Southern Nevada Health District

2017 Mosquito Surveillance Program - Activity Summary

Mosquito Disease Surveillance

2017 was a groundbreaking year for the Southern Nevada Health District's (SNHD) Vector Surveillance program. *Aedes aegypti*, the highly invasive mosquito and vector of Zika, dengue, and Chikungunya, was identified for the first time in Southern Nevada. In response, SNHD initiated its Incident Command System and mobilized the Invasive *Aedes* Response Plan. A discussion on this response, as well as a follow up to the St. Louis Encephalitis outbreak in 2016, are in this summary.

The Vector Surveillance program continued routine use of Gravid, BG Sentinel and Encephalitis Vector Surveillance (EVS) traps throughout Clark and areas of Nye County. During April through September staff set a total of 2,257 traps, comprising of 1,182 Gravid (52%), 644 Bio-Gents (BG) Sentinel (29%), and 408 Encephalitis Vector Surveillance (EVS) (18%) traps. Additionally, 19 Gravid *Aedes* Traps (GAT) and 4 emergence traps were set. From this trapping effort, 2,204 submission pools totaling 60,231 mosquitoes, were submitted to the Nevada State Department of Agriculture's Animal Disease Lab (ADL) for West Nile Virus (WNV), St. Louis Encephalitis (SLEV), and Western Equine Encephalitis (WEE) analysis. The Nevada State Department of Agriculture's Animal Disease Lab conducted arboviral analysis through the Epidemiology Laboratory Capacity (ELC) grant funding provided by the Centers for Disease Control and Prevention.

In Clark County, WNV was identified in 47 mosquito pools, totaling 1,469 mosquitoes, from 16 different zip codes. Saint Louis encephalitis was identified in 2 mosquito pools, totaling 72 mosquitoes, from 1 zip code. This was a stark contrast from 2016 where SLE was the predominant arbovirus with 180 pools testing positive and West Nile Virus being identified in only 10 submission pools. One mosquito pool, totaling 30 mosquitoes, was positive for WEE. No vertical transmission was identified from the emergence traps.

Staff coordinated surveillance activities with the Nye County Emergency Management and set 133 traps in Pahrump and Beatty, the two main population centers in Nye County. From these traps, 261 submission pools representing 7,517 mosquitoes, were submitted to the ADL for analysis. WNV was identified in two submission pools totaling 21 mosquitoes.

Tables 1- 3 detail the types and number of mosquito samples positive for arbovirus activity and maps 1 – 10 show distribution and results of surveillance activities.

In 2017, the Office of Epidemiology and Disease Surveillance (OEDS) conducted three WNV case investigations. Two were classified as probable and one was classified as a confirmed case of WNV neuroinvasive disease. Of the three cases, one was male and two were female, and the median age was 55. There was one WNV associated death. In addition to locally transmitted arbovirus investigations, OEDS conducted investigations into travel associated infections of Zika virus. In 2017, OEDS tested 91 people for Zika virus and reported 1 confirmed travel associated case and 1 probable congenital case.

The Public Information Office continued its communications program to educate the public about West Nile illnesses and prevention measures. The health district utilized social media, traditional news releases as well as media interviews. West Nile prevention messages, in both Spanish and English, were posted to the district's Twitter account and Facebook pages at least once per week between June and September and were repeated throughout the summer.

2017 – *Aedes aegypti* identification

Aedes aegypti and *Aedes albopictus* are well known to be highly invasive urban mosquitoes that vector exotic arboviruses including Dengue, Chikungunya and Yellow Fever. In 2014 SNHD enhanced existing mosquito surveillance capacity to target these mosquitoes, which had yet to be identified in Clark County. Trapping equipment specific for these vectors was purchased and deployed in areas likely for the introduction and colonization of these mosquitoes, including plant nurseries and cemeteries.

With the emergence of Zika in 2016, SNHD actively addressed the threat by developing an "Invasive *Aedes Aegypti* and *Aedes Albopictus* Mosquito-Borne Disease Response Plan", training additional Environmental Health Specialists on surveillance equipment to assist as 'surge capacity', and printing invasive *Aedes* prevention informational door hangers. Despite not being a mosquito abatement agency, SNHD augmented additional mosquito equipment and supplies for small scale, emergency larvicide and adulticide applications. Staff educated jurisdictional counterparts on *Aedes* prevention, Zika virus, and emphasized ongoing management of mosquito breeding areas. In response to reports of travel associated Zika virus cases, SNHD conducted surveillance around case-patient residences for invasive *Aedes* species mosquitoes, which have the potential to start localized transmission of the disease.

In May 2017, the vector surveillance program identified *Ae. aegypti* mosquitoes for the first time in Nevada. Staff responded to a citizen complaint of aggressive daytime biting mosquitoes at a residence and three female *Ae. aegypti* were collected from a BG Sentinel trap. Of the three initial mosquitoes captured, two were submitted to

the Nevada Department of Agriculture for ZIKA testing and one was sent to the Arbovirus Disease Branch at the Centers for Disease Control and Prevention for species confirmation.

In response, SNHD initiated its Incident Command System and mobilized the Invasive *Aedes* Response Plan. The Public Information Office coordinated a press release in conjunction with the affected jurisdiction and developed talking points for phone operators and field staff. Jurisdictional Public Works and Code Enforcement counterparts were notified and requested to inspect nearby infrastructure for mosquito breeding. Vector Surveillance staff partnered with the surge Environmental Health staff and initiated a door to door campaign in the affected area. Teams deployed an arsenal of BG Sentinel, EVS and Gravid traps in a 100-meter radius of the index home to identify the extent of the population, survey yards for potential breeding sources and place *Aedes* prevention door hangers in the community.

