

Ary Faraji

From: Foy,Brian <Brian.Foy@ColoState.EDU> on behalf of Foy,Brian
Sent: Thursday, June 8, 2023 3:22 PM
To: Chris Roundy - CDPHE; Ebel,Greg; Kading,Rebekah; Hemming-Schroeder,Elizabeth; Kelp,Nicole; Saavedra Rodriguez,Karla; McMillan, Joseph; Brelsfoard, Corey; Ary Faraji natalie.marzec; Southergill,Trisha; Caldwell,Valerie; Rogers,Susan
Cc:
Subject: RE: CDC-RFA-CK-23-005: Strengthening Training, Evaluation, and Partnerships in the Prevention and Control of Vector- Borne Diseases (STEP) - AMERICAN MOSIQUITO CONTROL ASSOCIATION
Attachments: Budget-Preparation-Guidance.pdf
Follow Up Flag: Follow up
Flag Status: Flagged

Hi all,

Natalie and I, along with CSU budget and administrative staff (Trisha, Val, Susan), just got off the call from the CD and they confirmed that we will receive this award! Congratulations to all for a stellar effort in the proposal writing!

The GMS for the award, Benita Bosier-Ingram, explained that by Aug 1 we need to respond to the recommendations in the Summary Statement that they will send to us soon. They will also ask us to revise our budgets according to a CDC template that she will soon send us and I will forward to you all. Attached is a guidance document on what they will need in the budget revision – essentially, we need to line-item all supply, other, and travel/per diem costs much more than we already have in the proposal budget. I am currently assuming given the text in the NOFO, that this revised budget will also be due by Aug 1, but will let you know ASAP if this is incorrect.

The NOA will be sent to us by June 28th. The period of performance will be through 2028 and start July 1. Meridith Towle at the CDC-DVBD was also on the call and either she or another of her staff will serve as the Project Officer for our award. She said we will have a kick-off meeting right around July 1.

Given we are in the vacation season, and everybody will be going to different places at different times throughout the summer, we cannot delay on these project and budget revisions as a group, so please plan to work on them when you are available. I know that I will be out of town around July 31 – Aug 8, so we will need to submit these by mid-late July.

Also, if you are planning on hiring people for the award, I highly recommend you start to write the job description(s) and get the position processed through your HR right away so we can be fully staffed as soon as possible. At the top of the list is a Project Manager based at CSU, which I will be advertising when able, so please send any people you may recommend my way.

Congrats again! I am really looking forward to working with you all over the next 5 years on this project and to work together to train and assemble a strong and cohesive VBD community for the RaHP VEC.

One more note, the CDC asked us to not send out any press releases or official notices of getting this award until they give us the go ahead. So you can start working with your press offices but any release is embargoed till then. I will contact CSU communications and have them link to all your communications directors/teams – maybe we can make a joint announcement.

Nice job everybody!
-Brian

From: Foy, Brian

Sent: Friday, June 2, 2023 2:50 PM

To: Marzec - CDPHE, Natalie <natalie.marzec@state.co.us>; Chris Roundy - CDPHE <chris.roundy@state.co.us>; Ebel, Greg <Gregory.Ebel@colostate.edu>; Kading, Rebekah <Rebekah.Kading@colostate.edu>; Elizabeth Hemming-Schroeder <elizabeth.hemming-schroeder@colostate.edu>; Kelp, Nicole <Nicole.Kelp@colostate.edu>; Saavedra Rodriguez, Karla <Karla.Saavedra_Rodriguez@colostate.edu>; McMillan, Joseph <josmcmil@ttu.edu>; Brelsfoard, Corey <Corey.Brelsfoard@ttu.edu>; Ary Faraji <ary@slcmad.org>

Subject: RE: CDC-RFA-CK-23-005: Strengthening Training, Evaluation, and Partnerships in the Prevention and Control of Vector- Borne Diseases (STEP) - AMERICAN MOSIQUITO CONTROL ASSOCIATION

Importance: High

Dear All,

This just came in my inbox. It seems promising, but it still only says that we are **"approved"**, so it may only still mean we are on the ABU list, but not necessarily funded? Anyways, I'm cautiously optimistic, and will schedule this meeting next week.

Natalie, please let me know when you are available during the dates they list below. I cannot do June 12 date.

Sincerely,
Brian

From: Bosier-Ingram, Benita (CDC/OCOO/OFR/OGS) <ula8@cdc.gov>

Sent: Friday, June 2, 2023 2:17 PM

To: Foy, Brian <Brian.Foy@ColoState.EDU>

Cc: Borchert, Jeff N. (CDC/DDID/NCEZID/DVBD) <gqx1@cdc.gov>

Subject: CDC-RFA-CK-23-005: Strengthening Training, Evaluation, and Partnerships in the Prevention and Control of Vector- Borne Diseases (STEP) - AMERICAN MOSIQUITO CONTROL ASSOCIATION

Importance: High

**** Caution: EXTERNAL Sender ****

Congratulations!

Hello,

This email is to notify you that funding for your application for the Funding Opportunity Announcement Number **CK-23-0005**, entitled : ***Strengthening Training, Evaluation, and Partnerships in the Prevention and Control of Vector- Borne Diseases (STEP)***, has been ***approved***. It is very important that we schedule a 1 hr. conference call with you and others from your agency (to include the Executive Director, Project Director (if different), Business Official, Budget/Accounting representative) as soon as possible. Please select the best time available from the time slots below:

Wednesday	6/7/2023 12pm to 1pm CST
Thursday	6/8/2023 3 pm to 4 pm CST
Friday	6/9/2023 3 pm to 4 pm CST
Monday	6/12/2023 11 am to 12 pm CST

Please confirm your date and time by noon Monday June 5, 2023 and provide the names and titles of the people expected to be on the call.

Due to the tight timeline of this award, we must conduct the call within this timeline. If key staff persons are unavailable, an alternate should be provided. Once you confirm the date/time, you will receive a meeting invitation.

Please do not make any official announcements or press releases regarding this selection for funding until you receive the official Notice of Award document in hand. Once I receive all required information from you, I will begin processing your award. Should you have any questions or concerns, please do not hesitate to contact me.

Information needed for the call:

- Confirm the Authorized Official, Project Director, Fiscal Contact (Name, Number, e-mail address)
- Confirm business address
- Confirm PMS EIN (if established)
- Confirm UEI
- Confirm indirect cost agreement date and percentage

BENITA BOSIER-INGRAM, MBA,MHA (she/her)

Grants Management Specialist

Branch 1

Office of Grants Services (OGS)

Office of Financial Resources (OFR)

Office of the Chief Operating Officer (OCOO)

Centers for Disease Control and Prevention (CDC)

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BENITA BOSIER-INGRAM, MBA,MHA (she/her)

Grant Title: RaHP VEC (SLCMAD)

Budget for Entire Proposed Project Period

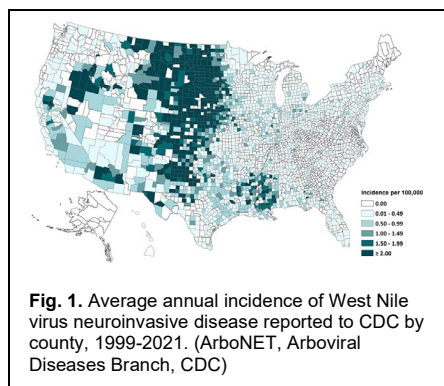
Budget Category	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Personnel: Full Time SLCMAD	\$59,097	\$62,052	\$65,154	\$68,412	\$71,833	\$326,548
Personnel: Seasonal Intern/Vector Surveillance Technician	\$12,000	\$12,600	\$13,230	\$13,892	\$14,586	\$66,308
Equipment/Supplies/PPE	\$7,500	\$7,875	\$8,269	\$8,682	\$9,116	\$41,442
Fuel	\$2,000	\$2,100	\$2,205	\$2,315	\$2,431	\$11,051
Pesticides (adulticide & larvicide)	\$30,695	\$32,230	\$33,841	\$35,533	\$37,310	\$169,609
Trainee Support (In State Utah)	\$20,000	\$21,000	\$22,050	\$23,153	\$24,310	\$110,513
Trainee Support (Out of State Utah)	\$24,000	\$25,200	\$26,460	\$27,783	\$29,172	\$132,615
Travel for Full Time Staff	\$10,000	\$10,500	\$11,025	\$11,576	\$12,155	\$55,256
Miscellaneous	\$1,500	\$1,575	\$1,654	\$1,736	\$1,823	\$8,288
Total Direct Costs	\$ 166,792	\$ 175,132	\$ 183,888	\$ 193,083	\$ 202,737	\$ 921,631
Indirect Costs	\$ 16,679	\$ 17,513	\$ 18,389	\$ 19,308	\$ 20,274	\$ 92,163
TOTAL DIRECT & INDIRECT COSTS	\$ 183,471	\$ 192,645	\$ 202,277	\$ 212,391	\$ 223,010	\$ 1,013,794

