



Vector Control Program 2018 Annual Report

SAINT LOUIS COUNTY DEPARTMENT OF PUBLIC HEALTH
6121 NORTH HANLEY ROAD, BERKELEY, MO 63134

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Saint Louis County Department of Public Health

Mission

The Saint Louis County Department of Public Health strives to keep Saint Louis County one of the best places in the region to live, work, or visit. This is accomplished by regularly assessing the health and environment of the county and responding with sound policies that help assure the availability of high quality public health services for everyone.

Vision

The Saint Louis County Department of Public Health's vision is a collaborative public health system entrusted to coordinate and allocate resources for prevention and outreach to promote and create a healthy and safe environment.

Values

The Saint Louis County Department of Public Health is committed to:

- Being a public health leader in the community;
- Operating in a manner that recognizes the value of all people;
- Continuously improving its operations;
- Using evidence-based practices;
- Attaining the highest level of service through efficiency, consistency, and relationship development;
- Promoting innovation to ensure all people in the community are served; and
- Operating in a transparent manner and accepting responsibility for outcomes.

Vector Control Program

Mission

The Saint Louis County Department of Public Health Vector Control Program protects the health of Saint Louis County residents and visitors by providing comprehensive vectorborne disease surveillance and implementation of Integrated Pest Management (IPM) strategies and principles in an environmentally friendly approach.

Vision

To protect the public health of Saint Louis County residents and visitors by providing a comprehensive vector control program that utilizes all aspects of IPM in an ecologically sound manner.

Report Preparation

This report was prepared by the Saint Louis County Department of Public Health, Division of Communicable Disease Control Services.

- Vector Control Program
- Epidemiology Program

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I. Introduction

A. Background

In 2017, the National Association of County and City Health Officials (NACCHO) conducted a survey of the 1,906 vector control organizations in the United States to assess mosquito surveillance and control capabilities. Results from this report indicate that 84% of vector control organizations were classified as “Needs Improvement” in at least one core competency area.¹ When results were limited to only local health departments, the percentage classified as “Needs Improvement” increased to 90%. The NACCHO report underscores the need for continued attention toward and funding of vector surveillance and control efforts at the local level. See [Appendix A](#) of this report for additional details on the NACCHO report and to see the Saint Louis County Department of Public Health (DPH) Vector Control Program’s (VCP) scores on both the core and supplemental mosquito surveillance and control competencies.

The Saint Louis County DPH VCP is tasked with providing vector control services to Saint Louis County residents and visitors. These services include not only comprehensive mosquito surveillance and control, but also surveillance and/or control of other arthropod vectors, as well as rodent abatement services. This report presents information on common vectors in the Saint Louis County region, describes the activities conducted by the Saint Louis County DPH VCP, and provides surveillance data for calendar year 2018.

B. About the Saint Louis County Department of Public Health Vector Control Program

The Saint Louis County DPH VCP provides full-scale vector control operations for the majority of the 523 square miles that comprise Saint Louis County. These operations include adult mosquito surveillance, testing of adult mosquitoes for the presence of arboviral disease, larvicidal treatment of mosquito breeding sites, Ultra-Low Volume (ULV) and barrier applications for the control of adult mosquitoes, as well as rodent abatement activities in public areas. The VCP conducts these operations throughout all of unincorporated Saint Louis County, as well as 72 municipalities (in 2018) within the county who contract with the VCP to provide vector control services for their residents. All operations are conducted in accordance with Integrated Pest Management (IPM) principles and are overseen by Vector Control Specialists who are licensed and certified by the Missouri Department of Agriculture in Public Health Pest Control. Saint Louis County DPH Vector Control Specialists must attend recertification training every three years through the Missouri Department of Agriculture to maintain their licenses in Public Health Pest Control. The VCP also utilizes Vector Control Assistants, seasonal employees who provide additional resources during the busy summer months. Vector Control Assistants are overseen by Vector Control Specialists and are required to complete online vector control training courses developed by the Centers for Disease Control and Prevention (Vector Control for Environmental Health Professionals), as well as an online information security awareness course (required for all DPH staff).

¹ <https://www.naccho.org/uploads/downloadable-resources/Mosquito-control-in-the-U.S.-Report.pdf>

Vector Control Program Services

- Adult mosquito surveillance to monitor the presence and distribution of disease-carrying mosquitoes
- Arboviral disease testing of adult mosquitoes to determine the presence and distribution of arboviral disease in the adult mosquito population
- Larvicidal treatment of mosquito breeding sites to reduce the number of adult mosquitoes
- ULV applications for the control of the adult mosquito population
- Barrier applications for the control of the adult mosquito population
- Rodent surveillance and control in public areas and easements
- Response to service requests and complaints regarding mosquito and rodent activity
- Inspections, technical assistance, and control recommendations to Saint Louis County residents, at no cost

C. Integrated Pest Management





Integrated Pest Management (IPM) is an evidence-informed, ecosystem-based strategy that focuses on long-term prevention of target organisms through a combination of control techniques that are practical and effective to protect public health, as well as the environment. These techniques include surveillance, prevention, education, source reduction, and chemical control methods. All control methods are surveillance-driven and do not occur until predetermined action thresholds are met. After surveillance results indicate that control methods are warranted, pesticide treatments are made with the goal of removing only the target organism. Pest control products are selected and applied in a manner that reduces pesticide resistance and minimizes risks to human health, non-target species, beneficial organisms, and the environment.

D. Disease Vectors in Saint Louis County

Although Saint Louis County and the state of Missouri are home to dozens of species of mosquitoes and ticks, most are not relevant vectors for disease in humans. In Saint Louis County, as in the state of Missouri and the United States as a whole, the majority of human vectorborne disease is caused by ticks. Notable vectors of human tickborne disease in Missouri include: *Amblyomma americanum* (the lone star tick); *Dermacentor variabilis* (the American dog tick); and *Ixodes scapularis* (the blacklegged tick). Additionally, the Saint Louis County region has recently seen cases of such emerging tickborne pathogens as Heartland and Bourbon viruses. However, tick surveillance with a public health focus has not been routinely conducted in Missouri. Because of the significant public health threat of tickborne illness, the VCP began development of a tick surveillance program in 2018. Implementation of this program is set to begin in mid-2019.

The majority of VCP activities involve the surveillance and control of mosquito populations to minimize human illness. Table 1 below presents information on four common genera of disease-causing mosquitoes found in Saint Louis County. See [section II.C](#) of this report for further information on human vectorborne illness.

Table 1: Common mosquito vectors in Saint Louis County

Name	<i>Culex</i>	<i>Aedes</i>	<i>Psorophora</i>	<i>Anopheles</i>
	 <i>(Cx. pipiens)</i>	 <i>(Ae. albopictus)</i>	 <i>(Ps. ciliata)</i>	 <i>(An. quadrimaculatus)</i>
Saint Louis species	<ul style="list-style-type: none"> • <i>Cx. pipiens</i> • <i>Cx. quinquefasciatus</i> • <i>Cx. erraticus</i> • <i>Cx. restuans</i> 	<ul style="list-style-type: none"> • <i>Ae. albopictus</i> • <i>Ae. vexans</i> 	<ul style="list-style-type: none"> • <i>Ps. ciliata</i> • <i>Ps. ferox</i> 	<ul style="list-style-type: none"> • <i>An. punctipennis</i> • <i>An. quadrimaculatus</i>
Egg laying and habitat	<ul style="list-style-type: none"> • Floating rafts of ~200 eggs • Ditches, standing water, vacant pools, some containers • Prefers polluted waters with high organic content 	<ul style="list-style-type: none"> <i>Ae. albopictus</i> • Small containers such as birdbaths, flower pots, buckets, kiddie pools, clogged gutters, tires <i>Ae. vexans</i> • Flood plains 	<ul style="list-style-type: none"> • Temporary rain pools 	<ul style="list-style-type: none"> • Ponds with growing vegetation, canals, irrigation ditches, sluggish streams
Relevant information	Active after dusk and just before dawn	Aggressive biters, especially during the day	Relatively large mosquito, aggressive biters, active during the day	Active during the day or night
Diseases transmitted	West Nile virus, Saint Louis encephalitis, and Eastern equine encephalitis	<ul style="list-style-type: none"> <i>Ae. albopictus</i> • Chikungunya, dengue fever, yellow fever, Zika virus <i>Ae. vexans</i> • Canine heartworm 	West Nile virus has been detected in certain <i>Psorophora</i> spp.	Malaria, yellow fever, canine heartworm, West Nile virus has been detected in certain <i>Anopheles</i> spp.

E. Vector Control Management Areas

The VCP divides Saint Louis County into five Vector Control Management Areas (VCMAs). As noted in Table 2, each of these areas contains sections of unincorporated Saint Louis County, as well as independent municipalities. The five VCMAs range in size and differ in population density and geographic features, though all regions are fairly uniform with respect to common mosquito breeding sites. Weather permitting, the VCP conducts trapping and adulticiding activities from Sunday to Thursday on a rotating schedule by VCMA.

Table 2: Description of the Saint Louis County Vector Control Management Areas

Region	Size ranking	# trap sites	Jurisdictions	Notable features	Common mosquito breeding sites
North	3	33	<ul style="list-style-type: none"> Unincorporated Saint Louis County 10 municipalities 	<ul style="list-style-type: none"> Populated, with a few rural areas Flood plains, areas not accessible by vehicle 	Standing water, ditches, creeks, swamps, retention basins, drainage culverts, some storm water sewers, some catch basins
North Central	4	43	<ul style="list-style-type: none"> Unincorporated Saint Louis County 28 municipalities 	<ul style="list-style-type: none"> Densely populated 	Standing water, ditches, creeks, retention basins, drainage culverts, storm water sewers, catch basins
South	2	49	<ul style="list-style-type: none"> Unincorporated Saint Louis County 10 municipalities 	<ul style="list-style-type: none"> Populated, with a few rural areas Meramec River flood plain 	Standing water, ditches, creeks, swamps, retention basins, drainage culverts
South Central	5	35	<ul style="list-style-type: none"> Unincorporated Saint Louis County 15 municipalities 	<ul style="list-style-type: none"> Moderately populated 	Standing water, ditches, creeks, retention basins, drainage culverts, storm water sewers, catch basins
West	1	68	<ul style="list-style-type: none"> Unincorporated Saint Louis County 9 municipalities 	<ul style="list-style-type: none"> Contains most diverse mosquito habitats Densely populated and rural areas Missouri and Meramec River flood plains 	Standing water, ditches, creeks, swamps, retention basins, drainage culverts

F. 2018 Climate Information

The weather patterns leading into and during the mosquito breeding season can influence mosquito abundance and West Nile virus (WNV) activity. Figures 1 and 2 below present average monthly temperatures and precipitation for 2018, compared with historical averages.