The community was a dense residential area with an equal mix of lush tropical vegetation and sparse desert landscaping. Staff identified larval sources including pools and spas that despite being covered had accumulated small amounts of water, a rain barrel and numerous small depressions that had filled with irrigtion water. Larvae collected from these sites were placed into containers where they emerged into *Ae. aegypti*. Breeding sources were physically removed or treated with a larvicide, and yards with *Ae. aegypti* adults were treated using handheld Ultra Low Volume (ULV) fogging machines.

During the first week of response, the team had set 184 traps at 108 homes and placed breeding prevention door hangers in the community. Seventeen sites yielded 24 *Ae. aegypti*, of which 21 were female. Geographic data indicated the *Ae. aegypti* population had extended throughout the entire neighborhood. SNHD requested approval from the municipal leadership to conduct truck mounted ULV fogging and the first residential fogging event covered 160 acres. Four truck mounted ULV events were conducted over a four-week span, however surveillance continued to demonstrate that *Ae*. *aegypti* were throughout the communities.

From May through September, staff set 611 traps in the immediate and surrounding communities with 183 female *Ae*. *aegypti* mosquitoes collected; all tested negative for Zika Virus. BG Sentinel traps where the most deployed with 64 of 400 traps capturing *Ae. aegypti* (17%), followed by Gravid, with 12 of 186 returning *Ae. aegypti* (6%), and 25 EVS which captured no *Ae. aegypti*. Trap-N-Kill oviposition traps were set as a monitoring and control tool, which proved effective as eggs were found on oviposition paper.

In an attempt to determine the genetic lineage and potential introduction of *Ae. aegypti* population into Nevada, SNHD submitted 31 male samples to the Powell Laboratory for Genetic Analysis at Yale University. According to the analysis, the most likely source of the *Ae. aegypti* are from Southern California. Of the 26 North American *Ae.*

aegypti populations included in the analysis, the closest genetic match to Las Vegas was Garden Grove, a town approximately 250 miles from Las Vegas[1]. Additionally, the Las Vegas samples had a low genetic diversity. This may indicate a founder effect, which occurs when a new colony is started by a few members of the original population.

Eradication of the invasive *Aedes* population is not expected. Staff will focus future efforts on routine surveillance to monitor the population's extent and arboviral status, as well provide community education on mosquito breeding and bite prevention.

2016 - St. Louis Encephalitis Outbreak

In 2016, the Vector Control program saw a major shift in mosquito borne disease. Typically, WNV is the most prolific virus in Clark County; however, the majority of arbovirus positive mosquitoes collected in 2016 were infected with SLEV. Prior to 2016, the only mosquitoes identified with SLEV were two submission pools of *Culex quinquefasciatus* in 2015, and the only confirmed human case was diagnosed in 2007.

In an effort to identify the mosquito's preferred host, staff collected and submitted 203 engorged female mosquitoes to the CDC Arbovirus Disease Branch for blood meal analysis. No previous studies of blood meal analysis in mosquitoes had been conducted in Nevada. *Culex quinquefasciatus* was the primary species collected and the analysis showed House Finches and House Sparrows were the most likely amplifiers of both WNV and SLEV. Blood meal analysis determined the sampled *Cx. quinquefasciatus* preferentially fed on birds, indicating a lower risk of SELV transmission to humans[2].

Additionally, the Department of Agriculture submitted SLEV isolates to the Davis Arboviral Research Lab for genomic sequencing. Analysis determined it grouped with other recent SLEV genomes from Arizona and California in 2014-2016, indicating that all those isolates shared a common origin[3].

As dramatic as the rise of SLEV was, it's abrupt disappearance is equally noteworthy. In 2017, of the 52,000 mosquitoes submitted for arboviral analysis from Clark County, only 2 submission pools totaling 72 mosquitoes (.1%) were positive for the SLEV. Conversely, WNV had a slight resurgence with 47 submission pools totaling 1,469 mosquitoes (2.8%) testing positive. No human cases of SELV were identified.

Conclusion

SNHD has developed a robust mosquito surveillance program that continues to demonstrate its value in the community. The SLEV outbreak and identification of *Aedes aegypti* are two recent examples that support this statement. Maintaining a single surveillance system across the six distinct jurisdictions of the county is the most

efficient way to ensure consistent information on vector disease prevalence and its prevention. Currently there is not a dedicated funding source for the mosquito surveillance program and ensuring its sustainability remains a challenge.

As invasive mosquito species expand geographically and the threat of arbovirus transmission continues, public health infrastructure must be equipped and ready to mobilize. Despite ongoing resource challenges, SNHD has proven to be a leader in the community regarding vector borne disease surveillance, targeted control and public health education.

References:

1. Pless, E., Powell, J. (2018). [Genetic analysis of Las Vegas *Aedes aegypti* samples]. Unpublished raw data.
2. Hannon, E. et al. (2018) *Blood Meal Host Selection of the Southern House Mosquito During and Arbovirus Outbreak in Las Vegas Nevada, USA.* Unpublished Manuscript.
3. Symmes, K., Stuart, J., Coffey, L. (2018). [Genetic analysis of Las Vegas SLEV samples]. Unpublished raw data.