Rockies and High Plains VECtor-borne diseases Center (RaHP VEC)

a. Background

Introduction: Recent decades have produced worldwide pandemics of mosquito-borne diseases that have affected the United States, including those caused by West Nile, dengue chikungunya and Zika viruses. Additionally, the incidence of tick-borne diseases (TBD) including Lyme disease, spotted fever group rickettsioses, ehrlichiosis, anaplasmosis, babesiosis, tularemia, and tick-borne arboviral and relapsing fevers also is increasing. Further, the continued spread of plague by fleas remains a local problem in particular regions of the US. The Rockies & High Plains (RaHP) region of the US, comprising the states of Colorado (CO), New Mexico (NM), Utah (UT), Wyoming (WY), along with the Texas (TX) panhandle faces unique vector borne disease (VBD) challenges, risks and opportunities in part due to high population growth, large regions that are poorly served by VBD control services, and environmental suitability to VBDs.

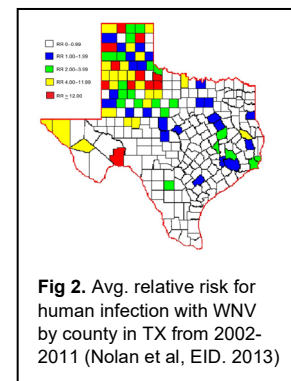
West Nile virus: **The 5 states in our region reported 25% (13,649/55,443) of all WNV disease cases, and 21% (5913/27,857) of all reported WNV neuroinvasive cases (Fig 1) reported in the US from 1999 (when WNV emerged in New York City) though 2021 despite accounting for only 12% of the nation's population.** In 2022, CO reported the most WNV cases of any



state, accounting for 20% (204) of US cases (1). High incidence WNV foci within the RaHP include the major river valleys on the CO and WY Front Range and Western Slope, the TX Panhandle, and tribal nation lands (Figs 1 & 2). WNV foci in our region are maintained by *Culex* mosquitoes and infected birds, with human infection primarily driven by regional populations of *Culex tarsalis* as primary vectors (2). The strong correlation between WNV human disease in northeastern CO and the vector index for *Cx.*

tarsalis (Fig. 3) supports this association (3). This same vector

system has historically spread Western Equine Encephalitis virus (WEEV) in our region (4), and mosquito surveillance data shows that the recent reintroduction of St. Louis Encephalitis virus (SLEV) into the southwest has now spread to RaHP states (5). Finally, these locally hyperabundant vectors have high potential to spread other globally emerging and reemerging arboviruses among humans as well as domestic and wild animals in our region, including Rift Valley Fever virus (RVFV) (6).



Tick and flea-borne diseases: The predominant tickborne diseases in the RaHP region are Colorado Tick Fever (CTF) and tick-borne relapsing fever (TBRF), Rocky Mountain Spotted fever (RMSF) and tularemia (Fig. 4). The tick vectors and transmission cycles of these diseases are poorly understood compared to the more common *Ixodes* tick-transmitted diseases including Lyme disease, anaplasmosis and babesiosis.

CTF virus (CTFV), the causative agent of CTF, is transmitted to humans by biting adult *Dermacentor andersoni* that live at high elevations in the western US mountains of our RaHP region (7, 8). Most people become infected with CTFV when they are outside working or

recreating (hiking, camping, hunting) in the mountains. CTF symptoms include fever with headache and myalgia that can be easily confused with other more common infections (although more severe neurological or blood disorders can occur). TBRF is caused by the spirochetes *Borrelia hermsii*, *B. turicatae* and *B. parkeri* which are transmitted by the argasid (soft) ticks *Ornithodoros hermsi*, *O. turicata* and *O. parkeri*, respectively. Symptoms include cyclic fevers from recurring spirochetemia but are nonspecific and are easily mistaken for other illnesses. The northern states in our region are endemic for both *O. hermsi* and *O. parkeri*, existing at high elevations including national parks in our region (9). Humans are most often bitten by these ticks in rustic cabins and at mountain lakes in the spring and summer when their typical rodent hosts abandon their nests. In contrast, *O. turicata* is endemic to the more southern states in our region, preferring animal burrows and caves in drier habitats. Communities with limited access to care and fewer resources for rodent control are at risk of infection if soft ticks infest rodents within domestic or peridomestic environments. Current TBRF prevention measures recommend that soft tick infested structures be treated by pest control operators to remove both rodent nests and the ticks (10), but this can be expensive and some pest control operators only remove rodents, leaving ticks searching for hosts that may include

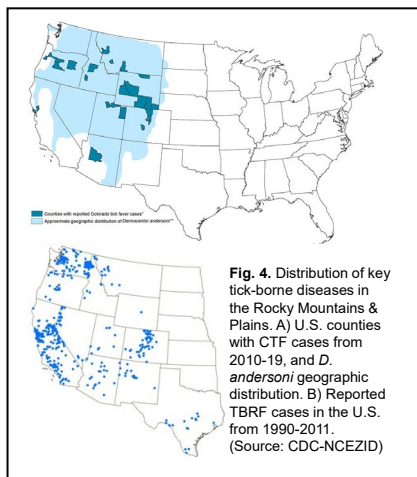


Fig. 4. Distribution of key tick-borne diseases in the Rocky Mountains & Plains. A) U.S. counties with CTF cases from 2010-19, and *D. andersoni* geographic distribution. B) Reported TBRF cases in the U.S. from 1990-2011. (Source: CDC-NCEZID)

humans. RMSF is a severe disease spread to humans and dogs by *D. andersoni* at high elevations, by *D. variabilis* which are now found in most Rocky Mountain states (11), and especially by the brown dog tick (*R. sanguineus* s.l.) that commonly feed on free-roaming dogs in communities such as some Native American reservations (12). All stages of brown dog ticks preferentially bite dogs (13), but humans are more likely to be bitten when temperatures are high (14). RMSF is fatal in 5-10% of cases without prompt treatment. It emerged as a serious health problem in the early 2000's in low income, rural border communities of Mexico; and on Native American reservations in the southwest (15, 16).

The most important flea-borne disease in the RaHP region is plague. Since the middle of the last century, most human plague cases in the US have clustered in the Rocky Mountain region and southwest. Since 1970, 70% (346/496) of all reported cases have come from rural and semi-rural areas in RaHP states (Fig. 5). The causative agent of plague is *Yersinia pestis* which circulates in our region in enzootic cycles between rodents and fleas. When epizootics occur, large die-offs of highly susceptible hosts such as prairie dogs and rock squirrels can occur, resulting in infected fleas feeding on domestic or commonly hunted animals (e.g. rabbits). Further, sick or dead rodents may be scavenged by dogs

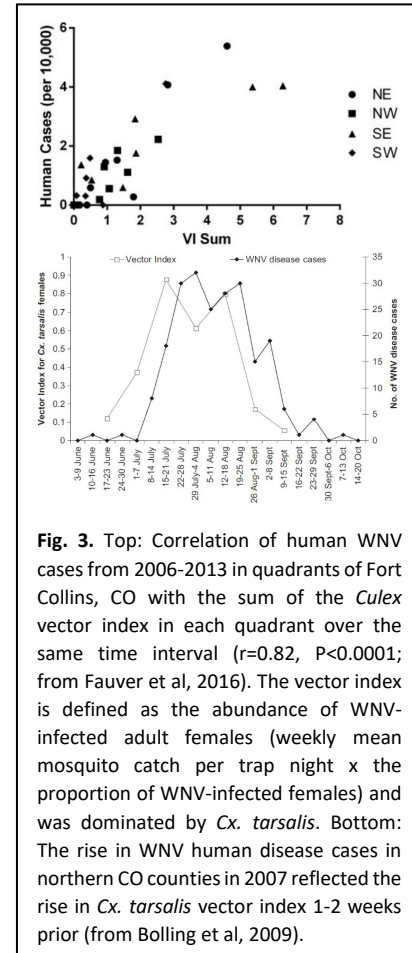
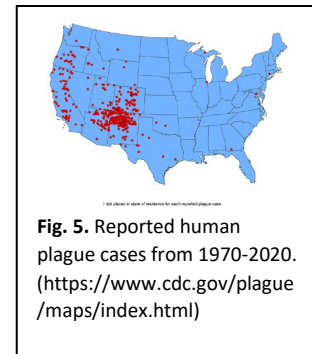