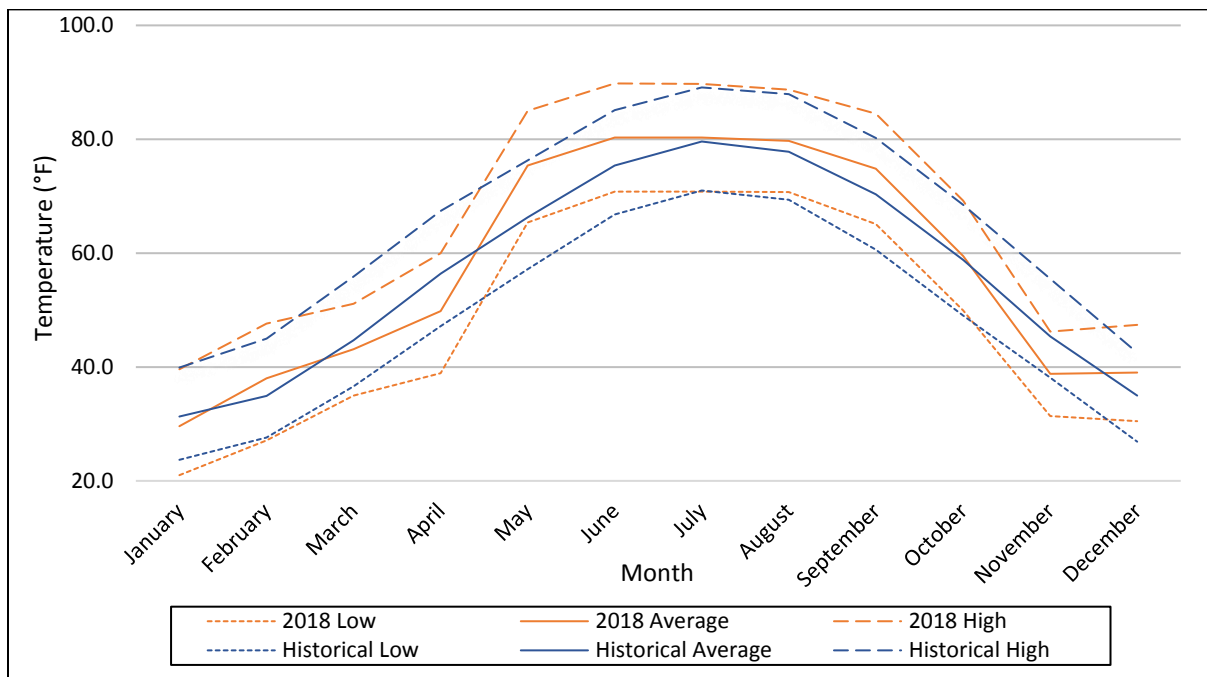
In 2018, temperatures in May and June tended to be warmer compared with historical averages, which could have encouraged early mosquito breeding and viral replication, resulting in the existence of West Nile virus positive (WNV+) mosquitoes in the spring and early summer. Additionally, while summer temperatures in

July and August were similar to historical averages, a warmer-than-average September could have provided favorable breeding conditions later into the fall.

Monthly precipitation in 2018 varied, with drier-than-average months in June, July, and September and wetter-than-average months in May and August. A more detailed look at both May and August, however, reveals that these months were characterized by numerous smaller rain showers, rather than days of heavy rain. Daily rainfall exceeded 1.0" on only two days in May and one day in August. While especially heavy rainfall could reduce mosquito populations by flushing out breeding sites, light rain showers often create mosquito breeding sites.

Taken together, these climate data indicate that breeding conditions were especially advantageous in June, continued to be favorable throughout the summer, and allowed breeding to continue into September. See Figures 3a and 3b below for further details regarding the impact of climate conditions on monthly average trap counts, which are a good indicator of mosquito breeding conditions.

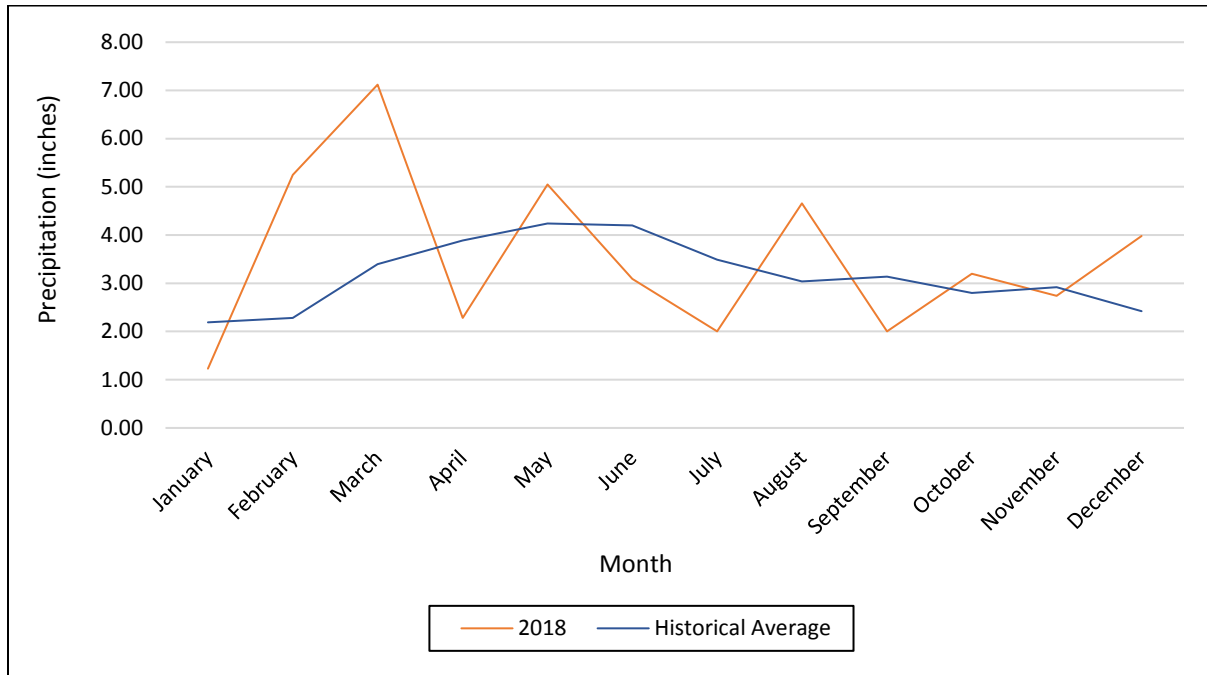
**Figure 1: High, average, and low monthly temperatures (°F)
Saint Louis, Missouri, 2018 and historical data***



Sources: http://www.weather.gov/media/lx/climate/stl/temp/temp_stl_monthly_seasonal_averages.pdf, <http://www.weather.gov/lx/cliplot>

* Data from 01/1836 – 3/2019

Figure 2: Monthly precipitation (inches)
Saint Louis, Missouri, 2018 and historical average*



Source: http://www.weather.gov/media/lx/climate/stl/precip/precip_stl_monthly_seasonal.pdf

* Data from 01/1870 – 3/2019

Figure 3a: Monthly precipitation (inches) and average temperature (°F)
Saint Louis, Missouri, 2018

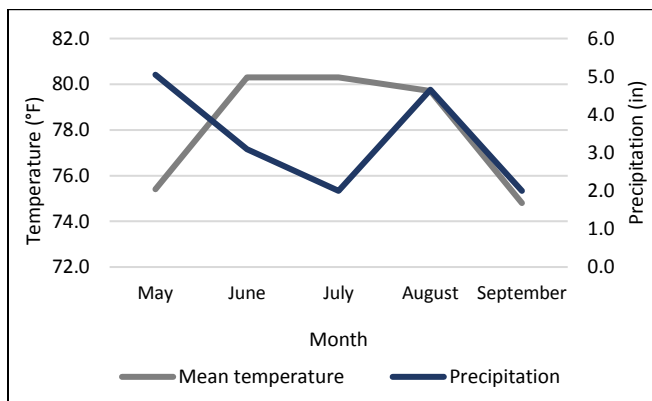
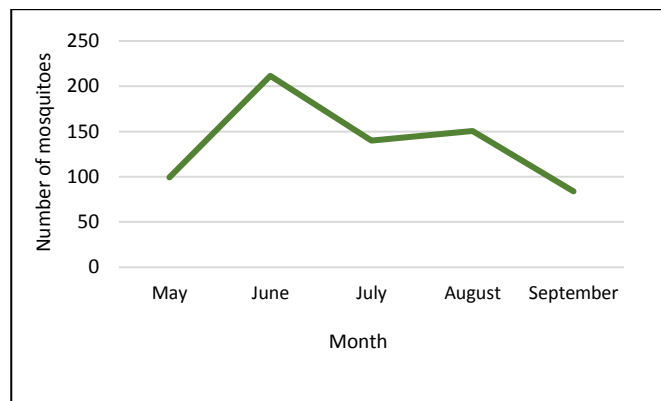


Figure 3b: Monthly average trap counts (female Culex spp.)
Saint Louis County, Missouri, 2018



Sources: <http://www.weather.gov/lx/cliplot> , http://www.weather.gov/media/lx/climate/stl/precip/precip_stl_monthly_seasonal.pdf

II. Arboviral Vector and Disease Surveillance

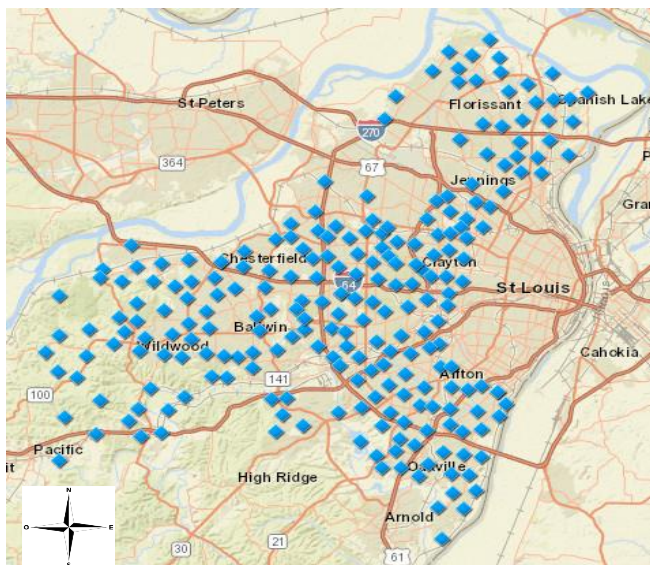
A. Description of Surveillance Activities, Traps, and Tests

The Saint Louis County Department of Public Health (DPH) Vector Control Program (VCP) monitors adult disease-carrying mosquito populations and tests adult *Culex* spp. mosquitoes for the presence of vectorborne disease. There are approximately 230 mosquito trap sites located throughout Saint Louis County (Figure 4). The most common type of mosquito trap used by the VCP, the gravid trap, is primarily used to collect gravid female *Culex* spp. mosquitoes to test for the presence of West Nile virus (WNV), although gravid traps are also useful for collecting several other species of mosquitoes including *Aedes albopictus*. Gravid traps are spaced equally throughout Vector Control Management Areas (VCMAs) based on the flight range of *Culex* spp. mosquitoes (~5 miles). Specific trap locations are selected according to several factors, including population density, ease of access (e.g., parks and easements), and desirability as a mosquito breeding site.