2017 Mosquito Surveillance Activities

Table 1: Numerical Distribution of Traps Set, Mosquitoes Samples and Results

Jurisdiction	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
City of Las Vegas (CLV)	638	22,160	896	0	30
Unincorporated Clark County (CC)	493	11,677	195	72	0
City of North Las Vegas (NLV)	633	6,764	125	0	0
City of Henderson (COH)	231	8,250	93	0	0
Boulder City (BC)	35	231	0	0	0
City of Mesquite	33	849	60	0	0
Paiute Reservation	32	2,749	100	0	0
Total	**2,095**	**52,680**	**1,469**	**72**	**30**
Nye County	133	7,517	21	0	0
Total	**133**	**7,517**	**21**	**0**	**0**

Table 2: Arbovirus Positive Mosquito Species and Number – Clark County

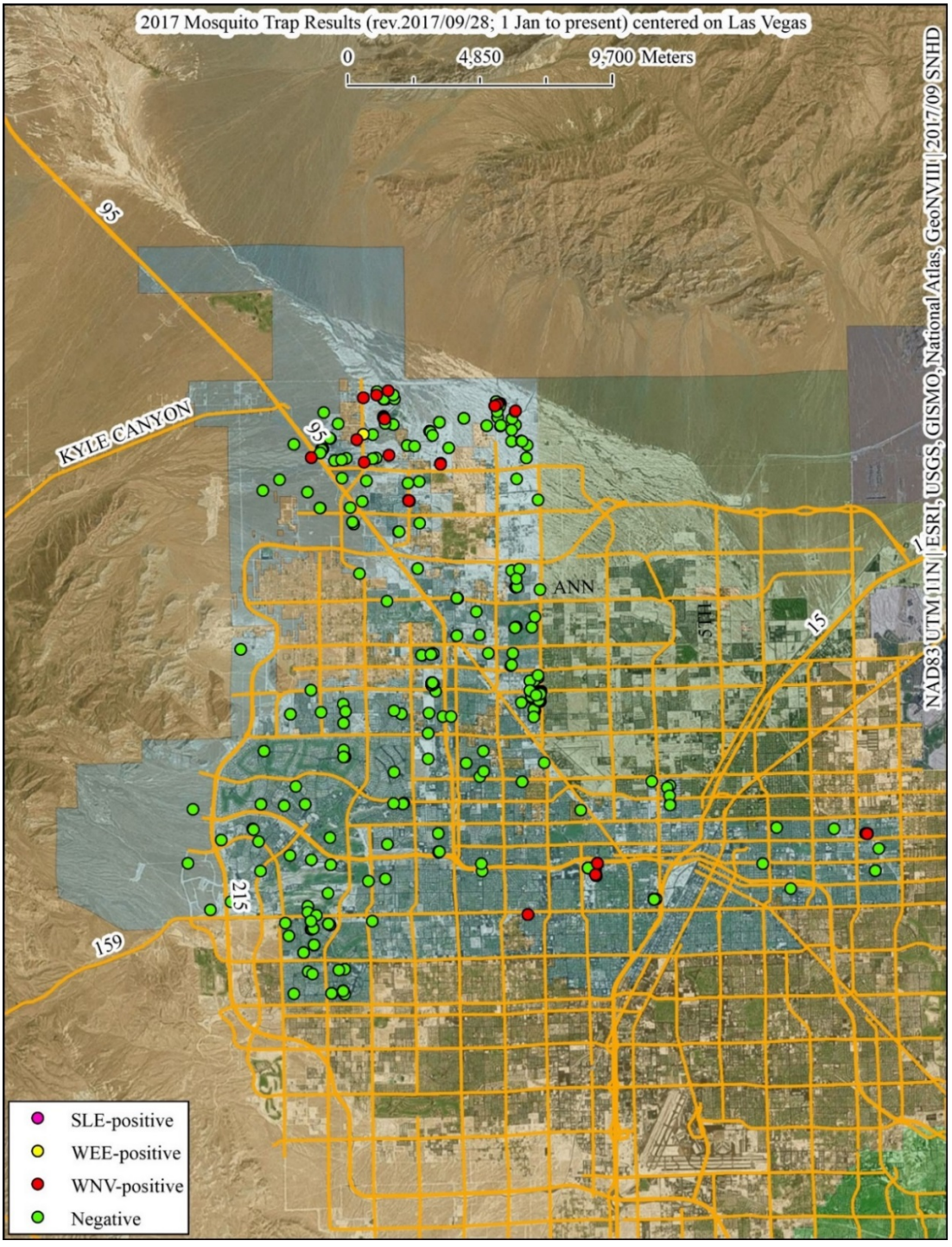
Mosquito Species	# WNV Mosquitoes	# of WNV + Pools	# SLE + Mosquitoes	# of SLE + Pools	# WEE Mosquitoes	# of WEE + Pools
Ae. aegypti	1	1	0	0	0	0
Ae. vexans	95	3	0	0	0	0
Cx. quinquefasciatus	1,098	35	72	2	30	1
Cx. tarsalis	173	5	0	0	0	0
Ps. signipennis	102	3	0	0	0	0
Total	**1,469**	**47**	**72**	**2**	**30**	**1**

Table 3: Arbovirus Positive Mosquito Species and Number – Nye County

Mosquito Species	# WNV Mosquitoes	# of WNV + Pools	# SLE + Mosquitoes	# of SLE + Pools	# WEE Mosquitoes	# of WEE + Pools
Cx. quinquefasciatus	6	35	0	0	0	0
Cx. tarsalis	15	5	0	0	0	0
Total	**21**	**2**	**0**	**0**	**0**	**0**

