide detailed geographic location and qualitative and quantitative information about each DWA, including size, number of times surveyed, estimated deer numbers, quality and availability of browse, and development and/or timber harvesting activity. In addition to

producing a statewide DWA map layer, this exercise will provide maps available at either town or WMU scale for resource professionals and conservation planning.

#### Objective 2: Predictive Model

Mapped DWAs will serve as the primary data source in developing an optimal Deer Wintering Area Habitat Model (DWM) for the northern, central and southern regions of New Hampshire. Vegetative and physical characteristics of active DWAs (e.g., stand composition, crown closure, elevation, aspect, annual snowfall) will be used as selective criteria from which a predictive model can be trained. Applying the selection criteria to a defined area will produce a GIS shapefile of potential DWA habitat. Ranges of selective criteria values will be tailored on a regional basis to reflect localized differences in physical and vegetative composition to produce a DWM unique to each of the 3 defined regions.

A minimum of 20-30 active DWAs in each of the 3 regions will be used to train the DWMs, and DWAs will be considered active if yarding was observed within the past 10 years. Ultimately, the performance of the models can be evaluated by comparing habitat predicted by the DWM with an independent data set to determine if the models perform better than random at predicting DWA habitat. Stand data will be developed and collected during the summer 2014. DWMs may be revised following ground truthing if necessary.

#### Objective 3: Ground Truthing DWMs

DWMs will also be evaluated by conducting on-the-ground surveys of habitat predicted as suitable winter cover that has not been assessed by state biologists. After DWMs have been developed, 10 randomly selected sites predicted to be a DWA within each DWM region will be assessed after DWMs have been developed. Rapid browse surveys and pellet group counts will be used to determine deer presence and relative use, and structural measurements (composition, crown closure, % available browse) and site characteristics (elevation, slope, aspect) will be recorded. Data collected during these site visits can potentially be used to make necessary alterations to the DWMs in order to more accurately predict DWA habitat.

#### Objective 4: Supplemental Feeding Assessment

It is hypothesized that supplemental feeding can be quantified using stable carbon isotope analysis. Fecal pellets will be collected in 3 regions to assess levels and distribution of supplemental feeding. In each region, 10 fecal pellet samples will be collected from 5 DWAs every 15-20 days (6 total visits per DWA) between 1 January- 30 March 2015 (n = ~900 samples). Coordinates of any feed site(s) will be recorded and distance from fecal pellet samples to feed site(s) will be calculated to evaluate relationship between proximity to feed site and supplemental feed levels. All fecal pellet samples will be evaluated using stable isotope analysis (Costech ECS4010 Elemental Analyzer) at the University of New Hampshire Stable Isotope Laboratory. Post-analysis, supplemental feeding levels will be classified (none, low, moderate, high) and statistical analysis performed to investigate relationships between supplemental feeding status and DWA site characteristics.

#### E. Scope of Work:

#### INTRODUCTION AND JUSTIFICATION

Given the biological, cultural, and economic importance of white-tailed deer (deer; *Odocoileus virginianus*) in New Hampshire, management of their population is a priority for state wildlife managers. Current deer population objectives are guided by the 2006-2015 Big Game Population Management Plan of the New Hampshire Fish and Game Department (NHFG). Targeted population levels are addressed within 20 wildlife management units (WMU), designated on the basis of localized differences in habitat, deer density, and hunting pressure. Quantitative and qualitative assessments of population size and distribution, physical condition, and productivity are monitored on an annual basis, typically through the analysis of related harvest data. Non-harvest data, including assessments of winter severity, winter mortality, vehicle kill, and hunter participation and effort, provide additional indices used to gauge the size and health of the population, and annual review of harvest and non-harvest data is used to establish either-sex hunting days during different seasons (archery, muzzleloader, firearms) to regulate antlerless harvest.