In addition to gravid traps, the VCP places Sentinel 2 traps and carbon dioxide-baited CDC Light traps at locations throughout the County. These are designed to attract *Aedes* spp. (*Ae. aegypti* and *Ae. albopictus*, in particular) and other mosquito species for identification and surveillance.

Weather permitting, up to 12 gravid traps are set five days per week throughout the mosquito season. These traps are set during the afternoon and retrieved the following morning. Sentinel 2 and CDC Light traps may be set on any weekday throughout the mosquito season and are retrieved the following morning. Mosquitoes collected from all traps are identified and sorted by sex and species. Female *Culex* spp. mosquitoes are then tested for the presence of WNV using an enzyme-linked immunosorbent assay (ELISA) according to a VCP-developed ELISA protocol. Surveillance data are used to determine where to concentrate mosquito control efforts and how best to utilize VCP resources. The VCP also provides surveillance data to programs within DPH, as well as other local, state, and federal programs.

Figure 4: Mosquito trap sites
Saint Louis County, Missouri, 2018



B. Vector Surveillance Tables

Gravid traps make up the bulk (91.6%) of traps set because surveillance and control of *Culex* spp. mosquitoes capable of transmitting WNV are currently the focus of the VCP’s mosquito activities. As described above, the geographic distribution of traps throughout Saint Louis County is dictated by population density and the presence of suitable mosquito breeding sites. Although traps are set throughout mosquito season, the majority of traps are set from June to September, largely due to increased *Culex* spp. activity, as well as an increase in VCP staffing and resources during these months. In 2018, the VCP did not set traps during October. See Tables 3a, 3b, and 3c below for additional information on the type and VCMA of traps set each month.

Table 3a: Number of mosquito traps set, by month, Vector Control Management Area, and trap type Saint Louis County, Missouri, 2018

		May	Jun	Jul	Aug	Sep	2018 Total
North	Gravid	-	19	35	27	6	87
	Sentinel	-	-	5	5	-	10
North Central	Gravid	2	31	26	14	5	78
	Sentinel	-	-	-	-	-	-
South	Gravid	-	12	58	12	13	95
	Sentinel	-	-	6	3	-	9
	Light	-	-	-	-	2	2
South Central	Gravid	1	21	36	20	7	85
	Sentinel	-	-	6	3	-	9
West	Gravid	-	34	33	28	8	103
	Sentinel	-	-	8	3	-	11
Total		3	117	213	115	41	489

Table 3b: Mosquito traps set, by trap type Saint Louis County, Missouri, 2018

	N	%
Gravid	448	91.6
Sentinel	39	8.0
CDC Light	2	0.4
Total	489	100.0

Table 3c: Mosquito traps set, by Vector Control Management Area Saint Louis County, Missouri, 2018

	N	%
North	97	19.8
North Central	78	16.0
South	106	21.7
South Central	94	19.2
West	114	23.3
Total	489	100.0

Over 1,500 female *Culex* spp. mosquito pools (Table 4) and almost 70,000 female *Culex* spp. mosquitoes (Table 5) were collected during the 2018 mosquito season. Of these, 94.4% of pools and 94.9% of mosquitoes were collected from June to August, corresponding to elevated mosquito activity and increased staffing during this time. As noted above, traps were not set during October 2018. Average trap counts (Table 6 and Figure 5) were highest in June overall for the County (211.5 female *Culex* spp. mosquitoes per trap) and for four of the five VCMA's. For the West VCMA, average trap count was highest in August (135.3 mosquitoes/trap), though June was only slightly lower (132.9 mosquitoes/trap). For all months, the North Central region exhibited the highest average trap counts, due largely to the region's dense population, advantageous breeding sites, and such structural factors as its combined sewer system.

Table 4: Number of mosquito pools collected, by month and Vector Control Management Area (female *Culex* spp.)

Saint Louis County, Missouri, 2018

Vector Control Management Area	May	Jun	Jul	Aug	Sept	2018 Total
North	-	111	92	104	10	317
North Central	6	200	115	67	12	400
South	-	39	146	18	29	232
South Central	1	82	133	62	14	292
West	-	103	96	87	15	301
Total	7	535	582	338	80	1,542

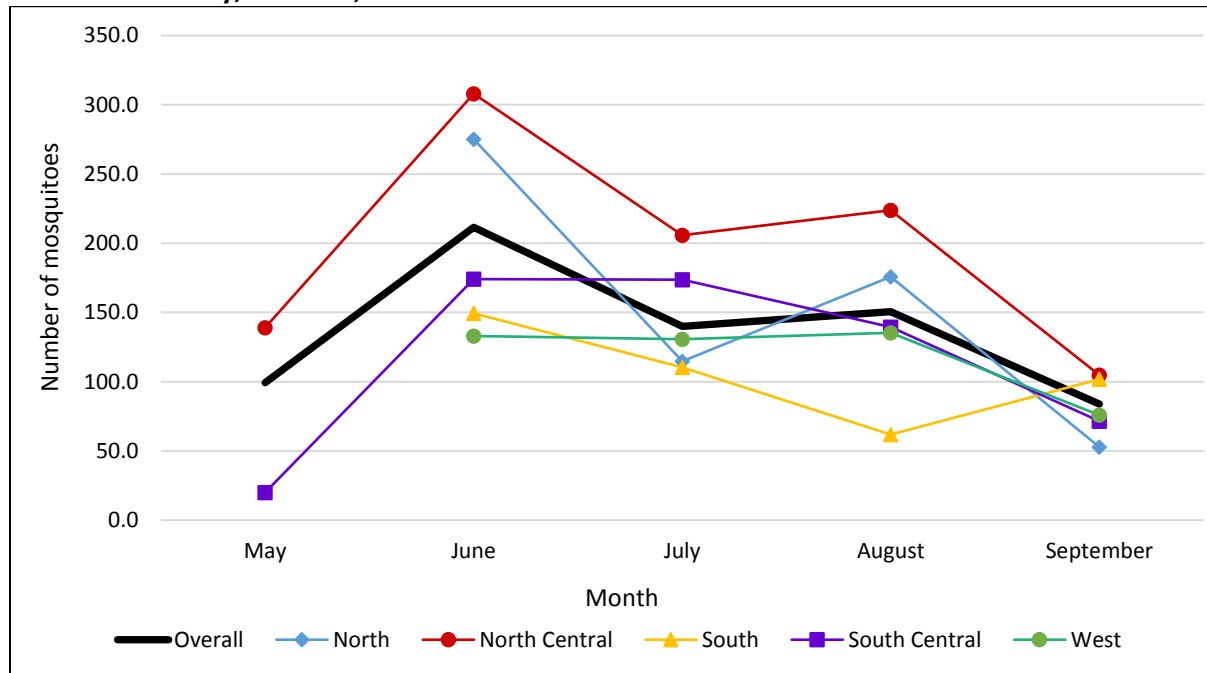
Table 5: Number of mosquitoes collected, by month and Vector Control Management Area (female *Culex* spp.) Saint Louis County, Missouri, 2018

Vector Control Management Area	May	Jun	Jul	Aug	Sept	2018 Total
North	-	5,229	4,016	4,746	317	14,308
North Central	278	9,548	5,354	3,133	524	18,837
South	-	1,793	6,397	742	1,322	10,254
South Central	20	3,656	6,249	2,791	500	13,216
West	-	4,520	4,314	3,789	607	13,230
Total	298	24,746	26,330	15,201	3,270	69,845

Table 6: Average trap counts, by month and Vector Control Management Area (female *Culex* spp.) Saint Louis County, Missouri, 2018

Vector Control Management Area	May	Jun	Jul	Aug	Sept	2018 Total
North	-	275.2	114.7	175.8	52.8	164.5
North Central	139.0	308.0	205.9	223.8	104.8	241.5
South	-	149.4	110.3	61.8	101.7	107.9
South Central	20.0	174.1	173.6	139.6	71.4	155.5
West	-	132.9	130.7	135.3	75.9	128.4
Total	99.3	211.5	140.1	150.5	83.8	155.9

Figure 5: Average trap counts, by month and Vector Control Management Area (female *Culex* spp.) Saint Louis County, Missouri, 2018



One-hundred-ninety-six WNV positive (WNV+) pools (12.7% of all pools tested) were identified during the 2018 mosquito season (Tables 7 and 8). WNV first amplifies in birds, peaking in July and August, with mosquito populations soon following.² The proportion of WNV+ pools increased dramatically from 3.0% in May and June to 24.4% in July and 32.5% in September. The low proportion of WNV+ pools in August (3.6%) was attributable to two factors. First, several traps were accidentally left out too long, leading to virus degradation in the mosquitoes. Second, the VCP was testing a new reagent for ELISA testing; this reagent did not perform as expected. The proportion of WNV+ pools was fairly similar across VCMAs (χ^2 p-value=0.08), although the proportions in the South and South Central regions were slightly higher than the other VCMAs. Interestingly, the North Central VCMAs had the highest number of mosquitoes collected and average trap count, but the lowest proportion of WNV+ pools. This is likely because over half of all mosquitoes collected from the North Central VCMAs were collected in June, before WNV began amplifying in mosquitoes. In the years prior to 2018, the VCP used Rapid Analyte Measurement Platform (RAMP®) testing to identify WNV+ mosquitoes. Because of that, direct comparison of 2018 ELISA results with previous years is not possible.