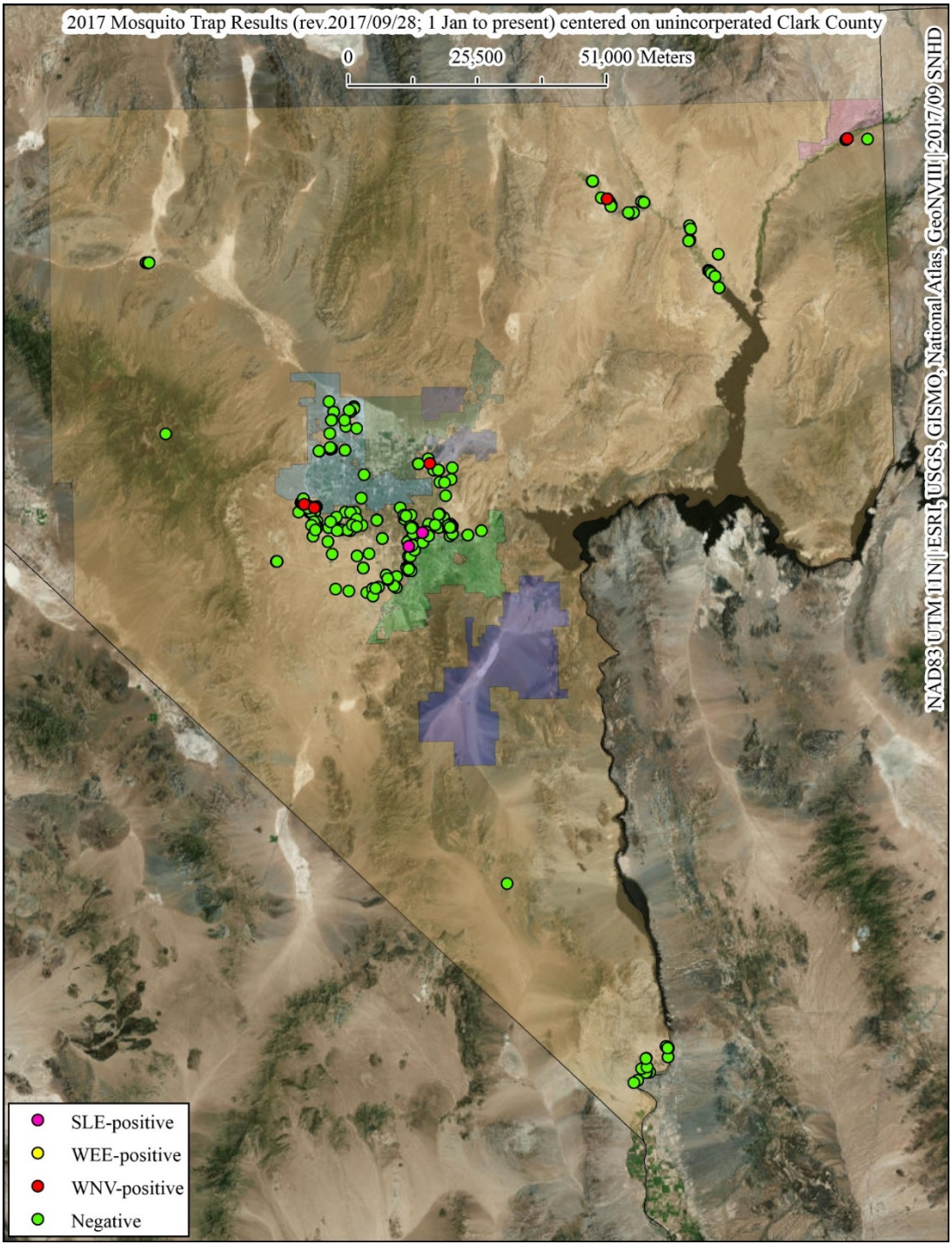
Map 1: City of Las Vegas - Mosquito Surveillance Distribution and Results

City of Las Vegas (CLV)					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	638	22,160	896	0	30