Fig. 3. Top: Correlation of human WNV cases from 2006-2013 in quadrants of Fort Collins, CO with the sum of the *Culex* vector index in each quadrant over the same time interval ($r=0.82$, $P<0.0001$; from Fauver et al, 2016). The vector index is defined as the abundance of WNV-infected adult females (weekly mean mosquito catch per trap night x the proportion of WNV-infected females) and was dominated by *Cx. tarsalis*. Bottom: The rise in WNV human disease cases in northern CO counties in 2007 reflected the rise in *Cx. tarsalis* vector index 1-2 weeks prior (from Bolling et al, 2009).

and cats. Human infections typically occur via flea bites, handling of infected animals, or respiratory droplets (17). Plague prevention revolves around personal protective measures, such as reducing rodent habitat around homes, preventing flea bites on humans, and limiting flea infestations of pets. Insecticide dusting of prairie dog colonies has been performed to dampen epizootic transmission and thus limit spillover to domestic animals (18).



Summary: WNV remains the most significant mosquito-borne pathogen in the US, and our region is one of highest-risk region for WNV in the US. Neuroinvasive disease occurs in about one out of every 150 people infected, and there are an estimated 30-70 cases of non-neuroinvasive disease for every neuroinvasive case (1). Therefore, based on our 2022 case count of 132 neuroinvasive cases, between 3960 and 9240 febrile cases of WNV should have been detected in Colorado in 2022, but only 74 were reported. There is clearly a bias toward reporting more serious cases, and underreporting of WNV disease affects risk perceptions, leading to apathy or antagonism towards control efforts. CO has some of the highest WNV incidence in the nation, yet there is only one large publicly funded mosquito control district (Grand River) which conducts operations along the CO river on the western slope. Communities in high-risk areas along the CO and WY Front Range either forgo surveillance and/or mitigation efforts or contract with private mosquito control companies (VDCI) and other public entities for control and surveillance. Moreover, vast portions of our region are grossly underserved with respect to WNV and other VBD surveillance, prevention, and control.

Despite the health burden of TBD, many are under reported or misdiagnosed, and publicly funded systems to control them do not exist. For example, misdiagnosis is prevalent in TBRF and training among laboratory staff to properly diagnosis it is rare in our region. A recent review of reported cases in CO by the CDPHE revealed that some medical facilities are also unaware that spirochetemia is pathognomonic for TBRF infection and are not reporting cases appropriately. Similarly, only a handful of CTF cases are reported each year but multiple lines of evidence suggest this is an underestimate of the true incidence, including a very high infection prevalence of CTFV in adult ticks when tested (19). However, relatively few laboratories test for the disease and when active enhanced surveillance of CTF was performed in one WY county in 2010, the 9 cases identified were more than the highest number of cases reported in any county or state in the previous 12 years (20, 21).

The lack of coordinated training and evaluation of VBD prevention and control in our region is deeply problematic because it leads to increasing health disparities, for example, between wealthy and populous Front Range communities that can afford WNV surveillance and control and low-income rural communities within the RaHP who cannot afford similar operations and that are that are comprised of a greater proportion of racial and ethnic minority groups. Fortunately, Utah does have a concentrated and coordinated network of mosquito abatement districts which can serve as a model for other programs within our region. Prevention and control efforts for TBDs and plague are rare in our region, and mostly left to personal protection guidelines and modest public education campaigns. There are no publicly funded control efforts for TBDs and plague in the RaHP region that we are aware of. Therefore, by developing regional partnerships, expanding training efforts and workshops among higher education students, public health and vector control professionals, and interfacing with vector control agencies and the

public in evaluation efforts, the RaHP has a unique opportunity to address both the lack of health equity in our region, improve overall health and enhance the VBD workforce in our region to deal with current and new VBD threats.

b. Approach

i. Purpose

The purpose of this project is to improve capacity in the RaHP region to prevent and control VBD through workforce development and training, evaluation of prevention and control methods, and expansion of our regional vector-borne disease professional network. These efforts will be coordinated through the establishment of the Rockies and High Plains Vector-borne diseases Center (RaHP VEC). Our region has historically been, and continues to be, an area of high risk for WNV disease as well as plague, TBRF, spotted fever group Rickettsioses and a variety of other vector-borne diseases. By formally coordinating academic institutional efforts to train students and professionals in methods to evaluate, prevent and control vector-borne diseases, with the applied VBD knowledge of public health agencies, vector control practitioners, physicians, and veterinarians we can improve control and prevention efforts at individual, local, state, and regional levels.

ii. Outcomes

In Training and Education, we expect to achieve in the short term:

- 1) **Improved and standardized VBD prevention and control training and education**, *through conducting surveys to RaHP VEC partners regarding VBD training, curricula, syllabi, etc. and needs assessment of skills for vector control and VBD agencies. These will then be used to develop and set core goals in training and education for students, public health professionals and vector control professionals that can be adopted by our regional partners and which we will monitor, evaluate and improve upon if our training goals are not met.*
- 2) **Increased number of VBD students and professionals trained in best practices**, *by initiating VBD training, certificates, fellowships for medical entomologists and public health students, continuing education credits for VBD prevention and control professionals, VBD workshops in current topics and communication strategies and mosquito control bootcamps for VBD students and professionals including travel stipends for attendance.*
- 3) **Increased awareness of VBD prevention and control among professionals and students of universities, colleges, and community colleges**, *by the training/education activities above in #2, initiating VBD webinars and developing our RaHP VEC website and other outreach platforms that communicates VBD issues across our region and connects our partners to each other and to the CDC and other CDC-funded entities.*

Intermediate outcomes in Training and Education include:

- 1) **Improved quality training and education that recognizes and reflects the diversity of the communities we are trying to reach**, *which will be via outreach to students/faculty/local public health agencies (LPHAs) in underserved/underfunded areas at high risk for WNV and other VBDs (e.g. rural communities with tribal communities), and include supplying internships and fellowships to students attending*

colleges/community colleges in these communities and providing them stipends to attend training events, conducting some training in Spanish where appropriate (via the efforts of Dr. Karla Saavedra-Rodriguez), and facilitating WNV surveillance for current entomological risk assessments in these communities.

- 2) **Improved understanding of risk, prevention, and control of VBDs among the VBD workforce**, *which will occur through the implementation of activities above and the Strategies/Activities section and achievement of outcomes #1-4.*

In Evaluation and Partnerships, we expect to achieve in the short term:

- 1) **New and improved vector control programs, tools and strategies evaluated at state and local agencies**, *through evaluation of the operational use of approved WNV control tools and strategies and through the implementation of integrated WNV surveillance, insecticide resistance (IR) monitoring and management, and Culex spp. vector control. Also, through evaluation of entomological outcomes of professionally administered larvicide and adulticide applications targeting WNV vectors.*
- 2) **New/stronger collaboration activities between universities and college community with federal, state, and local agencies**, *because the evaluations conducted in #6 will mostly be performed by embedded student interns and fellows from regional universities and colleges trained by our experts at RaHP VEC in conjunction with other professionals in our region, those at the CDC nearby by Training and Evaluation centers and the CDC-funded PacVec.*
- 3) **Increased number of VBD prevention and control resources are evaluated by VBD professionals**, *through the combined work of our students, interns, fellows and RaHP experts working with LPHAs and local vector control professionals to facilitate culture of continual improvement, re-evaluation and re-assessment in vector/vector-borne disease prevention and control efforts.*

All of which would facilitate the Intermediate outcome of 1) **Increased adoption and use of new and existing vector control tools, strategies, and programs developed or facilitated by the RaHP VEC in our region.**

Over the long term, we expect the combination of these activities and outcomes will facilitate 1) **A strengthened public health workforce in the RaHP region with knowledge and capacity of VBD control and prevention**, and 2) **Reduced transmission of VBD pathogens to humans living in the RaHP region.**

iii. Strategies and Activities

Strategy 1. TRAIN - Increase opportunities for students and professionals to receive training in vector-borne disease (VBD) prevention and control. In the event of an emerging VBD threat, all Training activities below would be re-oriented to rapidly gain information about what our partners and trainees currently know about the threat, and to quickly educate and prepare them for how to surveil, prevent and control it.