² https://www.cdc.gov/westnile/resources/pdfs/13_240124_west_nile_lifecycle_birds_plainlanguage_508.pdf

Table 7: Number of West Nile virus positive pools, by month and Vector Control Management Area Saint Louis County, Missouri, 2018

Vector Control Management Area	May	Jun	Jul	Aug	Sept	2018 Total
North	-	2	22	6	6	36
North Central	0	1	34	1	4	40
South	-	3	27	1	4	35
South Central	0	2	41	3	5	51
West	-	8	18	1	7	34
Total	0	16	142	12	26	196

Table 8: Percent of West Nile virus positive pools, by month and Vector Control Management Area Saint Louis County, Missouri, 2018

Vector Control Management Area	May	Jun	Jul	Aug	Sept	2018 Total
North	-	1.8	23.9	5.8	60.0	11.4
North Central	0.0	0.5	29.6	1.5	33.3	10.0
South	-	7.7	18.5	5.6	13.8	15.1
South Central	0.0	2.4	30.8	4.8	35.7	17.5
West	-	7.8	18.8	1.1	46.7	11.3
Total	0.0	3.0	24.4	3.6	32.5	12.7

To estimate the proportion of infected mosquitoes in pooled samples, DPH uses the maximum likelihood estimation (MLE) method, which calculates the most likely infection rate given the testing results. In contrast to the minimum infection rate, which estimates the lower bound of possible infection rates, the MLE is preferred if the assumptions of small pool size and low infection rates are violated. The results below present point estimates calculated using bias-corrected MLE and skewness-corrected 95% confidence intervals (CIs).³

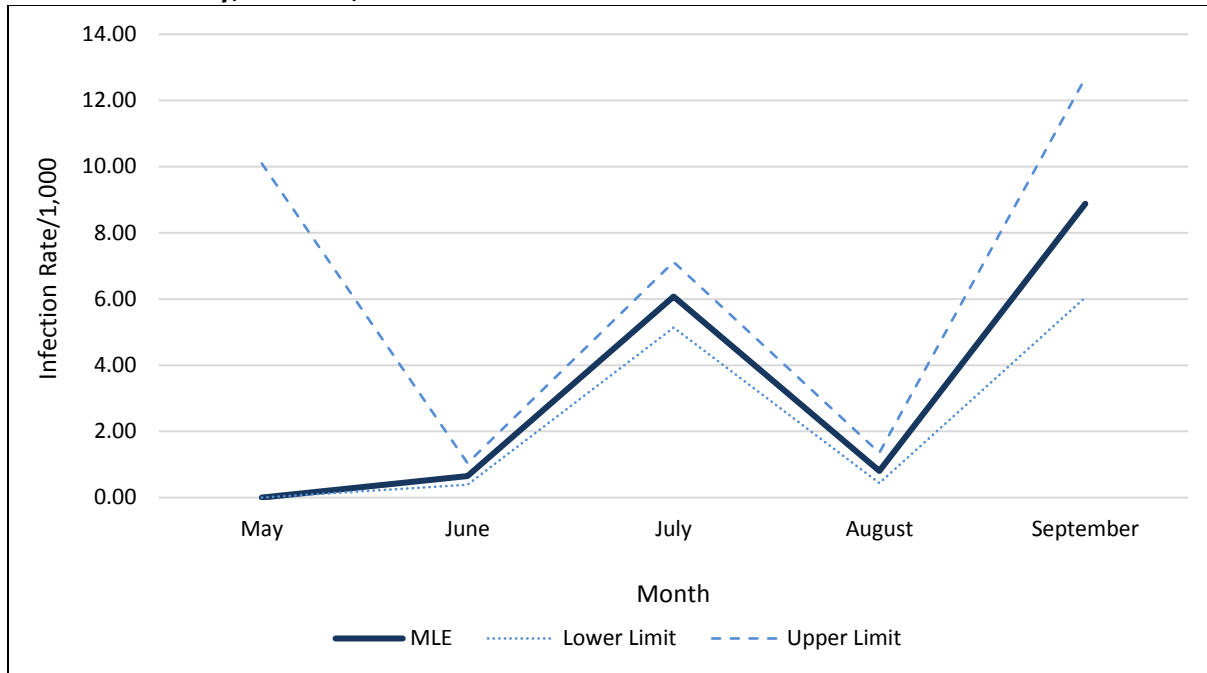
The monthly MLE ranged from a low of 0.0/1,000 (95% CI 0.0 to 10.1) in May to a high of 8.9/1,000 (95% CI 6.1 to 12.7) in September (Figure 6). Especially wide confidence intervals in May and September reflect that only seven and 80 pools were tested in those months, respectively. A rapid increase in infection rates from June (0.7, 95% CI 0.4 to 1.0) to July (6.1, 95% CI 5.1 to 7.1), as well as a low infection rate in August (0.8, 95% CI 0.4 to 1.4) reinforce the mosquito and WNV data presented above in Tables 5 and 8.

³ <https://www.cdc.gov/westnile/resourcepages/mosqSurvSoft.html>

The MLE was highest in September for all VCMA's except the South, where it was highest in July (Figure 7). All VCMA's followed the general trend of notable increases in infection rates from June to July, then a drop in August due to the limitations noted above, and finally an end-of-season rise in September.

Figure 6: Maximum likelihood estimation (MLE) mosquito infection rates and 95% confidence intervals*, by month

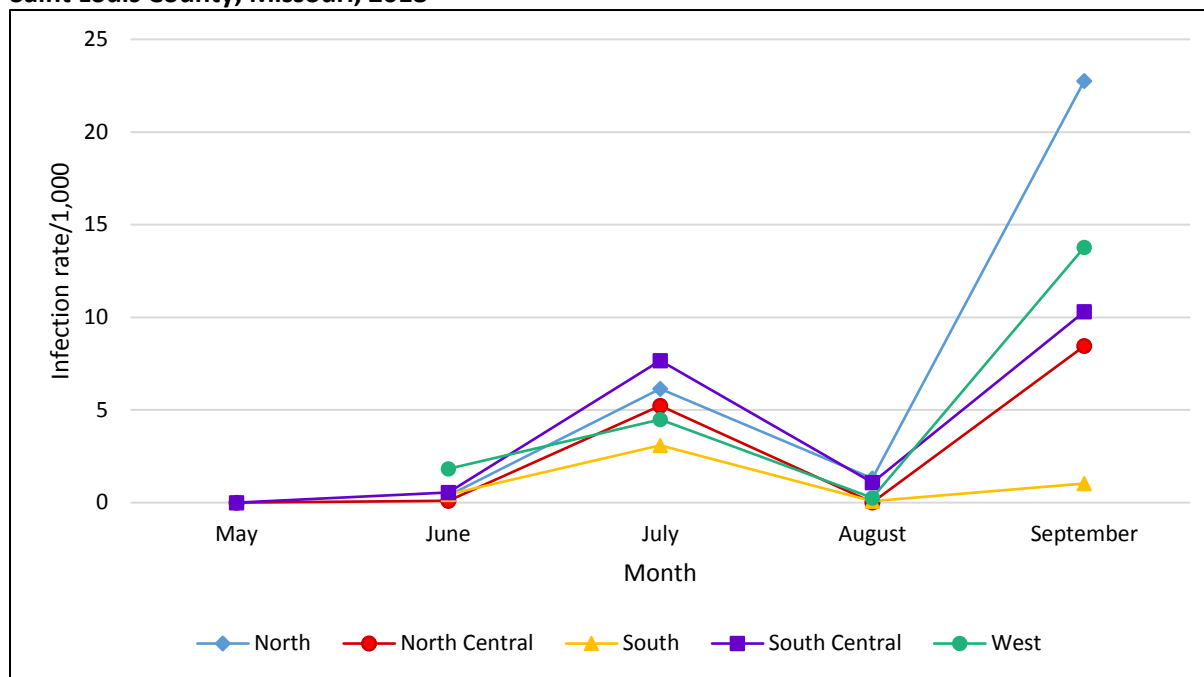
Saint Louis County, Missouri, 2018



*MLE and 95% confidence intervals calculated using CDC mosquito surveillance software

(<https://www.cdc.gov/westnile/resourcepages/mosqSurvSoft.html>, accessed on 05/22/2018) in accordance with the method described in: Biggerstaff BJ (2013) PooledInfRate, version 4.0: a Microsoft office Excel Add-In to compute infection rates from pooled data. Centers for Disease Control and Prevention, Fort Collins, CO, USA.

**Figure 7: Maximum likelihood estimation (MLE) mosquito infection rates*, by month and Vector Control Management Area
Saint Louis County, Missouri, 2018**



*MLE calculated using CDC mosquito surveillance software (<https://www.cdc.gov/westnile/resourcepages/mosqSurvSoft.html>, accessed on 05/22/2018) in accordance with the method described in: Biggerstaff BJ (2013) PooledInfRate, version 4.0: a Microsoft office Excel Add-In to compute infection rates from pooled data. Centers for Disease Control and Prevention, Fort Collins, CO, USA.

Among approximately 55 species of mosquitoes known to exist in Saint Louis County, traps set by the VCP identified at least 11 non-*Culex* species (Table 9). As noted in Tables 5 and 9, the overwhelming majority of mosquitoes trapped and identified were *Culex* spp., which is expected based on the types of traps set and the goal of identifying the presence, proportion, and location of WNV+ mosquitoes. However, with the exception of May (when only three total traps were set), non-*Culex* spp. mosquitoes were collected in VCP traps throughout the season. Notably, two light traps (both set in September) collected 1,789 total mosquitoes, including *Culex* spp. mosquitoes and six additional species.

**Table 9: Number of non-Culex spp. mosquitoes collected, by species and month
Saint Louis County, Missouri, 2018**

		Jun	Jul	Aug	Sept	2018 Total
<i>Aedes</i>	<i>Ae. albopictus</i>	123	520	336	34	1,013
	<i>Ae. vexans</i>	33	387	121	1,510	2,051
<i>Anopheles</i>	<i>An. punctipennis</i>	17	178	27	2	224
	<i>An. quadrimaculatus</i>	2	25	32	1	60
<i>Ochlerotatus</i>	<i>Oc. canadensis</i>	3	-	-	-	3
	<i>Oc. japonicus</i>	6	16	23	-	45
	<i>Oc. triseriatus</i>	15	41	4	-	60
	<i>Oc. trivittatus</i>	4	6	3	10	23
<i>Orthopodomyia</i>	<i>Or. signifera</i>	-	1	2	1	4
<i>Psorophora</i>	<i>Ps. ciliata</i>	-	3	1	2	6
	<i>Ps. ferox</i>	-	3	2	252	257
Grand Total						3,746