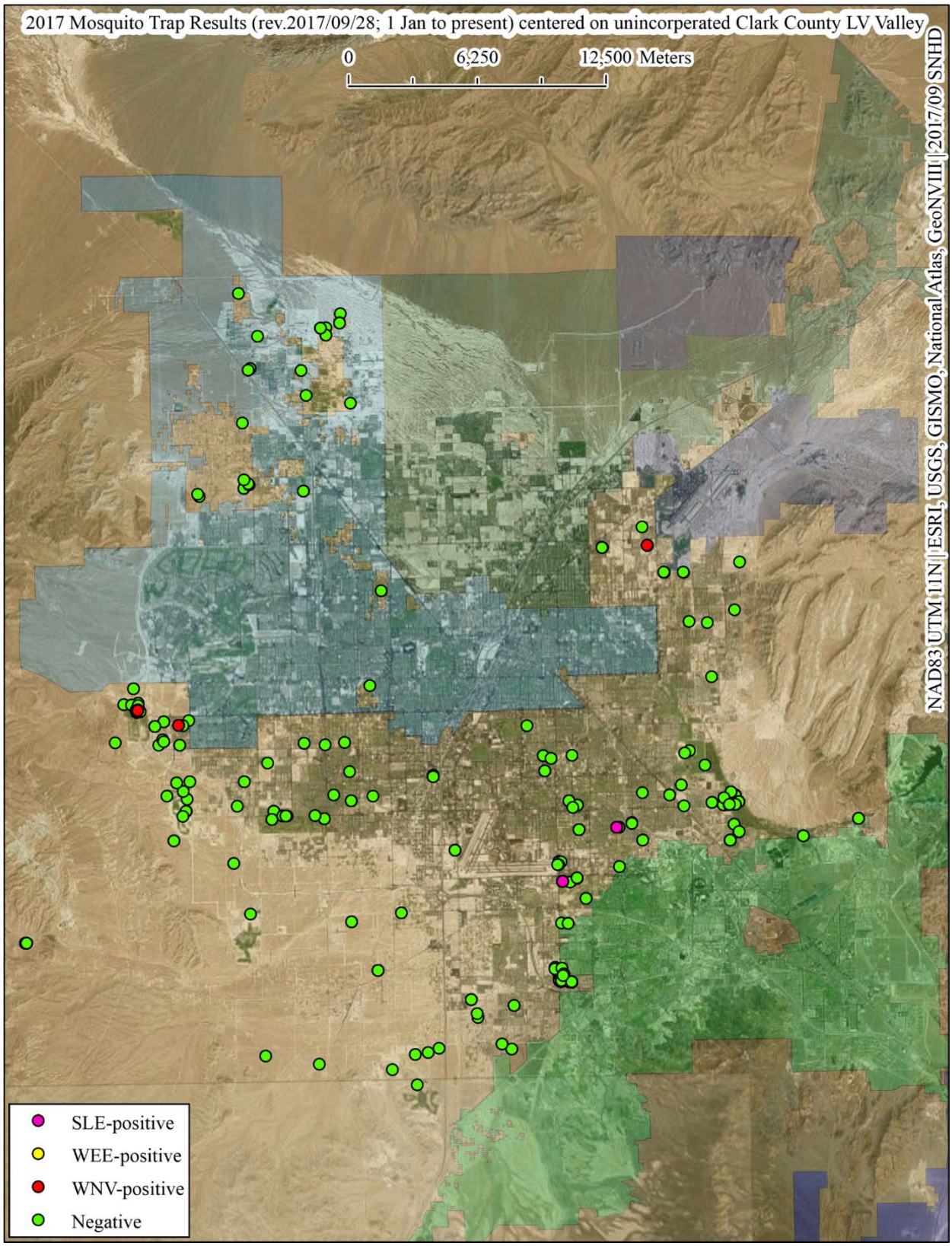


Map 2: Unincorporated Clark County - Mosquito Surveillance Distribution and Results

Unincorporated Clark County (CC)					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	493	11,677	195	72	0

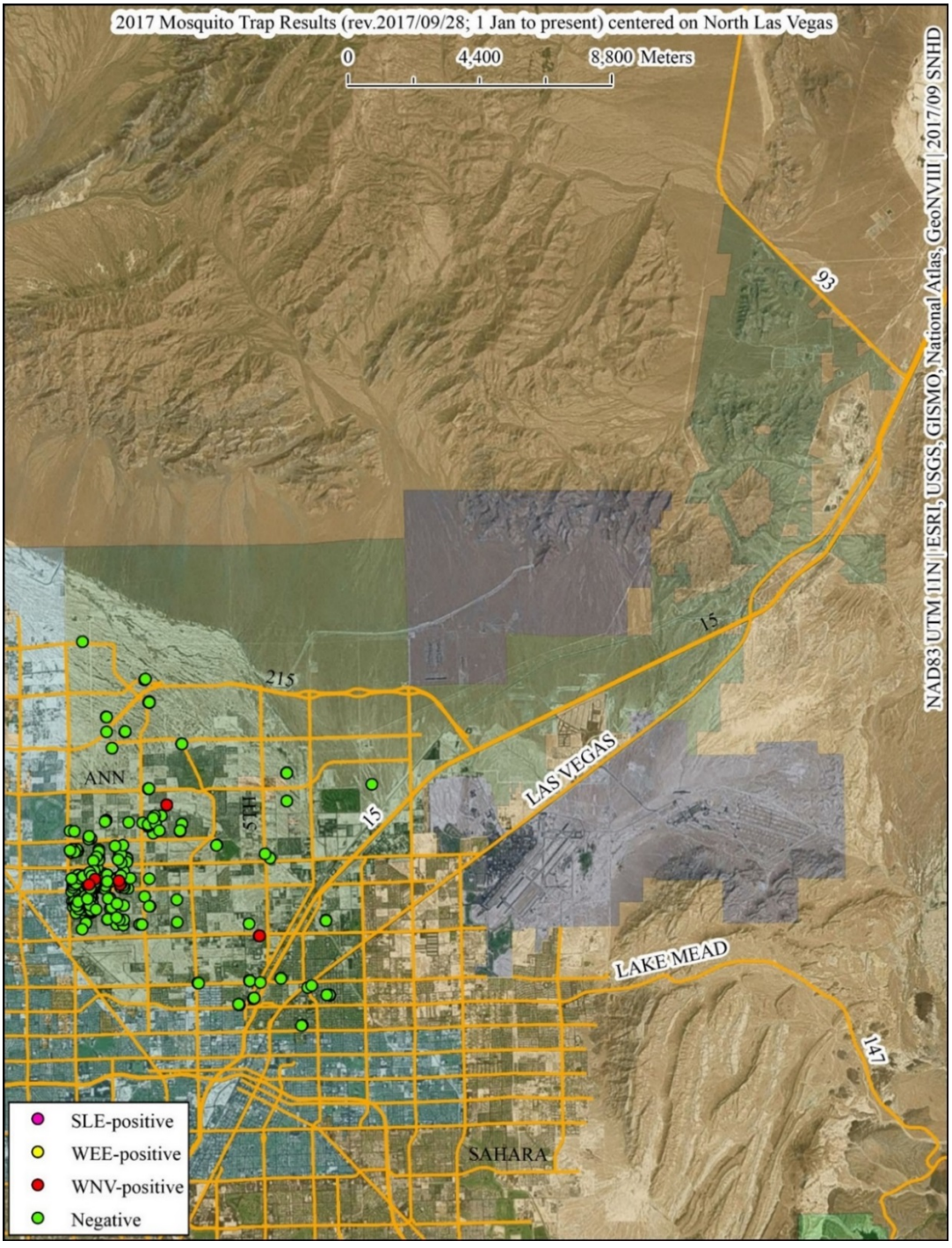


Map 3: Urban Unincorporated Clark County - Mosquito Surveillance Distribution and Results