TRAIN/Activity 1. Conduct training and educational needs assessments for VBD prevention and control professionals and students to develop and maintain readiness across the existing VBD workforce.

TRAIN/Activity 1.a. *Development and deployment of surveys and other materials needed to evaluate current VBD training and curricula being used by VBD prevention and control professionals as well as assess needs, capacity, and limitations:* CDPHE with SLCMAD will develop and distribute surveys to public (local public health and environmental health partners), private vector control organizations, Tribal Nations, as well as academic programs that train students in VBD.

TRAIN/Activity 1.b. *Survey local stakeholders, including public health agencies and private sector vector-borne disease partners to compile a list of skills that are desirable in entry-level professionals in their respective fields:* CDPHE will survey regional VBD prevention and control agencies, including public health departments, environmental health scientists, as well as private agencies, to assess desirable skills for entry-level professionals. This survey will focus on applied knowledge and technical skill sets essential to public health VBD surveillance, prevention, and control.

TRAIN/Activity 1.c. *Survey and evaluate courses/syllabi (or any certificate trainings/courses), offered in the region by universities and colleges that teach about vectors, VBD and vector-borne pathogens biology and control:* CSU, TTU and CDPHE investigators will identify, collate, and evaluate curricula that are used to educate university and college students, including public health students, about VBDs in the first year of this grant period.

TRAIN/Activity 2. Define training and education goals for VBD prevention and control programs. *Develop training and education goals developed from surveys and assessments in Strategy 1/Activity 1 and determine core training and education goals for VBD prevention and control programs:* Based on surveys and assessments from Activity 1, we will perform a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of current training and education about VBD prevention and control being performed in the region and identify training and education goals including goals for VBD professionals working in state and local government.

TRAIN/Activity 3. Train undergraduates, graduate students, or post-doctoral fellows, such as those involved in the fields of human or veterinary medicine, entomology, vector control, public health, and environmental health, to strengthen the workforce of prepared VBD prevention and control professionals.

TRAIN/Activity 3.a. *Develop a VBD training program or certificate for students/postdocs at CSU and TTU from the current and adapted curricula:* We will institute transcribed certificate training programs at both CSU and TTU that are accessible to undergraduate, graduate, and postdoctoral level trainees. Once established, we envision broader roll-out of these programs to other academic institutions, as well as offering online opportunities to continuing education credits. Our overarching goal is to engage and train future leaders in academic, county, state, and federal positions in the biology, surveillance and control of vectors and VBD.

TRAIN/Activity 3.b. *Engage RaHP VEC partners by hosting zoonoses disease-surveillance webinars:* CDPHE will expand their current web-based library of training webinars on a variety of communicable disease topics to include medical entomology and WNV/VBD control and prevention and advertised to non-public health agencies as well as agencies in partner states.

TRAIN/Activity 3.c. *Host professional degree (DVM, MD, NP) and One Health MPH students for practical public health experience and mentorships:* We will host and mentor veterinary, medical, and public health trainees as well as CDC Epidemic Intelligence Officers, CSTE Applied Epidemiology Fellows, and regional medical residents to provide them practical

experience as well as support for practicums, for summer rotations/scholarships, and capstone coursework and to provide mentorship and information regarding VBD prevention and control.

TRAIN/Activity 4. Train and educate VBD prevention and control professionals, such as those involved in the fields of human or veterinary medicine, entomology, vector control, public health, and environmental health.

TRAIN/Activity 4.a. Institute continuing education (CE) credits for VBD prevention and control training into the CDPHE's annual One Health Conference: We will expand upon our existing state-wide One Health conference which already provides veterinary continuing education credits and begin offering credits toward other professional licenses and certificates. The goal is to leverage our the conference to expand training efforts in our region, especially for VBD prevention and control professionals, and to provide these professionals with credit offering that will build their careers more oriented towards VBD awareness.

TRAIN/Activity 4.b. Host yearly VBD workshops at the WCMVCA annual conference & CSU and yearly mosquito control training at SLCMAD: The RaHP VEC will host an annual workshop connected to the annual WCMVCA annual conference on current/hot VBD topics for our region (e.g. invasive vectors, re-emerging arboviruses like SLEV, new approved control methods, etc.) and bi-annual conferences at CSU that will be either in Fort Collins or our Mountain campus that will be more hands-on training, including tick and mosquito ID workshops. Additionally, SLCMAD will host a yearly week-long mosquito abatement 'bootcamp'.

TRAIN/Activity 5. Develop and implement an evaluation and performance monitoring/improvement plan to evaluate the impact of training programs and ensure training goals are accomplished. *Develop pedagogy-based evaluation metrics for all TRAIN programs:* We will develop pre and post surveys based on the training and education goals developed in Activity in VBD prevention and control as it relates to our training activities.

TRAIN/Activity 6. Support fellowships focused on medical entomology and the prevention and control of VBDs. *Develop a graduate fellowship program:* To ensure the success of VBD graduate trainees (graduate students and postdocs), we will support RaHP VEC VBD graduate fellowships at partner institutions.

Strategy 2: EVALUATE - Evaluate the impact and effectiveness of VBD prevention and control tools, strategies, and programs. In the event of an emerging VBD threat, all Evaluate activities below would be rapidly re-oriented to assess ours and our partners abilities to potentially prevent or control the threat, and to support them to quickly deploy these countermeasures including developing and implementing a surveillance system, and evaluation metrics to assess the control efficacy.

EVALUATE/Activity 1. Evaluate the operational use of approved VBD prevention and control tools, strategies, and programs. *Evaluate the operational use of approved larvicides and adulticides from publicly funded or commercial programs performing WNV control in the RaHP region:* Following stakeholder meetings over the region we will compile a report on the current state of VBD control and prevention in the region, determine strategies for improvement, and initiate a process of evaluating the surveillance, larvicide and adulticide protocols at a mosquito control district in Colorado. The short-term goals are to perform at least one successful

evaluation and use the process to hone our evaluation methods, write clear guidelines for future evaluations and learn and understand the choices and pressures the mosquito control districts/organizations have. The intermediate goal is to perform similar evaluations in several other districts/organizations. Long term goals are to foster common best practice procedures among districts based on regular internal or external evaluations and guidelines.

EVALUATE/Activity 2. Implement/evaluate vector or VBD surveillance tools/programs.

EVALUATE/Activity 2.a. *Evaluate and support the successful integration of WNV entomological surveillance, IR management, and vector control for Culex spp. mosquitoes:* The RaHP VEC will evaluate and enhance the prevalence and utility of action thresholds (Minimal Infection Rate (MIR), Vector Index (VI)) for WNV disease prevention in our region. Our *short-term goals* are to 1) identify stake holder needs for vector control programs that facilitate or hinder the adoption of infection-based action thresholds, and 2) educate and train programs on deriving and implementing action thresholds for specific control objectives. Our *intermediate goals* are to 1) evaluate the need for IR surveillance and how IR information alters action thresholds and informs the implementation of future interventions, 2) implement IR surveillance in participating programs, and 3) facilitate surveillance and IR data linkages to VectorSurv to aid adoption and implementation of infection-based action thresholds. Our *long-term goal* is to develop best practices guides for vector control action thresholds that synthesize the goals- and funding-based needs of participating communities and programs.

EVALUATE/Activity 2.b. *Implement active WNV mosquito surveillance in underserved and underfunded high-risk areas in our region:* Entomological surveillance for WNV in the RaHP VEC region concentrates in the wealthier and more populous metropolitan areas. To address this important public health surveillance gap, we will establish mosquito infection and resistance surveillance activities in two underserved, yet vital economic corridors in the region.