C. Human Vectorborne Disease

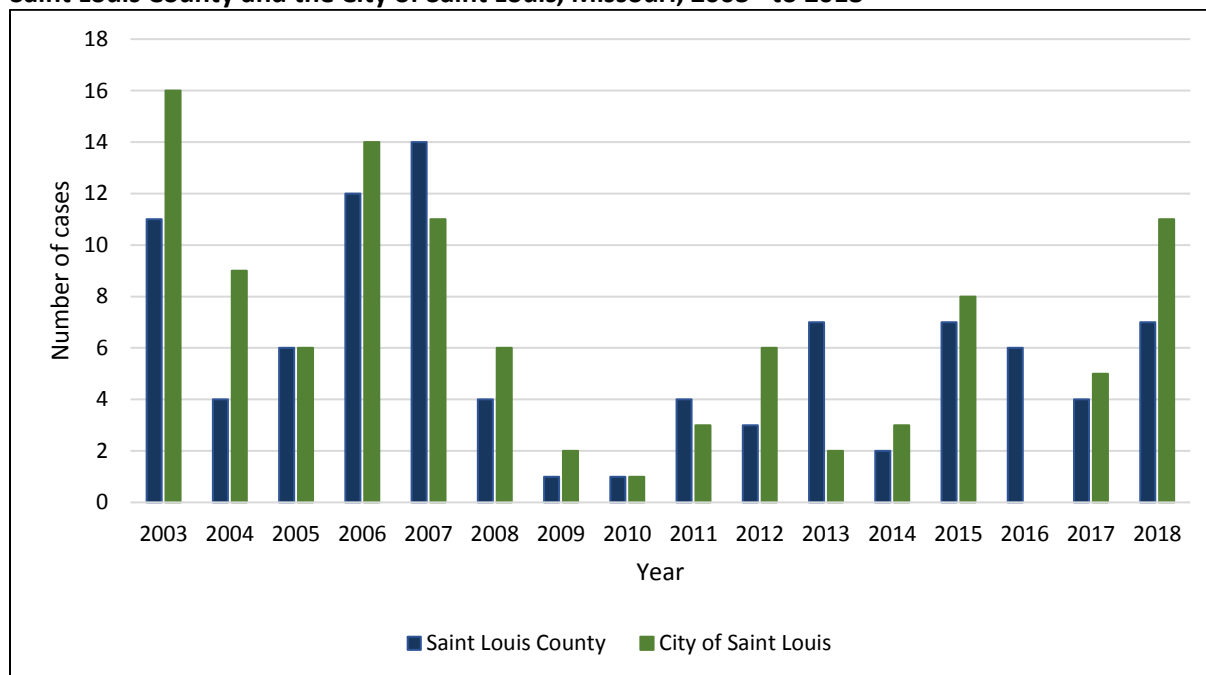
Vectorborne illness, including arboviral diseases as well as those caused by bacteria/rickettsia, protozoa, and helminths, are responsible for causing a substantial burden of human morbidity and mortality throughout the world. Clinically, these illnesses vary in presentation and severity, ranging from asymptomatic infections and mild febrile illness to hemorrhagic and neuroinvasive disease. With a few notable exceptions (e.g., yellow fever, Japanese encephalitis), vaccinations are unavailable to prevent vectorborne infections. Changes in climate, land use, human travel, and commercial trade have dramatically increased the global distribution of vectorborne diseases and introduced a myriad of new conditions previously unseen in Missouri and other non-tropical areas of the Western Hemisphere.

In Missouri, depending on how certain conditions are classified, at least 20 vectorborne diseases are considered reportable to the state of Missouri and notifiable nationally. See [Appendix B](#) for a list of these conditions, along with the case definitions used by the Council of State and Territorial Epidemiologists and the Missouri Department of Health and Senior Services to identify confirmed, probable, and suspected cases of each disease. In addition to the morbidity and mortality due to naturally occurring vectorborne diseases, several conditions (plague, Q fever, and tularemia) are considered to be potential bioterrorism agents. Because of this, cases of these illnesses are of particular interest to public health investigators. When cases of any reportable vectorborne illness are received by Saint Louis County DPH, communicable disease investigators work with the VCP to ensure that proper control measures are implemented to prevent/minimize the further spread of

disease. (See [Appendix D](#) for the Communicable Disease Control Services and Vector Control Notification and Response of Human Arboviral Disease Case Subtype(s) Protocol.)

Human WNV disease was first reported in Saint Louis County (and in the state of Missouri) in 2002, and has been a nationally notifiable disease since 2005. During the period from 2002 to 2018, a median of 6 cases of human WNV disease (both neuroinvasive and non-neuroinvasive) were reported in Saint Louis County residents each year, with a peak of 57 cases occurring in 2002 (Figure 8). Notably, the number and pattern of human cases of WNV in Saint Louis County are similar to those in the neighboring City of Saint Louis, though the City has a population of approximately 320,000 (compared with approximately one million Saint Louis County residents). The total number of cases in Missouri from 2002 to 2017 was 588. (Provisional 2018 data are not yet available for Missouri.) The proportion of Missouri cases reported in Saint Louis County from 2002 to 2017 ranged from 11.1% (in 2004) to 54.5% (in 2016). It is likely that many factors, including population susceptibility, national focus, climate, and access to healthcare and laboratory services contributed to the variations in the geographic and temporal distribution of human WNV cases.

Figure 8: Probable and confirmed human West Nile virus cases Saint Louis County and the City of Saint Louis, Missouri, 2003* to 2018

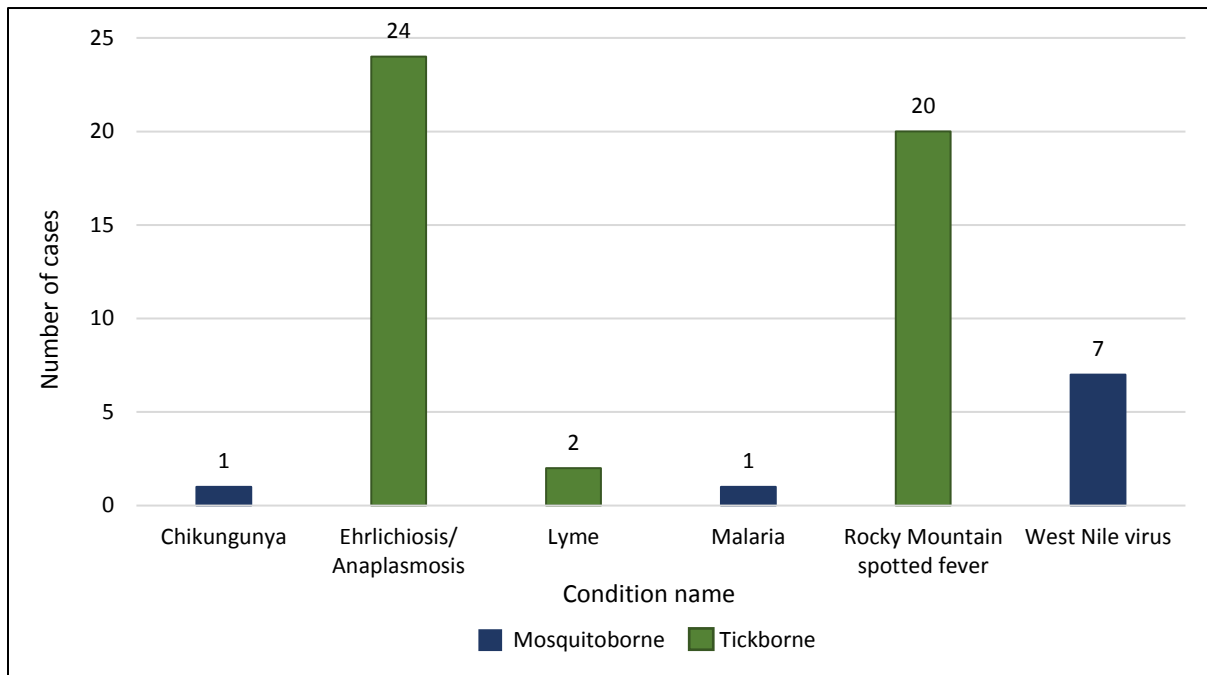


* Note: Cases from 2002 are not included in Figure 8 in order to clarify data visualization for subsequent years. In 2002, Saint Louis County and the City of Saint Louis reported 57 and 54 West Nile virus cases, respectively.

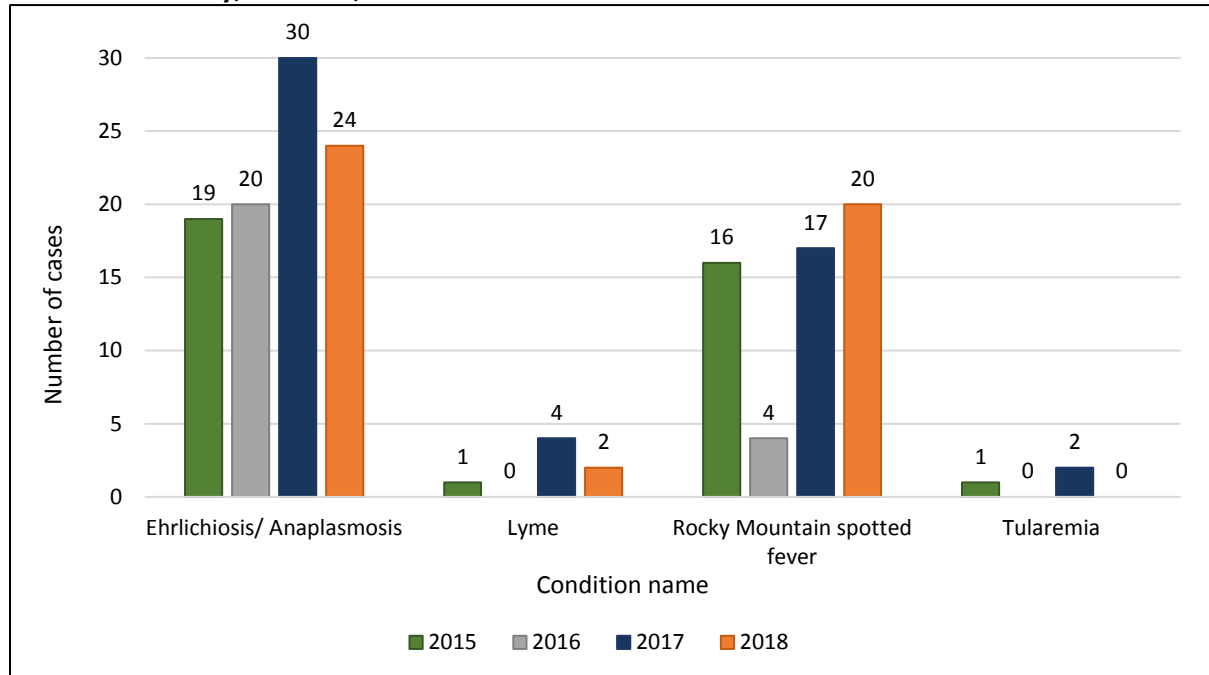
In 2018, 55 cases of human vectorborne illness were reported to the Saint Louis County DPH (Figure 9). Of these, 16.4% were mosquito-borne and 83.6% were tick-borne. Aside from seven cases of WNV, all other cases of mosquito-borne illness were travel-acquired. Tick-borne illnesses, including ehrlichiosis, the most commonly reported vectorborne illness in Saint Louis County, were likely locally-acquired. The 46 cases of tick-borne illness

reported in 2018 represented a 13.2% decrease compared with 2017, but a 24.3% increase over 2015 and a 91.7% increase over 2016 (Figure 10). Notably, the relative number of ehrlichiosis/anaplasmosis and Rocky Mountain spotted fever (RMSF) cases varied substantially by year. For example, in 2017, there were 1.8 times as many ehrlichiosis/anaplasmosis cases as there were RMSF cases, but that dropped to only 1.2 times in 2018.