In New Hampshire, winter weather and habitat are considered the limiting factors of the population. Specifically, annual survival is related to winter severity, measured temporally by days of deep snow and cold. Consequently, the availability of suitable wintering habitat, or deer wintering area (DWA), is vitally important to mitigate the effects of snow depth on mobility and forage resources (Pekins and Tarr 2009). The importance of protecting DWAs was first recognized in the 1950s at a time when unregulated timber harvesting led to widespread loss of many DWAs (Gill 1957, Boer 1978). Most state and provincial agencies have since taken measures to protect DWAs, including the development of specific guidelines or regulations for their protection and management (New Hampshire Fish and Game 1970, Reay et al. 1990, New Brunswick Department of Natural Resources 2002, Bennett 2010) and publication of non-technical articles available to landowners and the general public (New Hampshire Fish and Game 2001).

Despite more attentive management, the amount and condition of suitable DWA habitat remains in flux as a consequence of both human activity and ecological processes. New Hampshire's population rose 6.5% between 2000 and 2010 (U.S. Census 2010), adding 80,700 residents and exceeding the growth rate of every other state in the Northeast (Johnson 2012). Over a similar period (2005-2013), the state deer herd increased by an estimated 13% (NHFG, unpub. data). Given the concurrent increases in human and deer population and related land development, there is a subsequent need for assessment and documentation of DWAs to better inform wildlife management and conservation planning.

Although site specific composition of DWAs is variable throughout New Hampshire, all DWAs provide two basic habitat components: mature conifer or mixed-conifer stands which provide cover and increased mobility, and interspersed or adjacent foraging habitat to meet nutritional demands (Verme 1965, Telfer 1978, Pekins and Tarr 2009). Snow depth, typically  $\geq 30$  cm, is the driving factor for deer to occupy wintering areas. Stands composed of  $\geq 50\%$  conifers with  $\geq 50\%$  crown closure offer superior winter cover, with the relative necessary amount related to annual snowfall (Richens and Lavigne 1978).

The disproportionate importance of DWAs is underscored by the fact that they typically account for just 5-15% of the annual range, yet are often used  $>25\%$  of the year (Pekins and Tarr 2009). Further, deer often migrate 10-40 km from summer ranges to DWAs (Rongstad and Tester 1969, Hoskinson and Mech 1981), and deer demonstrate strong annual site fidelity to DWAs that are used by generations of offspring (Verme 1973, Drolet 1976). However, despite the existence of "traditional" DWAs used for many decades, most are not permanent and may be abandoned or have reduced use

as a result of forest maturation or unfavorable changes in ecological condition. For example, in New Brunswick, Boer (1992) found that of 99 DWAs, 42% were vacant within 13 years.

In light of the critical importance of DWAs to deer survival, NHFG has monitored, to varying degree, the location, condition, and level of use of DWAs for ~40 years. Beginning in the 1970s, state biologists began mapping DWAs; many are still used and digitized as part of a publicly available GIS layer for conservation planning. More recently (~15 years), regional biologists have conducted annual winter surveys at known or suspected DWAs to document use. A variety of metrics including snow depth, availability and use of browse, bark stripping, mortality, estimated number of deer, new development and forestry operations, and any other noteworthy findings (e.g., evidence of supplemental feeding) are recorded. These data provide continual information about use and condition to help identify trends and fate of DWAs. However, no summary document of these data exists for use by either NHFG or conservation planning.

One factor confounding a clear analysis of DWA existence and use is the prevalence of supplemental feeding sites that disrupt deer movement and habitat use (Lewis and Rongstad 1998, Tarr and Pekins 2002). Hurst and Porter (2008) found that deer in the Adirondacks region of New York spent more time in residential areas rather than traditional DWAs and suspected this behavior was caused by supplemental feeding. In Wisconsin, supplemental feeding on summer range delayed migration to wintering areas by up to 19 days (Lewis and Rongstad 1998).

Deer throughout New Hampshire have access to supplemental food (Tarr and Pekins 2002, Ross 2003, W. Staats personal comm.). Ross (2003) analyzed deer fecal pellets from DWAs in New Hampshire to evaluate supplemental feeding levels of pelleted concentrate and found widespread access and use of supplemental food, but most (62-89%) individual consumption levels of pelleted concentrate were <30 % of the diet; the mean % pelleted concentrate in diets varied throughout the state. However, how location, timing, and level of use of supplemental feeding sites might influence establishment of new or abandonment of old DWAs remains unknown.