Our *short-term goals* are to establish partnerships with local LPHAs and community colleges in each corridor to develop seasonal surveillance internship programs. Our *intermediate goals* are to build base line surveillance information in these economic regions to evaluate how risk factors of WNV derived from urban surveillance programs apply to underserved and more agrarian communities in the RaHP region. Our *long-term goal* is to equip local partners with the tools, training, and agency connections necessary to sustain surveillance programs. A key objective of this long-term goal is to build a scaffold model of academic, public health, and vector control professionals that can replicate these surveillance activities in areas outside of the corridors of focus.

EVALUATE/Activity 3. Evaluate meaningful outcomes of commercially available products when applied by the intended end users.

Evaluate entomological outcomes of larviciding and adulticiding for control of WNV vectors: We will evaluate and enhance entomological impacts of WNV control strategies. Our *short-term goals* are to partner with, and train vector control professionals interested in designing efficacy trials or using existing/historical data to evaluate pre- and post-intervention metrics. Our *intermediate goals* are to 1) demonstrate measurable reductions in larval and adult control of *Culex* spp. mosquitoes, and 2) provide relevant, applied vector control training and experience for undergraduate and graduate level students. Our *long-term goals* are to improve epi-impacts of vector control for WNV risk prevention.

EVALUATE/Activity 4. Evaluate health communication activities and products implemented at state, local, territorial, and Tribal levels; health communication messages

should be coordinated with CDC technical advisors to ensure consistency with CDC messaging. *Evaluate health communication for WNV surveillance and control activities in the RaHP:* We will assess health communication activities being performed by CDC, CDPHE, and local health department and city entities in Colorado regarding WNV. We will assess the efficacy of these communications for diverse audiences, including those in underserved areas or individuals/groups who are especially vulnerable to VBDs.

Strategy 3: PARTNER - Build partnerships among relevant stakeholders to accomplish the activities proposed in Strategies 1 and 2. In the event of an emerging VBD threat, we would rapidly build partnerships with public health associations whose jurisdictions are most impacted by the threat and with vector/VBD control professionals in the region and the nation who may have unique abilities to better prevent and control the threat.

PARTNER/Activity 1. Establish collaborative partnerships in VBD prevention and control, involving relevant partners needed to develop and implement training and evaluation activities: The core of RaHP VEC is an assemblage of two universities, a state public health department and a large urban mosquito abatement district. This group will further partner with other regional universities and colleges, local public health programs and public/private vector/VBD control agencies for evaluation and training activities and collaborate with public health partners in neighboring states to expand and support VBD prevention and control efforts.

PARTNER/Activity 2. Embed graduate, undergraduate, associate degree students, or fellows in vector control organizations or state, Tribal, territorial, city, or county health departments: The RaHP VEC will create internship program to fund undergraduate and MS-MPH students from regional universities, colleges, and community colleges to work in 3-month paid internships each year at different schools, vector control agencies or state/local PHAs.

Collaborations

The RaHP VEC will collaborate/coordinate with several other CDC projects and CDC-funded organizations as well as those outside of the CDC. The CDPHE has their own CDC-funded projects including a grant from the ELC program, and a WNV capacity building grant. Dr. Foy has long been working with partners at the CDC-DVBD to develop and test endectocide-treated bird feed for WNV control and is collaborating with the Arboviral Diseases Branch, Ecology and Entomology Team members to register the product we are developing as an Investigational New Animal Drug with the FDA. We have a Letter of Support (LOS) from the Pacific Southwest Center of Excellence in Vector-Borne Diseases (PacVec) and hope to collaborate with them in developing best practices in Training and Evaluation of WNV control specifically in the western US and uploading our data into the CDC-funded VectorSurv. We also have a LOS from the Vector-Borne Disease Training and Evaluation Center – South-Central (VBD TECS) group that also hopes to gain funding from this proposal. We expect that RaHP VEC, VBD TECS, PacVec and others could form a cross-center working group to address issues common to our collective fight against VBDs.

Outside of the CDC and these CDC-funded entities, we will coordinate with regional universities, colleges and community colleges, and even internal university institutes from which we will choose many students for our internship program and pair and learn from other VBD experts in these organizations, including Metro State University, South Plains College, CSU's

One Health Institute, and others. We also will collaborate with the WCMVCA to leverage their annual meeting with our workshops, and with the Wyoming Mosquito Management Association (WMMA), Vector Disease Control International (VDCI), the City of Fort Collins, City of Lubbock, and others for evaluations and training. We fully expect these collaborations to grow and change over the life of the RaHP VEC.

1. Target Populations and Health Disparities

Health equity issues are addressed in all RaHP VEC projects. We have many underrepresented minorities and lower socioeconomic group in our region who are most at-risk of disease. Drs. Hemming-Schroeder, Kelp, Saavedra-Rodriguez and the program manager will gather data streams including social determinants data in our Training and Evaluation activities, so they impact the most affected populations in our region and we have a Data Management Plan in place for this. The internship program will focus training on under-represented students from regional universities and colleges including HACUs and Tribal Nation associated colleges. We will work to evaluate WNV prevention and control efforts in socioeconomically disadvantaged small rural agricultural towns on the High Plains who often have large populations of migrant workers and racially diverse populaces, and Tribal Nation lands.

c. Applicant Evaluation and Performance Measurement Plan

To ensure the RaHP VEC achieves the short, intermediate, and long-term outcomes of the proposal as well as works with CDC in a timely manner to identify successes, future directions, and areas for improvement in the RaHP VEC, a board consisting of the PIs at each core-funded institution (Foy-CSU, Marzec-CDPHE, McMillan-TTU and Faraji-SLCMAD), the program manager, and two colleagues from non-member institutions will develop and implement an Evaluation and Performance Measurement Plan (EPMP) specific to the activity. The EPM board will work with the relevant activity PIs to evaluate achievements, build communication strategies of results that connect to target demographics, and identify areas for improvement and strengthening within the activity. Where activity evaluations involve a EPM board member, that board member will recuse themselves and ultimate review decisions will be made by the two non- member institution representatives.

All evaluations and updates will use a similar format: Annually, the program manager will collate information from RaHP VEC quarterly updates to the CDC, and a self-assessment form will be sent to the activity PIs. This self-assessment form will request numeric info relevant to the activity (e.g., number of workshops and enrollments), summary of achieved goals, and revised timeline of project progress. The EPM board will then review all assessments, ranking progress from Satisfactory to Unsatisfactory; these rankings will be communicated to the PIs through either F2F or teleconference meetings. Satisfactory rankings generally entail PIs are amassing appropriate evidence, are following the work plan, and are on target to complete their objectives. Unsatisfactory rankings mean the Activity is deficient in one or more areas. Though all future funding of Activities depends on available funds and the emergence of new priorities within the RaHP region, it is the expectation that Satisfactory rankings will continue as planned while Unsatisfactory rankings will enter a two-quarter trial period to present an actionable plan of correction to the EMP Board. Where and when needed – either based on results or emerging needs in the region – the EPM board will also consult with non-member institutions to incorporate VBD priorities into the RaHP VEC.

The scope of our EPMP will necessitate review by the CDC Office of Management and Budget and a Data Management Plan that we have already generated, and which will be initiated and implemented by the program manager working under the supervision of Drs. Hemming-Schroeder and Kelp and staff at CDPHE. The DMP entails requirements to manage the collection and generation of public health data, ensuring data quality, providing timely access to, and archival/long-term preservation of collected and generated data. The data to be collected include; social determinants of health, training and education needs assessments, ongoing VBD prevention activities, vector infection and data records, landscape/environmental data, and performance and evaluation data. The DMP further details standards and formats and metadata, access and sharing plans, an archiving plan, roles and responsibilities and a translation(dissemination) plan.