**Figure 9: Human cases of mosquitoborne and tickborne illness
Saint Louis County, Missouri, 2018**



**Figure 10: Human cases of tickborne illness
Saint Louis County, Missouri, 2015 to 2018**



III. Mosquito Control Activities

A. Larviciding Activities

The Saint Louis County Vector Control Program (VCP) monitors roughly 6,000 known mosquito breeding sites throughout unincorporated Saint Louis County and contracting municipalities. The types of sites monitored include ditches, ponds, lakes, creeks, canals, swamps, marshes, sewers, storm water retention basins, and any other areas where standing water is present and the potential exists for mosquito breeding to occur. Sites are regularly monitored by Vector Control Specialists and Vector Control Assistants for the presence of mosquito breeding activity throughout the mosquito season. Sites in which mosquito breeding is identified or where conditions show a high potential for mosquito breeding are treated with an appropriate EPA-registered mosquito control product. See [Appendix E](#) for a list of larvicides used by the VCP. All mosquito control products are applied in accordance with the product label. Whenever possible, the VCP uses biologically- and environmentally-friendly mosquito control products and application methods that minimize potential impacts on beneficial organisms and the environment.

In 2018, larviciding occurred from April to October, with VCP staff spending a total of 1,863 hours on larviciding activities (Table 10). At least 175 hours of larviciding occurred in each month from May to October, with 31.9% of the total number of hours occurring in unincorporated Saint Louis County and 68.1% occurring in municipalities. Larviciding routes received an average of four larvicide applications throughout the 2018 season. Field staff inspected over 17,000 potential mosquito breeding sites (79.7% in municipalities) and administered over 81,000 applications of larvicide (71.3% in municipalities). Compared with 2017, in 2018 the VCP reported a 20.3% decrease in both the number of larviciding hours and larviciding sites inspected, and a 5.0% decrease in larvicide applications. However, compared with only 50,419 larvicide applications in 2016, the increase in larvicide applications initially reported in 2017 (n=85,719) was sustained into 2018. Although multiple factors likely contributed to the decrease in larviciding in 2018, the largest contributor was the difficulty in recruiting and maintaining Vector Control Assistants throughout the season.

**Table 10: Mosquito larviciding, by month and jurisdiction
Saint Louis County, Missouri, 2018**

	Apr	May	Jun	Jul	Aug	Sept	Oct	2018 Total
Larviciding Hours	17.00	215.50	485.25	410.25	295.00	262.25	177.75	1,863.00
Municipal	-	158.25	331.00	280.25	197.50	178.25	122.75	1,268.00
Unincorporated	17.00	57.25	154.25	130.00	97.50	84.00	55.00	595.00
Larvicide Sites Inspected	-	2,261	4,491	3,841	2,610	2,400	2,028	17,631
Municipal	-	1,760	3,663	3,099	2,189	1,979	1,361	14,051
Unincorporated	-	501	828	742	421	421	667	3,580
Larvicide Applications	-	9,499	18,885	18,115	13,745	13,249	7,936	81,429
Municipal	-	7,331	13,124	12,532	9,775	9,417	5,879	58,058
Unincorporated	-	2,168	5,761	5,583	3,970	3,832	2,057	23,371

B. Adulthood Activities

To control the adult mosquito population, the Saint Louis County VCP conducts nighttime Ultra-Low Volume (ULV) mosquito adulticide applications using truck-mounted ULV machines throughout unincorporated Saint Louis County and contracting municipalities. During the mosquito season, ULV applications are conducted five nights per week, as weather conditions allow. When conducting ULV operations, control efforts are focused on areas where arboviral disease has been identified in the mosquito population, followed by areas where surveillance has indicated the presence of higher numbers of mosquitoes with the potential to transmit disease. The VCP works with local beekeepers (both amateur and professional) to minimize the impact of ULV spraying on bee populations. Residents that maintain bee hives on their properties are able to request that their addresses be placed on a “No Spray” list or they can request to be notified via email when the VCP will be conducting ULV operations in their areas so that they may take appropriate actions to protect their hives. Residents may also call the VCP’s “Spray Hotline” (314-615-4BUG), which is updated every evening with the locations of that night’s ULV operations. In addition to ULV spraying, the VCP administers barrier applications in areas such as parks and ballfields for both routine and special event control of adult mosquito populations.

In 2018, the VCP devoted 593 total hours to adulticiding, with 37.5% of these in unincorporated Saint Louis County, and 62.5% in various municipalities (Table 11). In addition, 7.5 hours were spent administering barrier applications; most of these were by request. The amount of time necessary for control activities of adult mosquito populations dropped sharply in October, with the onset of cooler nighttime temperatures. Because mosquito activity was still observed, however, the VCP shifted its focus and resources to larviciding. Compared with the previous year, in 2018 the VCP reported a 44.0% decrease in adulticiding hours and a 15.4% increase in barrier application hours. As with larviciding, this decrease was largely due to limited staffing resources.

**Table 11: Mosquito adulticiding, by month and jurisdiction
Saint Louis County, Missouri, 2018**

	May	June	July	August	September	October	2018 Total
Adulticiding Hours	8.75	78.00	197.75	175.75	103.75	29.00	593.00
Municipal	5.25	61.75	117.00	109.75	63.75	13.25	370.75
Unincorporated	3.50	16.25	80.75	66.00	40.00	15.75	222.25
Barrier Applications Hours	-	2.0	4.0	1.0	0.5	-	7.5

IV. Rodent Control Activities

The Vector Control Program (VCP) works to control rodents which are capable of spreading disease to humans within Saint Louis County. The Saint Louis County VCP’s Rodent Control Program is a complaint-driven program that investigates citizen complaints on public and private property as a reactive approach to rodent control. County residents notify the VCP when rat activity is observed, initiating an investigation by a Vector Control Specialist in the area of the complaint. Based upon the Specialist’s findings during the complaint investigation, proper control methods are utilized using Integrated Pest Management, or, if on private property, professional recommendations for proper treatment methods are given to the property owner. The VCP also conducts proactive rodent control measures. These measures include: retreatment of areas where activity has been previously identified; assessing neighborhoods for evidence of rodent activity; and surveying/treating areas with historically high rodent populations.

In 2018, 350 total rodent inspections were conducted, with 64.9% of these occurring in unincorporated Saint Louis County, and 35.1% in various municipalities (Table 12). Additionally, 131 rodenticide applications were administered (64.1% in unincorporated Saint Louis County and 35.9% in municipalities). Compared with 2017, fewer rodent abatement activities were performed in 2018 (decreases of 26.2% and 26.0% in rodent inspections and applications, respectively).

**Table 12: Rodent abatement activities, by month and jurisdiction
Saint Louis County, Missouri, 2018**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2018 Total
Rodent Inspections	9	9	23	32	38	45	40	52	40	26	22	14	350
Municipal	5	3	8	10	10	18	15	22	13	8	7	4	123
Unincorporated	4	6	15	22	28	27	25	30	27	18	15	10	227
Rodenticide Applications	4	4	6	19	15	25	19	13	12	6	7	1	131
Municipal	1	-	3	7	5	10	7	5	3	3	2	1	47
Unincorporated	3	4	3	12	10	15	12	8	9	3	5	-	84

V. Additional Services and Summary of Service Requests

In addition to service requests for rodent- or mosquito-related issues, the Saint Louis County Department of Public Health (DPH) Vector Control Program (VCP) responds to service requests from Saint Louis County residents regarding stinging insects. After inspecting the property and/or area for stinging insects, the VCP provides either advice (if on private property) or treatment (if appropriate and on public property). In 2018, the VCP conducted 25 stinging insect inspections (60.0% in unincorporated Saint Louis County, 40.0% in municipalities) and administered 16 stinging insect applications (56.2% in unincorporated Saint Louis County, 43.8% in municipalities, Table 13).

**Table 13: Stinging insect activities, by month and jurisdiction
Saint Louis County, Missouri, 2018**

	May	Jun	Jul	Aug	Sept	2018 Total
Stinging Insect Inspections	3	4	5	7	6	25
Municipal	1	2	2	3	2	10
Unincorporated	2	2	3	4	4	15
Stinging Insect Applications	-	4	4	8	-	16
Municipal	-	2	1	4	-	7
Unincorporated	-	2	3	4	-	9

Although mosquito surveillance and control activities are concentrated in the summer months, the VCP responds to service calls year-round. When requests are received, each request is assessed and the VCP responds appropriately. In 2018, the VCP received 1,009 service requests for the inspection and control of adult mosquito populations, mosquito breeding sites, stinging insect populations, rodent populations, rodent habitats and numerous other vector-related concerns (Table 14). Of these 1,009 requests, 48.2% were for adulticiding services, 18.4% were for control of mosquito breeding sites, 22.7% were for rodent control, and 10.7% were for other services. Compared with 2017, the VCP saw a 4.5% increase in the number of adulticide service requests but decreases in the number of all other types of service requests (Table 15). However, compared with 2016, the VCP had increases in mosquito breeding and total service requests, in addition to adulticide service requests.

**Table 14: Summary of service requests, by month and jurisdiction
Saint Louis County, Missouri, 2018**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2018 Total
Adulticide Service Requests	-	-	-	-	13	81	146	112	111	23	-	-	486
Municipal	-	-	-	-	3	52	76	62	37	8	-	-	238
Unincorporated	-	-	-	-	10	29	70	50	74	15	-	-	248
Mosquito Breeding Service Requests	-	-	2	8	20	32	45	35	33	11	-	-	186
Municipal	-	-	2	5	11	19	21	19	18	6	-	-	101
Unincorporated	-	-	-	3	9	13	24	16	15	5	-	-	85
Rodent Service Requests	5	5	13	26	33	35	35	32	21	11	9	4	229
Municipal	5	3	8	11	13	18	17	22	15	8	7	4	131
Unincorporated	-	2	5	15	20	17	18	10	6	3	2	-	98
Stinging Insect Service Requests	-	-	-	-	3	4	6	8	6	-	-	-	27
Municipal	-	-	-	-	1	2	2	3	2	-	-	-	10
Unincorporated	-	-	-	-	2	2	4	5	4	-	-	-	17
Miscellaneous Service Requests	-	-	-	4	9	15	23	17	13	-	-	-	81
Total Service Requests	5	5	15	38	78	167	255	204	184	45	9	4	1,009

**Table 15: Percentage change in service requests
Saint Louis County, Missouri, 2016 to 2018**

	2016	2017	2018	% Change 2017 to 2018
Adulticide Service Requests	427	465	486	↑ 4.5%
Mosquito Breeding Service Requests	102	194	186	↓ 4.1%
Rodent Service Requests	261	310	229	↓ 26.1%
Stinging Insect Service Requests	33	33	27	↓ 18.2%
Miscellaneous Service Requests	102	110	81	↓ 26.4%
Total Service Requests	925	1,112	1,009	↓ 9.3%