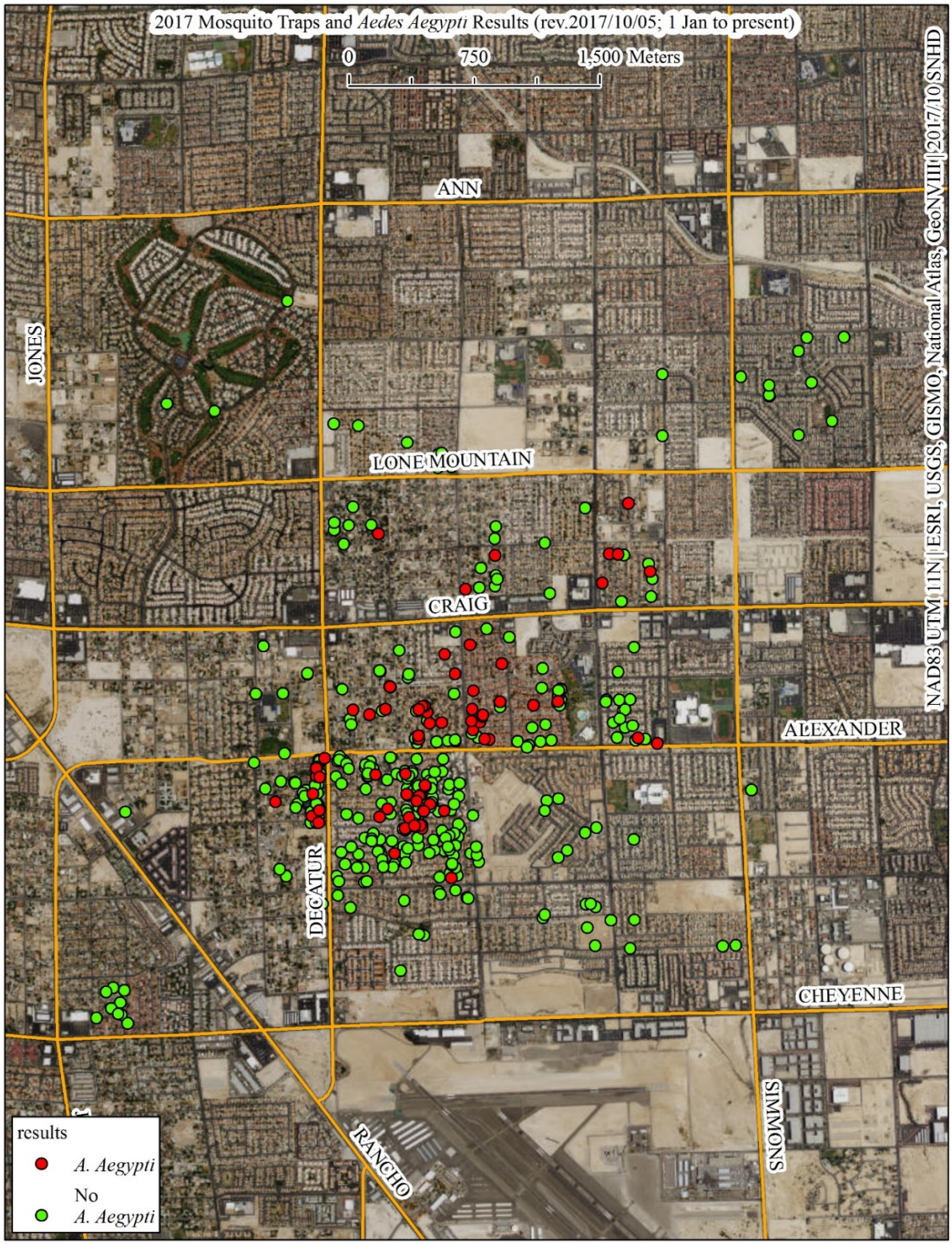


Map 4: City of North Las Vegas - Mosquito Surveillance Distribution and Results

City of North Las Vegas (NLV)					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	633	6,764	125	0	0