For Training and Education activities, the EMP board, activity PIs, and CDC will evaluate performance measures within each of the core outcomes as follows:

- 1) **Improved and standardized VBD prevention and control training and education.** Primary metrics of evaluation include number of surveys distributed, number of respondents as well as demographics of respondents, number and types of core training needs identified for academic and professional training, enrollment/retention/educational records for fellows and interns, number of workshops created/presented with accompanying participant information. In YR1, RaHP VEC leadership will also work with PIs to develop timelines of goal implementation using Train Strategies 1-3 results. Success of these goals will be evaluated as described above based on improvements and/or changes in responses post-implementation in YR2-5
- 2) **Increased number of VBD students and professionals trained in best practices.** Primary metrics of evaluation include number of students enrolled, number of certificates and CEs awarded, number of students matriculating, number of interns, and number of students employed in a VDB career as well as the type of career. RaHP VEC expects to see growth in these categories from YR1-3 with matriculation and employment goals assessed in YRS 3-5.
- 3) **Increased awareness of VBD prevention and control among professionals and students at universities, colleges, and community colleges.** Primary metrics include changes in hiring criteria/needs of VBD staff determined through Goal 1, number of active users of messaging campaigns (i.e., click counting), number of reformat of LPHA websites to list VBD prevention information, change in stakeholder values from Activity 1-5 follow up evaluations, number and type of workshops performed with relevant attendee data, adoption of VBD training criteria in universities. In YR1, RaHP VEC leadership will work with PIs to develop timelines of goal implementation using Train Strategies 1-3 results. Success of these goals will be evaluated as described above based on improvements and/or changes in responses post-implementation in YR2-5
- 4) **Improved quality training and education that recognizes and reflects the diversity of the communities we are trying to reach.** Primary metrics include those listed for Outcome 2 as well as relevant information obtained through instructor course evaluations, grade distributions, dual enrollment rates from community colleges to TTU/CSU, number of training tools employed by partner institutions. In YR1, the EPM board will identify training needs from all Training Activities in YR1 which will be implemented throughout YR2-5. Success of these identified needs for training will then be evaluated as listed for Goals 1 – 3.

- 5) **Improved understanding of risk, prevention, and control of VBDs among the VBD workforce** Primary metrics include those of Outcome 1 – 3 as well as number of professionals engaged in training, number of training tools made available, and variety of training tools developed. RaHP VEC expects development and deployment of training tools in YR1-2 and increased engagement with training in YR2-5.

For evaluation activities, the EMP board, PIs, and CDC will evaluate performance measures within each of the core outcomes as follows:

- 1) **New and improved vector control programs, tools and strategies evaluated at state and local agencies.** Primary metrics of evaluation include changes in entomological indexes and WNV prevalence before and after deployment of novel tools or improved VBD control strategies. Surveys will be conducted among LPHA's and vector control agencies in YR1-5 to assess which VBD control tools and strategies were used, entomological surveillance data, perception of results and/or main implementation barriers. This information will be entered into a database on the RaHP VEC website. We will track the participation of VBD experts, LPHAs and vector control agencies in case-discussion and assessments to improve VBD strategies.
- 2) **New/stronger collaboration activities between universities and college community with federal, state, and local agencies.** Primary assessment criteria include changes in the number of collaborative interactions between the LPHAs, vector control agencies and Universities/Community colleges. From YR2-5, surveys will be done to screen the number of collaboration interactions (personal, email, phone calls, chat) covering operational trainings, evaluation design/ analysis consulting, etc. Every year, we expect that each agency will develop one area of partnership with universities and community colleges.
- 3) **Increased number of VBD prevention and control resources are evaluated by VBD professionals.** Primary metrics include changes in the number of curated resources available for vector control agencies and local LPHAs, Universities/Community Colleges. Our goal is to create a VBD expert committee to discuss and assess the content of these resources in YR1-5. The evaluation reviews and modifications will be kept on the RaHP VEC website.
- 4) **Increased adoption and use of new and existing vector control tools, strategies, and programs developed or facilitated by the RaHP VEC in our region.** Primary metrics of evaluation involve changes in implementation of new VBD prevention and control tools/strategies. Surveys in YR2-5 will assess which new evaluation tools and strategies are used, perception of results and/or main implementation barriers. Our goal is that vector control programs apply a new evaluation strategy at least once during YR2-5 in collaboration with RaHP VEC. Adoption or recommendation of new tools or strategies will be intensively discussed with the CDC and RaHP VEC partners.

d. Organizational Capacity of Applicants to Implement the Approach

The core institutions of the RaHP VEC make up some of the leading institutions of higher learning with specific expertise in vector biology and VBD (CSU/TTU), of VBD prevention, control, and health promotion (CDPHE), and of mosquito/vector abatement expertise (SLCMAD) in the Rockies and High Plains region. Each institution is uniquely positioned in the region to achieve the outcomes of this proposal. The investigators at these institutions have worked over decades in their respective specialties, and all are considered leaders or rising stars

in their fields (see attached biosketches/cv's). We are already well-integrated with each other as colleagues who have attended meetings/workshops together, and sometimes worked on common projects and published with each other. Together we have the experience and contacts to engage the region's other partners and collaborators to form a strong network of professionals in teaching, public health, and vector control, as well as to link to national professionals in these same areas (e.g. CDC, PacVec and other Center of Excellence colleagues). Our institutions together bring in and responsibly manage hundreds of millions of dollars in federal, state and local and private foundation grants and contracts from many sources and are well equipped to manage staffing, financial reporting, communication and data systems needed for the success of this project.

Work Plan

TRAIN/Activity 1.a-c. (Roundy, Marzec, Foy, Faraji, Brelsfoard) State health department partners within the region will meet with CDPHE to determine how best to approach surveying their jurisdictions. Surveys will address the ability to meet current VBD surveillance and control needs, limitations, and challenges to expansion. Specific topics will include existing WNV surveillance and control, IR testing, and identification of novel vectors and diseases. In addition to surveying existing VBD prevention and control programs, surveys will be distributed to counties and Tribal Nations without such programs to assess barriers to adoption of integrated pest management strategies. The CDPHE will also survey local VBD prevention and control agencies in the region, including public health departments, environmental health scientists, as well as private agencies, to assess desirable skills for entry-level professionals. This survey will focus on applied knowledge and technical skill sets essential to public health VBD surveillance, prevention, and control. CDPHE will also work with neighboring states to distribute this survey to additional partners. The feedback gathered in these surveys will be used to inform the goals in the other training activities described (e.g. data will be used to assess current vector-borne disease curricula at regional universities and colleges for the undergraduate, graduate, and professional levels in TRAIN/Activities 2 & 3). Finally, TTU investigators will partner with CDPHE investigators to identify, collate, and evaluate curricula that are used to educate university and college students, including public health students, about VBDs in the first year of this grant period. The focus will be broad, meant to identify class/training sections that teach about vectors, VBD and vector-borne pathogens, including their biology, epidemiology, ecology, and methods for surveillance and control including understanding pesticide modes of action, toxicity, application, IPM, as well as public health prevention efforts such as communication and policies, environmental management, drug treatments and vaccines. The end goal is to work with vector control professional partners (investigators at SLCMAD and our partner organizations including WCMVCA, WMMA, and VDCI) in a taskforce to identify curriculum gaps/regions/online certificates they would like to see addressed to strengthen the professional vector/VBD control workforce. In subsequent years, this work will be expanded to public health schools in partner states as well as medical, veterinary medical, nursing and other professional training programs to identify curriculum gaps/regions/online certificates they would like to see addressed to strengthen the professional public health workforce.

TRAIN/Activity 2. (*Kelp, Hemming-Schroeder, Roundy, Marzec*) Nicole Kelp and Elizabeth Hemming-Schroeder will collaborate with CDPHE, building on their surveys and assessments from Activity 1. Kelp and Hemming-Schroeder will perform a SWOT analysis of current training and education about VBD prevention and control being performed in the region and identify training and education goals. In addition to biology, surveillance and control of VBDs, basic health and risk communication related goals will be included considering the SWOT findings from Activity 1. Additionally, based on the surveys and stakeholder meetings held as part of Activity 1, we will develop a set of training goals for VBD professionals working in state and local government. These goals are likely to include an understanding of disease surveillance both in humans and vectors, epidemiologic principles of disease surveillance, prevention methods and effective risk communication. Draft goals will be shared with RaHP VEC investigators and partners for discussion, feedback, and improvement prior to finalizing goals and uploading to the project database and website. This work will be completed within two months of the completion of Activity 1.