It should be possible to measure the relative use of supplemental food using stable isotope analysis of fecal pellets collected during winter. The locations of fecal pellets and their proximity to feeding sites and new and traditional DWAs can be evaluated spatially through GIS analysis. Further, fecal pellets have a short isotopic turnover time (2-14 days), making it possible to document short-term variability in use and timing of supplemental feed (Sponheimer et al. 2003, Najera-Hillman and Mandujano 2013). Analysis of these factors in concert would help identify how winter habitat use by deer in New Hampshire is impacted by supplemental feeding.

Stable isotope analysis compares the relative concentration of specific isotopes found in tissues and feces to evaluate dietary and trophic ecology (Kelly 2000, Bearhop et al. 2004, Botha and Stock 2005, Codron et al. 2007). For herbivores, carbon isotopic composition ( $\delta^{13}C$ ) is reflected in the photosynthetic mechanism (C3, C4, CAM) of the primary producers which they feed upon (O'Leary 1981, Wittmer et al. 2010). Isotopic studies have shown that C4 plants possess less negative  $\delta^{13}C$  values than C3 plants (O'Leary 1981). Consequently, in environments where available food sources have distinct carbon isotopic signatures, stable isotope analysis is useful to evaluate feeding strategies (Codron et al. 2007, Najera-Hillman and Mandujano 2013).

In New Hampshire, corn (C4 plant) and corn-based supplements are believed to be the most prevalent supplemental food source (W. Staats personal comm.). Natural winter forage for deer includes woody browse, lichen, litterfall, and hard mast—all plants with C3 carbon isotopic signatures (O'Leary 1981, Teeri 1981). It is hypothesized that collection of fecal pellets and subsequent  $\delta^{13}C$

stable isotope analysis will reveal presence and levels of supplemental feeding in New Hampshire as indicated by the C3 (natural diet):C4 (corn-based) ratio.

Given increases in deer and human populations, wildlife managers and conservation planners need current documentation of DWA habitat and its use to guide decision making. Three concerns in New Hampshire are 1) a lack of updated maps that identify DWA locations, 2) the need to revise a predictive GIS model developed by NHFG in 2007 that identifies DWA habitat, and 3) minimal information about the use of supplemental food by deer in or near DWAs. This project is designed to improve the current understanding and documentation of DWA use in New Hampshire through a combined application of GIS mapping of field survey data, modeling of habitat components associated with DWAs to identify suitable DWA habitat, and stable isotope analysis of fecal pellets to identify relative use of supplemental food.