VI. 2017 Vector Control Program Updates and Achievements

Vector Control Program (VCP) Updates

- 2018 staffing
 - 6 full-time Vector Control Specialists
 - 8 seasonal Vector Control Assistants
- Updated VCP logic model to describe and evaluate the program’s resources, activities, and outcomes (See [Appendix C](#))
- Developed and implemented an ELISA testing protocol to test mosquitoes for the presence of West Nile virus
 - Laboratory equipment purchased in 2017 and 2018 used to conduct ELISA testing
 - ELISA testing replaced more expensive RAMP testing, saving Saint Louis County thousands of dollars per calendar year
- Worked with Saint Louis County’s Geographic Information Systems (GIS) Service Center to develop and implement GIS applications for use in nearly all aspects of VCP activities
 - Six GIS web applications in use or under development by the end of 2018
 - Applications in use
 - Service request application
 - Rodent abatement application
 - Adulticide application
 - Larviciding application
 - Applications still under development or undergoing testing
 - Surveillance application
 - Reporting application
- Began development of a tick surveillance program
 - Received in-person field training by medical entomologists specializing in tick surveillance at the Indiana State Department of Health
 - Performed staff training on tick collection methods and conducted late-season tick drags in preparation for implementing tick surveillance in 2019

Presentations

- 02/26/2018: American Mosquito Control Association, 84th Annual Meeting (Kansas City, MO) – “Protecting Public Health by Integrating Vector and Communicable Disease Control” (poster presentation)
- 03/13/2018: 2018 NACCHO Vector Control Summit (Orlando, FL) – “Moving forward: integration with communicable disease control services and other program improvements” (oral presentation)

- 04/14/2018: Saint Louis University Public Health Open House
- 05/02/2018: CSTE North Central Vectorborne Diseases Regional Meeting (Chicago, IL) – “Vector Control: The Local Perspective” (oral presentation)
- 05/31/2018: Boy Scout Presentation – Public Health Merit Badge
- 06/25/2018: Saint Louis County DPH Lunch and Learn Presentation – “Mosquitoes, Rats, Ticks, Oh My!”
- 07/17/2018: Frontenac City Hall – Vector Control Program overview
- 08/02/2018: North County Recreation Center – Community Health Fair
- 09/05/2018: Missouri Department of Corrections, Annual Health Resource Fair – Overview of the VCP
- 09/29/2018: Active Learning Institute – STEAM Into Fall Learning – “Vector Control in the Classroom”
- 10/09/2018: Saint Louis County Government SPARK Poster Competition – “Migrating Vector Control Functions to a GIS Environment” (poster presentation)
- 10/11/2018: Saint Louis County Government SPARK Awards – Vector Control Program receives Sparkler Award
- 11/05/2018: Lindworth Drive Homeowners’ Association – Residential mosquito control
- 11/15/2018: 2018 Illinois Mosquito and Vector Control Association Annual Meeting (Bloomington-Normal, IL) – “Mosquito Control and Public Education” (oral presentation)

News articles and press releases

- 05/02/2018: Saint Louis County DPH Press Release – “[Prevention essential during mosquito season](#)”
- 05/09/2018: Saint Louis County DPH Press Release – “[Bite prevention essential as tick season arrives](#)”
- 08/08/2018: Saint Louis County Community News – “[Helping Hazelwood Swat Mosquitoes - The City of Hazelwood has contracted with St. Louis County in an effort to better control mosquito populations](#)”
- 08/09/2018: Interview, KSDK – “[Preventing the West Nile Virus in St. Louis](#)”

VII. Appendix A: The National Association of County and City Health Officials 2017 Mosquito Surveillance and Control Assessment

In 2017, the **National Association of County and City Health Officials (NACCHO)** distributed the **2017 Mosquito Surveillance and Control Assessment** to 1,906 vector control organizations in the United States, representing all organizations identified by NACCHO, the Centers for Disease Control and Prevention (CDC), and the American Mosquito Control Association.

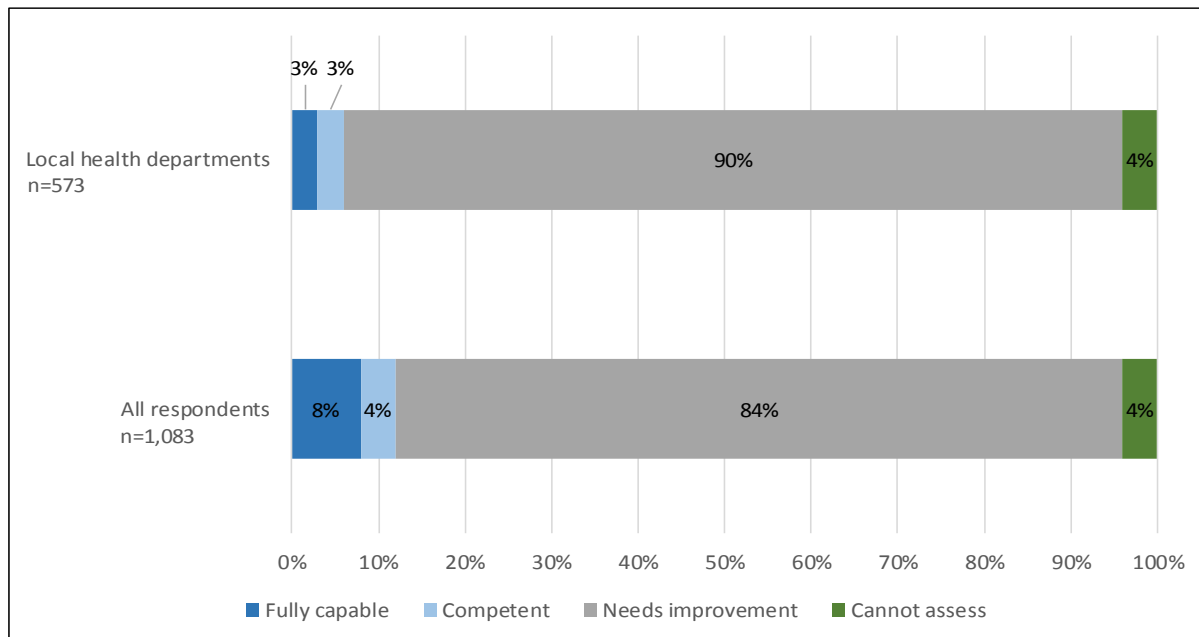
Of the **1,083 survey respondents**:

- 53% were from local health departments;
- 20% were from mosquito control districts; and
- 27% were from other departments (e.g., public works, street and sanitation, environmental health services, parks and recreation, and utilities).

Using a **CDC framework for vector control competency** as guidance, five core competencies were used to rank each organization.

- A **Fully Capable** vector control organization performs all core and supplemental competencies.
- A **Competent** vector control organization performs all core competencies.
- A **Needs Improvement** vector control organization fails to perform one or more core competency.

Appendix A: Results of the NACCHO 2017 Mosquito Surveillance and Control Assessment



2017 Mosquito Surveillance and Control Assessment –

Core and Supplemental Competencies

✓ = Currently conducted by the Saint Louis County

Department of Public Health Vector Control Program

Core Competencies

- ✓ 1. Routine mosquito surveillance through standardized trapping and species identification
- ✓ 2. Treatment decisions using surveillance data
- ✓ 3. Larviciding, adulticiding, or both
- ✓ 4. Routine vector control activities (e.g., chemical, biological, source reduction, or environmental management)
- 5. Pesticide resistance testing **Coming in 2019!**

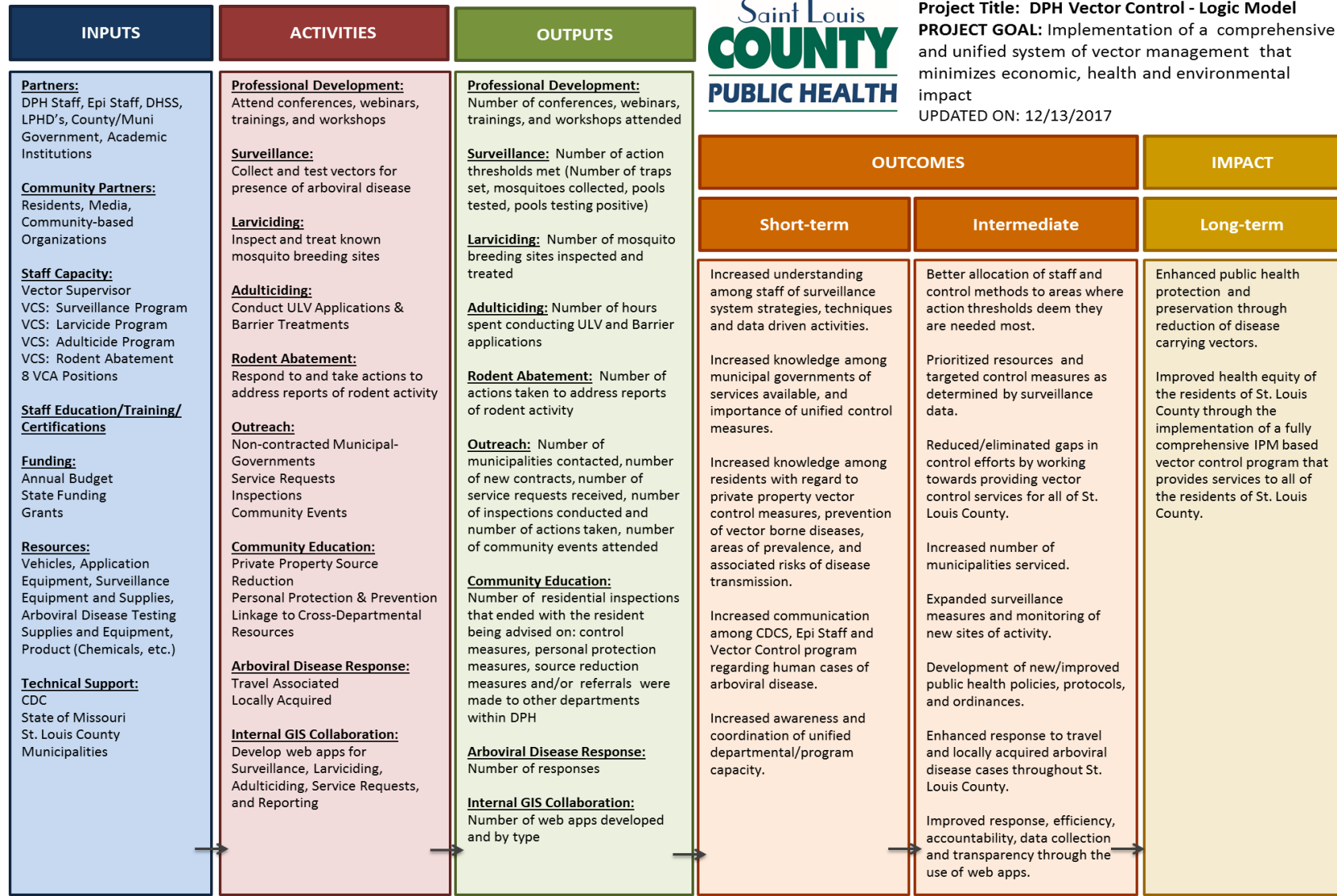
Supplemental Competencies

- ✓ 6. Licensed pesticide application
- ✓ 7. Vector control activities other than chemical control (e.g., biological, source reduction, or water management)
- ✓ 8. Community outreach and education campaigns regarding mosquitoborne diseases, how they spread, and how to prevent infection
- ✓ 9. Regular communication with local health departments regarding surveillance and epidemiology
- ✓ 10. Outreach (e.g., communication and/or cooperation) with nearby vector control programs