TRAIN/Activity 3.a-c. (*Kading, Marzec, Foy, Brelsfoard*) Certificate Programs in VBD at CSU and TTU will be developed to aid in the training of the next generation of the vector biology workforce and provide a bridge between academia and public health and vector control agencies for recruitment of this workforce. To meet this educational and training need, parallel certificates will be developed at each institution during Year 1, and advertised throughout the undergraduate and graduate programs, including to

underrepresented students (United in STEM, MURALS program students, MIP capstone students, MARC students, and McNair Scholars). Curricular alignment across institutions will focus on the below subject areas and course offerings at CSU and TTU (Table 1), from which students would choose two core classes. To meet this educational and training need, parallel certificates will be developed at each institution during Year 1, and advertised throughout the undergraduate and graduate programs, including to underrepresented students (United in STEM, MURALS program students, MIP capstone students, MARC students, and McNair Scholars). Curricular alignment across institutions will focus on the below subject areas and course offerings at CSU and TTU (Table 1), from which students would choose two core classes and two elective classes for a minimum of 12 credits. Classes will be offered as synchronous face-to-face and/or as asynchronous online delivery formats to accommodate as many students as possible. To enhance student learning experiences and networking between CSU and TTU, a team-teaching

Table 1. Curriculum for Proposed Certificate in Vector-Borne Diseases		
Course/topic area*	CSU course options	TTU course options
General / Introductory Entomology	BSPM302 or BSPM303A	PSS2401
Vector Biology / Medical Entomology*	MIP462 (undergraduate) or MIP563 (graduate)	BIOL6301, BIOL5313
Integrated Pest Management	BSPM451	PSS4305
Toxicology / Pesticides	EHR502	PSS5307
Virology	MIP420 (undergraduate) or MIP530 (graduate)	BIOL 6311
Emerging Infectious Diseases / Epidemiology*	MIP533	BIOL6301 or BIOL4301
Taxonomy and identification	MIP535	BIOL4321
*proposed core topic area		

model will be initiated in YR 2 whereby entomology faculty at each institution will provide guest lectures in courses at the partner institution. Elective course options beyond the two core areas offer students the opportunity to tailor their certificate towards a more operational vector control position or virology and infectious diseases. Our vision is that once this model program is established at CSU and TTU, it can be expanded to include other partners in our Center.

The CDPHE training webinars will be expanded to include other aspects of VBD control and prevention and advertised to non-public health agencies as well as agencies in partner states. A CDPHE administrative coordinator will schedule, record and manage this library of webinars.

Mentoring of veterinary, medical, and public health trainees will provide practical experience as well as support for practicum and capstone coursework. CDPHE staff host CDC Epidemic Intelligence Officers, CSTE Applied Epidemiology Fellows, and University of Colorado medical residents on a regular basis. CDPHE staff will coordinate with these, and other trainees, including CSU veterinary medical students, to provide mentorship and information regarding VBD work. CDPHE staff will host at least one trainee per year to provide practical public health experience, with additional trainees receiving mentorship and guidance outside of formal internships, capstones and rotations. A CDPHE administrative coordinator will assist in scheduling and logistics of these rotations and meetings.

Drs. Kading and Foy have been regular participants as mentors for the CSU Veterinary Summer Scholars Program and have hosted two summer scholars each to date. Veterinary students accepted into this program are fully funded to gain 10 weeks of summer research experience in a mentor's laboratory, which for us focuses on VBD training and research projects. At the end of the program, summer scholars participate in a symposium to present their work to their cohort and the campus community. This program has been a valuable cross-disciplinary training program and opportunity for veterinary students to gain laboratory experience and enhance their skills in bench science, experimental design, and diagnostics. As part of our Center, the VSSP program represents one mechanism to engage veterinary students in Center research and training activities. Dr. Foy is also an adjunct faculty in the Colorado School of Public Health, Department of Epidemiology and in this role, he brings MPH students into his lab for capstone projects focused on VBD. He is currently hosting two MPH students in their capstone projects and has previously mentored one other MPH student in their capstone. MPH capstone projects that provide VBD training for these professional students will be further supported by the Center.

TRAIN/Activity 4.a-b. (Program Manager, Marzec Foy, Faraji) The CDPHE's One Health conference has offered veterinary medical CE credit in the past. CDPHE will work to add CE for medical professionals, potentially environmental health professionals and other professional groups as well. We will reach out to the Colorado Environmental Health Association, WCMCVA, state licensing boards and other groups to determine how to proceed.

WCMCVA workshops will focus on current events in VBD for our region (invasive vectors, tick ID, re-emerging arboviruses (e.g. SLEV), new approved control methods, etc.). CSU bi-annual workshop will be didactic + hands on (e.g. Tick ID). SLCMAD boot camp in VBD control. All these Activities will begin in YR1.

TRAIN/Activity 5. (Kelp, Hemming-Schroeder) Nicole Kelp, who performs research on STEM education outcomes, will collaborate with CSU STEM Center and other resources for pedagogical evaluation. Pre and post surveys aligned to training goals will be administered

congruent with each training activity to evaluate gains in trainee knowledge, communication skills, and self-efficacy in VBD prevention and control. We will identify milestones and desired learning gains for students in knowledge, skills, and confidence. If learning gains are not being met, we will coordinate with instructors to provide feedback and adjustments. Different evaluations will be developed for university students, VBD professionals, and other learners. Evaluations will ensure we are meeting training/education goals as per Train/Activity 2.

TRAIN/Activity 6. (Kading, Foy, Brelsfoard, McMillan) We will promote these graduate fellowships on our RaHP VEC website and distribute emails, flyers/notices to LPHAs, vector control professional orgs, regional universities, and colleges for posting and links to the application. We will ensure diversity, equity, and inclusion in awarding fellowships and to increase opportunities, individuals will not be able to receive the fellowship for longer than two consecutive years. CSU will award two fellows each year, one who will work with the program manager and Dr. Kelp in VBD communication efforts and the other with Dr. Saavedra-Rodriguez in regional IR training and evaluations. CDPHE will award one PhD-level fellow per year who will receive practical training in vector surveillance and control strategies, vector identification, and public communication. TTU will award one PhD-level who will focus on evaluating integrated vector control measures for *Culex* spp. and WNV risk prevention, and one MS-level fellow who will be trained in vector control applications and evaluations.

EVALUATE/Activity 1. (Faraji, Roundy, Foy, Saavedra-Rodriguez, McMillan, Brelsfoard). VBD prevention and control strategies are currently being determined through stakeholder meetings with local Colorado jurisdictions. Determinations will be compiled into a report on the current state of VBD control and prevention in CO and shared with other partners to determine strategies for improvement. After year one, Drs. Foy, Ebel, McMillan and Brelsfoard, and student interns/fellows will assist Dr. Faraji, SLCMAD staff, and Dr. Roundy in evaluating surveillance, larvicide and adulticide protocols at one CO mosquito control district that will be selected via stakeholder meetings. Initial efforts will focus on implementation schedules, permits (e.g. pesticide applicators license, pesticide discharge management plan), guidelines for pesticide application timing, environmental regulation, personal protective equipment, reporting documents, and insecticide choice. Next, we will evaluate surveillance activities (trap placement, sorting, vector ID) and of the efficacy of the test substances used for mosquito control. Evaluations will use standardized protocols maintained at SLCMAD that can be implemented elsewhere. Examples include IR evaluation using CDC bottle bioassays wind tunnel assays to evaluate failure risk of adulticide products against field specimens, and operational comparison to entomological indices obtained from traps placed in treatment and control regions (minimum of 3 each). Analysis of data will include standard formulas such as Mulla's formula, relative to more sophisticated analyses including Before-After Control Impact and Mixed model regression techniques. The short-term goals are to perform at least one successful evaluation and use the process to hone our evaluation methods, write clear guidelines for future evaluations and learn and understand the choices and pressures the mosquito control districts have. The intermediate goal is to perform similar evaluations in several other districts. Long term goals are to foster common best practice procedures among districts based on regular internal or external evaluations and guidelines.