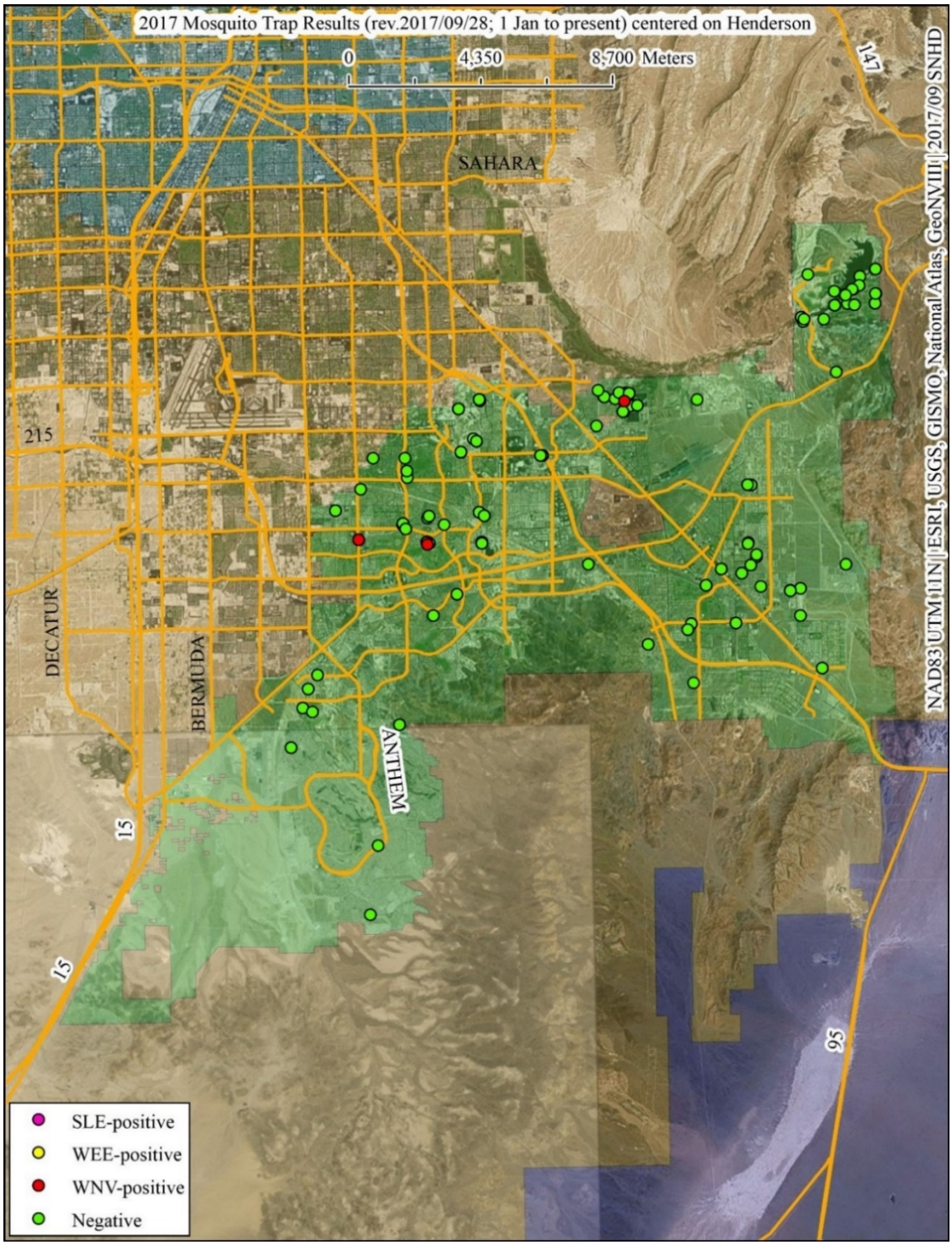


Map 5 – North Las Vegas: Targeted *Aedes* Surveillance



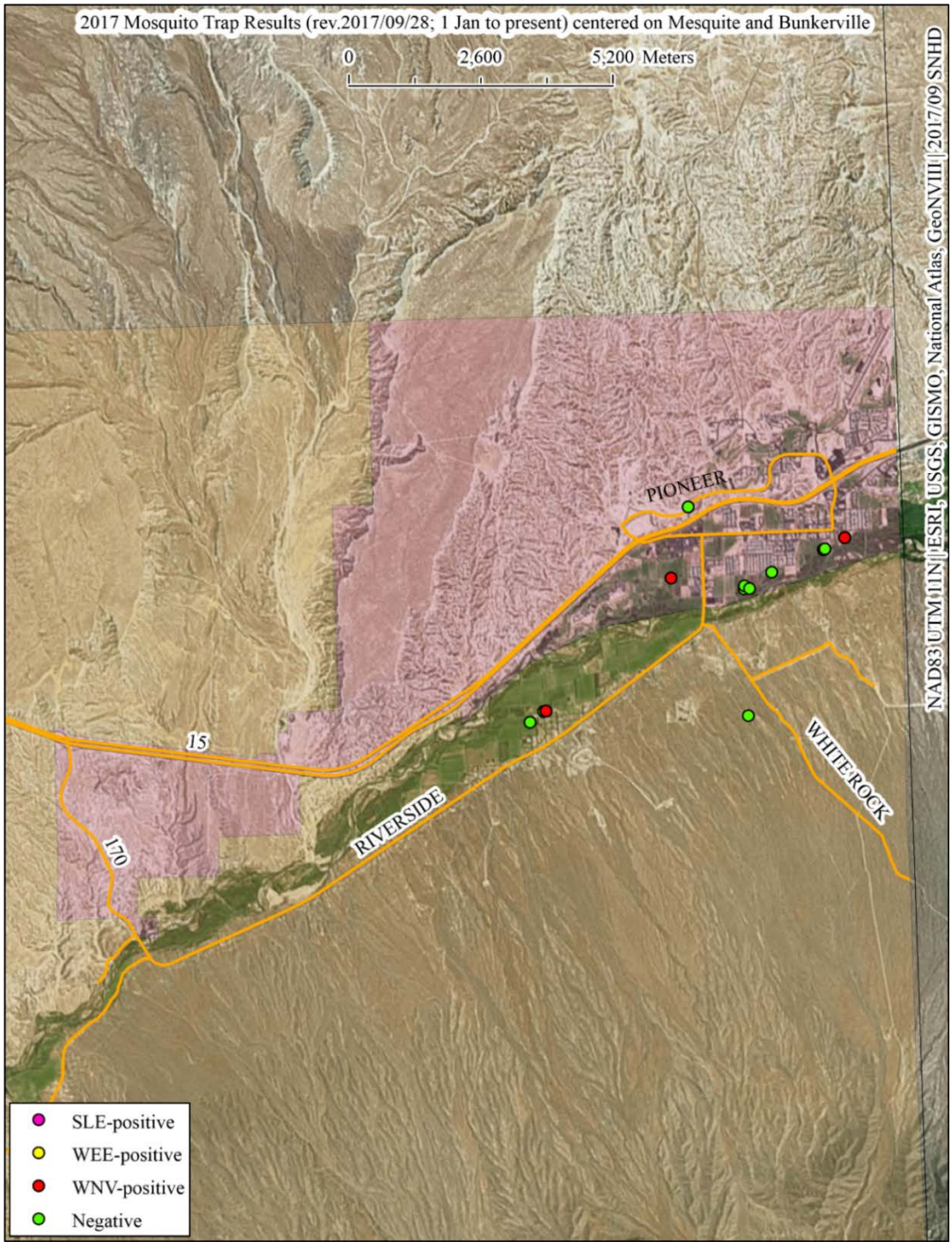
Map 6: City of Henderson - Mosquito Surveillance Distribution and Results