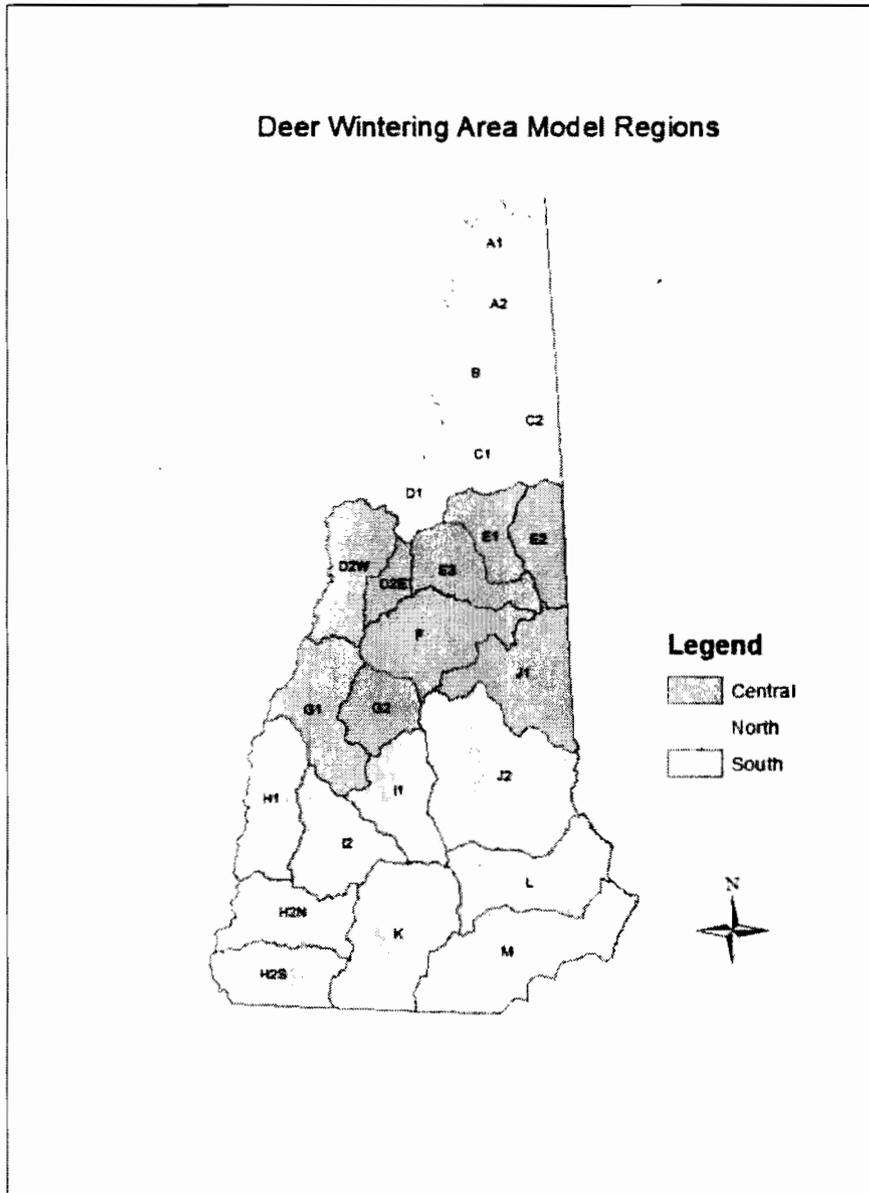


Figure 1. Regions (North, Central, South) based on WMU boundaries used for Deer Wintering Area Model (DWM) and supplemental feeding analysis.

## LITERATURE CITED

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**E. Deliverables Schedule:** Quarterly progress reports, GIS layer(s) providing the location and status of known DWAs as well as the location and status of potential DWAs based on the development of deer wintering area habitat models, and final report in the form of a MS Thesis (12/30/15).

**F. Budget and Invoicing Instructions:** Campus will submit invoices to State on regular Campus invoice forms no more frequently than monthly and no less frequently than quarterly. Invoices will be based on actual project expenses incurred during the invoicing period, and shall show current and

cumulative expenses by major cost categories. State will pay Campus within 30 days of receipt of each invoice. Campus will submit its final invoice not later than 60 days after the Project Period end date.

Budget Items	State Funding	Cost Sharing	Total
1. Salaries & Wages	21,319	15,477	36,796
2. Employee Fringe Benefits	1,684	1,223	2,907
3. Travel	8,500	0	8,500
4. Supplies and Services	8,180	0	8,180
5. Equipment	0	0	0
6. Facilities & Admin Costs	10,317	0	10,317
Subtotals	50,000	16,700	66,700
Total Project Costs:			66,700

## EXHIBIT B

This Project Agreement is funded under a Grant/Contract/Cooperative Agreement to State from the Federal sponsor specified in Project Agreement article F. All applicable requirements, regulations, provisions, terms and conditions of this Federal Grant/Contract/Cooperative Agreement are hereby adopted in full force and effect to the relationship between State and Campus, except that wherever such requirements, regulations, provisions and terms and conditions differ for INSTITUTIONS OF HIGHER EDUCATION, the appropriate requirements should be substituted (e.g., OMB Circulars A-21 and A-110, rather than OMB Circulars A-87 and A-102). References to Contractor or Recipient in the Federal language will be taken to mean Campus; references to the Government or Federal Awarding Agency will be taken to mean Government/Federal Awarding Agency or State or both, as appropriate.

Special Federal provisions are listed here:  None or .