EVALUATE/Activity 2.a-b. (Ebel, Foy, Saavedra-Rodriguez, McMillan, Brelsfoard, Faraji, Kelp) For WNV risk reduction, best practices recommend utilizing an infection-based metric such as an MIR or Vector Index. Despite important WNV surveillance coverage within main population centers, the outlying suburbs and satellite towns often lack operational surveillance programs despite higher reported incidence of mosquito and human infections reported through local public health offices. This uneven coverage is a weakness in the regional understanding, control, and prevention of WNV incidence in humans, and makes it impossible to use infection-based metrics for decision support. Where infection-based action thresholds are utilized by member programs in the RaHP VEC region, thresholds can vary locally due to the underlying local eco-epidemiology of WNV. The driving needs of vector control can also vary among programs, such that the need for infection-based action thresholds varies within a season or are not considered relevant to different control objectives.

To achieve our short-term goal of developing partnerships for surveillance we will work through community organizations and LPHAs and community colleges in each corridor to define regional vector control needs, attitudes towards action thresholds, and identify areas where action thresholds would be beneficial. Training groups including seasonal surveillance internships will be established through Training Activities 1 and 2 in YR1. Opportunities for viral testing will be coordinated through regional testing facilities with ELC funding. Lab capacity training for interested support staff will be achieved through Activity 4. RaHP VEC members will help train and outfit these units through Train/Activity 1 and 2 and Partner/Activity 2.

To achieve our intermediate goal of defining the degree to which ‘urban’ derived WNV action thresholds may be useful in rural/tribal regions, we will build baseline surveillance data in two underserved economic regions to evaluate how risk factors of WNV derived from urban surveillance programs might apply to underserved and more agrarian communities. In Colorado, we will work to expand and support WNV surveillance in the South Platte River basin running from Fort Collins/Berthoud/Loveland to Fort Morgan, representing a gradient from predominately white and high median income households in the west, to rural, predominately Hispanic or mixed race and low median income households in the east. In Texas, we will focus on the I-27 corridor from urban Lubbock to moderately urban Amarillo, TX, with small rural towns in between. Disease surveillance efforts in each region have identified risk levels of WNV up to 5x higher in the more rural/lower elevation/lower income regions versus the urban centers. We will integrate concepts of Evaluation/Activity 3 in this region where cities or counties (such as Amarillo, TX) operate seasonal mosquito control programs yet lack a surveillance program. Our long-term goal is to equip local partners with the tools, training, and agency connections necessary to sustain surveillance programs. A key objective of this long-term goal is to build a scaffold model of academic, public health, and vector control professionals that can replicate these surveillance activities in areas outside of the sentinel corridors. Initial target areas are along the N. Platte River in WY and the San Juan River in southwest CO/northwest NM in tribal nation lands.

We also plan to incorporate IR testing into this objective to evaluate the likelihood that commonly used pesticides will fail given the likely higher agricultural use of pesticides outside of the major population centers in the RaHP region. IR data for participating programs will be obtained by developing a centralized testing facility (CSU) for IR testing using the Bottle Bioassay. This activity will be coordinated by the local departments of public health (LDPH), CSU and SLCMAD. Information from TRAIN/Activity1.c will be used to identify important needs and gaps in undertaking IR surveillance. CSU and SLCMAD insectaries and laboratories

are well equipped to provide hands-on trainings (TRAIN/activity1) and monitoring of IR in *Culex tarsalis*, *Cx. quinquefasciatus* and *Cx. pipiens* populations throughout the region. CSU, SLCMAD and LDPH will identify high WNV risk areas that have recently had insecticide mitigation activities. We propose testing ~10 mosquito populations every year, providing several opportunities for training during the summer. Results will be documented in a database maintained by the RaHP that links to VectorSurv. We will also work with the CDC and the PacVec to inform and train end users on VectorSurv's streamlined data management and personalized action threshold capabilities; our aim in YR2-3 is to identify and implement thresholds for nuisance and disease prevention operations in 3+ publicly supported programs.

Overall, our work with surveillance and IR testing will inform a new policy document outlining the applications, methods, advantages, and tradeoffs of action thresholds for different vector control objectives specific to the RaHP VEC region. With input from CDC, this document will be modeled after global and national scale guides for vector control for disease prevention as previously developed by CDC, PAHO, and WHO.

EVALUATE/Activity 3. (McMillan, Brelsfoard, Faraji, Foy, Ebel) We will evaluate and enhance the impact of vector control strategies on vector abundance, VI and MIR. Our short-term goals are to partner with, and train vector control professionals interested in designing efficacy trials or using existing/historical data to evaluate pre- and post-intervention metrics. Our intermediate goals are to 1) demonstrate measurable reductions in larval and adult control of *Culex* spp. mosquitoes, and 2) provide relevant, applied vector control training and experience for undergraduate and graduate students. Our long-term goals are to improve epi-impacts of vector control for WNV risk prevention.

To achieve the goals of this Activity, we will initially focus on current collaborations in Lubbock County, TX (TTU, COL-VC) and Larimer County, CO (CSU) where existing relationships with vector control professionals already exist. These YR1 partnerships will allow us to directly evaluate historical data for collections trends pre/post applications, work with and train partner program staff on study design and identify sentinel areas for YR2-5 activities. Larval control in identified sentinel areas will focus on examining population counts pre/post applications and comparing counts in treated to untreated sites (identified in Evaluation/Activity 2.b). We will use these results to make recommendations on product application rates and schedules that may improve impacts. Larval control evaluations will occur YR1-5 while all identified improvements in treatment strategies will be implemented and evaluated in each subsequent YR. In YR3, we aim to consolidate information on larval evaluation and treatment strategies and apply these methods in new areas in the RaHP VEC (YR4-5). Evaluations of adult control will focus on linking surveillance systems to control data systems to evaluate reductions in infection metrics (YR1-3, linking to Evaluation/Activity 2.a), using light traps and human landing catches to estimate reductions in host seeking adults pre/post-application (YR2-4), identifying barriers to public acceptance of broad scale adulticides (YR1-5, linking to Training/Activity 1.b), and identifying and managing IR (YR2-5, linking to Evaluation/Activity 1.a). In all years, we will work with our CDC partners to identify areas where our partners need to increase surveillance coverage (see Evaluation/Activity 2.b), improve workflows for WNV testing (see Evaluation/Activity 1.a and 2.b), and explore county/state/federal funding opportunities for increased technological capacities.

EVALUATE/Activity 4. (*Kelp, Roundy*) Dr. Kelp will lead student teams in mixed-methods research including surveys and focus groups with diverse community members to assess efficacy of communication from CDPHE to communities and to vector control professionals. Surveys will incorporate questions about the language and source of communications most desired by specific groups including migrant workers, people living on tribal lands, occupationally exposed people etc. In particular, we will focus on the Fort Morgan, Greeley, and Fort Collins corridor, examining differences in understanding and perceptions of WNV messaging and acceptance of surveillance and control methods in differently resourced communities. This will be done in tangent with testing of surveillance and control methods in these areas. We will focus on barriers to protective behaviors that residents in these areas may be experiencing and provide guidance on improved CDC/CDPHE messaging in response. This will occur during Year 2-3 of the 5-year period, so it can build on previous work and we can adjust future work in response to this work.

PARTNER/Activity 1. (*Program Manager, Foy, Marzec*) Our partner core (CSU, CDPHE, TTU and SLCMAD) is set. Investigators and staff will have weekly online calls to stay connect and on task with trainings and evaluations. A website will be created in Yr 1 to be our centralized hub for maintaining and growing connections, displaying new reporting data from surveillance and IR testing efforts. We will post Quarterly Newsletters highlighting the new partnerships and people, evaluation projects, VBD threats, and IVM best practices. This website will also link to CDPHE's and other state reporting systems in our region, the CDC's website and other centers and CoEs. In Yrs 2-5 the goals will be expand our partnerships across the region to other colleges, PHAs, vector control professionals and hope to integrate with cross-center working groups. We also plan to implement surveillance reporting in our region with VectorSurv.

PARTNER/Activity 2. (*Program Manager, Foy, Marzec*) The RaHP VEC will create an internship program to fund students/fellows from partner organizations to work in 3-month paid internships each year. Currently, CSU's budget includes 13 interns per year, starting Yr1, to be given to students/fellows to be trained and work (\$20/hr for 3 months) at different schools, vector control agencies, or public health agencies; TTU's budgets including money for 5 interns in Yrs1-3 and 1 in Yrs 4-5; CDPHE will host at least one veterinary student and one medical entomology student per year. SLCMAD has funds to help train some of these interns in their yearly mosquito abatement bootcamp.

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