VIII. Appendix B: Vectorborne Diseases and Conditions Reportable in Missouri in 2018

Condition	Link to case definition
Anaplasmosis/Ehrlichiosis	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Ehrlichiosis.pdf
Arboviral diseases, neuroinvasive and non-neuroinvasive <ul style="list-style-type: none"> • California serogroup viruses, including La Crosse virus • Chikungunya virus • Eastern equine encephalitis • Powassan virus • Saint Louis encephalitis virus • Venezuelan equine encephalitis virus • West Nile virus • Western equine encephalitis virus 	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Arbovirus.pdf
Babesiosis	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Babesiosis.pdf
Dengue	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Dengue.pdf
Lyme-like disease	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Lyme.pdf
Malaria	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Malaria.pdf
Plague	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Plague.pdf
Q Fever	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/QFever.pdf
Rocky Mountain spotted fever	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/RMSF.pdf
Tularemia	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/Tularemia.pdf
Yellow fever	http://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/cdmanual/pdf/YellowFever.pdf
Zika	https://wwwn.cdc.gov/nndss/conditions/zika/case-definition/2016/06/

IX. Appendix C: Vector Control Program Logic Model



X. Appendix D: Communicable Disease Control Services and Vector Control Notification and Response of Human Arboviral Disease Case Subtype(s) Protocol

California Serogroup Viruses including La Crosse Virus	Venezuelan Equine Encephalitis Virus
St. Louis Encephalitis Virus	West Nile Virus
Eastern Equine Encephalitis Virus	Western Equine Encephalitis Virus
Zika Virus	Dengue Virus
	Chikungunya Virus

I. PROTOCOL

The Saint Louis County Department of Public Health (DPH), Division of Communicable Disease Control Services (CDCS) is charged with protecting the health of Saint Louis County residents and visitors by investigating human cases of arboviral disease, as well as providing comprehensive surveillance and control of potential disease carrying vectors. When a case of human arboviral disease is identified, CDCS Investigators will work with the CDCS Vector Control Program (VCP) to minimize the potential for further spread of virus. Information on this process can be found below. Additional information in the investigation of human arboviral disease cases may be found in the Missouri Department of Health and Senior Services (MDHSS) [Communicable Disease Investigation Reference Manual](#) (CDIRM).

II. PURPOSE

The purpose of this protocol is to provide a consistent and uniform approach for the investigation and follow-up (including environmental assessment and mitigation) of human arboviral disease cases in Saint Louis County.

III. DIVISION OF COMMUNICABLE DISEASE CONTROL SERVICES, ORGANIZATION AND RESPONSIBILITIES

A. Director, Division of Communicable Disease Control Services, Saint Louis County DPH

1. During business hours, all calls concerning reportable diseases and/or conditions are routed to CDCS. After normal business hours, the Division Director of CDCS or a designee may be notified by the DPH answering service or the MDHSS Department Situation Room (DSR) about an unusual event. Typically, human cases of arboviral disease would not be considered unusual events warranting immediate, after-hours action by the CDCS Division Director.
2. The CDCS Division Director or designee assigns cases for follow-up.
3. The CDCS Division Director will determine if a press release is necessary for specific disease occurrences (e.g., the first human arboviral disease case of a calendar year).

4. The CDCS Division Director will provide timely notification of locally-acquired human arboviral disease cases to municipalities for which the Saint Louis County DPH provides vector or pest control services.

B. Communicable Disease Control Services Case Investigators, Saint Louis County DPH

1. CDCS Investigator(s) and Epidemiologists work together to conduct ongoing surveillance to monitor health status, respond to community health problems, and identify threats to public health. Investigation and surveillance of reportable diseases/conditions are accomplished by following the guidelines presented in the MDHSS [CDIRM](#).
2. Information gathered from any investigation is relayed to the CDCS Manager and Epidemiology Program Supervisor. As appropriate, information may also be relayed to the Director of the Saint Louis County Department of Public Health, the CDCS Division Director, and/or the Senior Epidemiology Specialist of the MDHSS Eastern District (ED) Office.
3. The CDCS Manager or appropriate CDCS Investigator is responsible for communicating with the VCP Supervisor or other VCP staff, as appropriate.

C. Communicable Disease Control Services Vector Control Program, Saint Louis County DPH

1. The CDCS VCP provides vector control operations, including adult mosquito surveillance, testing of adult mosquitoes for the presence of arboviral disease, larvicidal treatment of mosquito breeding sites, and Ultra-Low Volume (ULV) applications for the control of adult mosquitoes throughout much of Saint Louis County. These activities are conducted in accordance with Integrated Pest Management (IPM) principles and are overseen by Vector Control Specialists who are licensed and certified by the Missouri Department of Agriculture in Public Health Pest Control.
2. When information on an individual with probable or confirmed arboviral disease is received by the VCP, assessment and mitigation activities are undertaken by Vector Control Specialists as described below.
3. The VCP Supervisor or appropriate Vector Control Specialist is responsible for communicating with the CDCS Manager or other CDCS Investigators, as appropriate.

IV. PROCEDURE

A. Communicable Disease Control Services Case Investigators

1. Upon receipt of a neuroinvasive or non-neuroinvasive arboviral disease subtype report, appropriate CDCS staff will verify the diagnosis and obtain pertinent epidemiologic information (e.g., demographic, clinical, and laboratory information) and ensure the appropriate data is entered into WebSurv.
2. The CDCS Investigator will follow the MDHSS [CDIRM](#) for the case definition and human investigation process.
3. If it is the first arboviral disease subtype of the year, the CDCS Investigator will notify both the CDCS Division Director and CDCS Manager. The CDCS Division Director will decide if a press release is necessary. Additionally, the CDCS Division Director will notify the DPH Director of the first human case of an arboviral disease subtype of the year. Examples of situations which may indicate a press release include:

- a. The “beginning of the mosquito season” (i.e., a prevention message informing the public about measures they can take to prevent mosquito bites);
 - b. The first West Nile virus (WNV) case and death of the season; or
 - c. The first locally acquired confirmed case of Zika virus.
3. The CDCS Investigator will notify the VCP of all probable/confirmed reportable arbovirus cases within one business day.
- a. The CDCS Investigator will email the VCP Supervisor and his/her designated backup. Within the email, the following people should be cc’ed:
 - i. all CDCS Nurse Investigators;
 - ii. the CDCS Manager;
 - iii. the CDCS Division Director; and
 - iv. the CDCS Epidemiology Program Supervisor.
 - b. The email should include the following information:
 - i. Identified arbovirus;
 - ii. WebSurv Condition ID number;
 - iii. Street name and 100 block, municipality, and ZIP code; and
 - iv. Work location/address, if appropriate and available.

Note: For probable/confirmed cases with local transmission by an Aedes spp. mosquito, (e.g., a case of Zika or chikungunya), the VCP will need the exact street address.

B. Environmental Assessment and Mitigation Summary Form

- 1. For each notification, the VCP will fill out the Environmental Assessment and Mitigation Summary form and fax it to the CDCS office at 314-615-8346. This should be done within three business days from the initial notification.
- 2. CDCS will fax the Environmental Assessment and Mitigation Summary Form to MDHSS for all probable/confirmed Zika cases. Additionally, CDCS will attach the form with the corresponding human arboviral condition report.

C. Vector Control Program, Travel-Acquired Cases

- 1. The Vector Control Specialist assigned to the case will survey the patient’s location to determine the extent/presence of the associated vector and potential vector habitat.
- 2. The Vector Control Specialist will verify that the treatment of known breeding sites is current and reapply treatment to sites as needed.
- 3. The Vector Control Specialist will conduct an environmental survey to determine the presence of any previously unknown breeding sites and apply proper treatment as needed.
- 4. The Vector Control Specialist, or other appropriate VCP staff, will conduct ULV treatment of the area using truck-mounted sprayers to reduce adult mosquito populations.

D. Vector Control Program, Locally-Acquired Cases

1. The Vector Control Specialist assigned to the case will survey the patient's location to determine the extent/presence of the associated vector and potential vector habitat.
2. The Vector Control Specialist will verify that the treatment of known breeding sites is current and reapply treatment to sites as needed.
3. The Vector Control Specialist will conduct an environmental survey to determine the presence of any previously unknown breeding sites and apply proper treatment as needed.
4. The Vector Control Specialist, or other appropriate VCP staff, will conduct ULV treatment of the area using truck-mounted sprayers to reduce adult mosquito populations.
5. The Vector Control Specialist will conduct intensified larval and adult mosquito control according to CDC recommendations (e.g., within a 150 yard radius around the local transmission source), as needed.
6. The VCP, in conjunction with other CDCS staff, will conduct a public education campaign. Components of this campaign may include:
 - a. Distribution of brochures/door hangers to residents advising them to eliminate standing water/adult mosquito harborage; and
 - b. Mosquito control/bite prevention recommendations.

E. Communication with Saint Louis County Municipalities

1. In accordance with HIPAA guidelines, the CDCS Division Director will provide timely notification to municipalities for which the Saint Louis County DPH provides vector or pest control services.

F. Patient Data Protection

1. All client information will be managed in accordance with the [Health Insurance Portability and Accountability Act of 1996 \(HIPAA\)](#), and data management guidelines established by DHSS and the Saint Louis County DPH.

XI. Appendix E: Abatement Products

Product	Active Ingredient	EPA Registration No.	Application
AquaDUET	Prallethrin Sumithrin Piperonyl Butoxide	1021-2562-8329	Adulticide
Aqua-Reslin	Permethrin Piperonyl Butoxide	432-796	Adulticide
Summit BTI	B.t.i.	6218-47	Larvicide
VectoLex WSP	Bacillus sphaericus	73049-20	Larvicide
VectoMax WSP	Bacillus sphaericus B.t.i.	73049-429	Larvicide
Fourstar Briquets (45)	Bacillus sphaericus B.t.i.	83362-3	Larvicide
Fourstar Briquets (180)	Bacillus sphaericus B.t.i.	83362-3	Larvicide
Fourstar MGB	Bacillus sphaericus B.t.i.	85685-3	Larvicide
AquaBAC xt	B.t.i.	62637-1	Larvicide
CocoBear	Mineral Oil	8329-93	Larvicide/Pupicide
Mavrik	Tau-fluvalinate	2724-478	Perimeter Control
Final	Brodifacoum	12455-89	Rodenticide
Terad 3	Cholecalciferol	12455-106	Rodenticide
Maki	Bromadiolone	7173-187	Rodenticide