City of Henderson (COH)					
2017	231	8,250	93	0	0



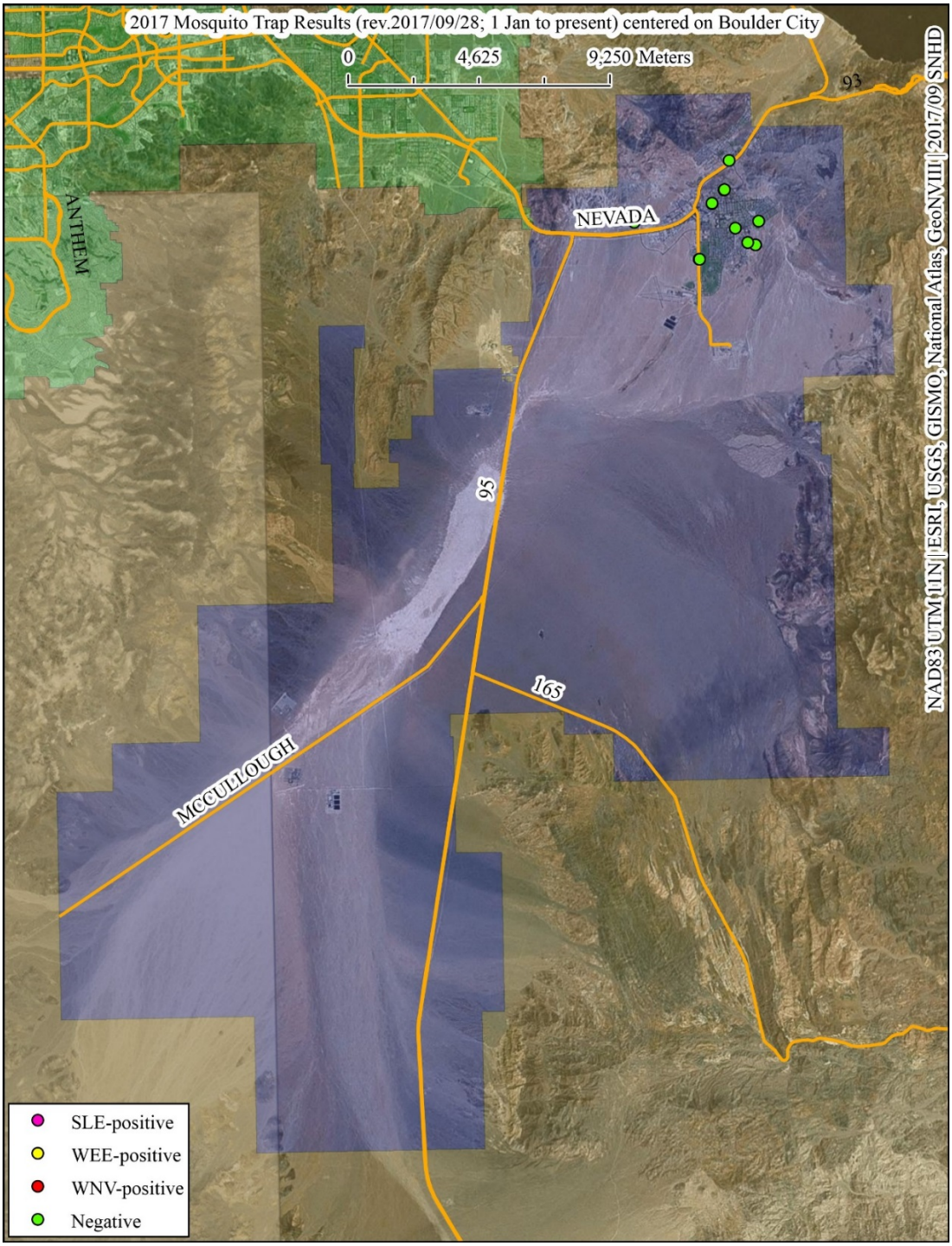
Map 7: City of Mesquite / Bunkerville (Unincorporated) - Mosquito Surveillance Distribution and Results

City of Mesquite					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	33	849	60	0	0



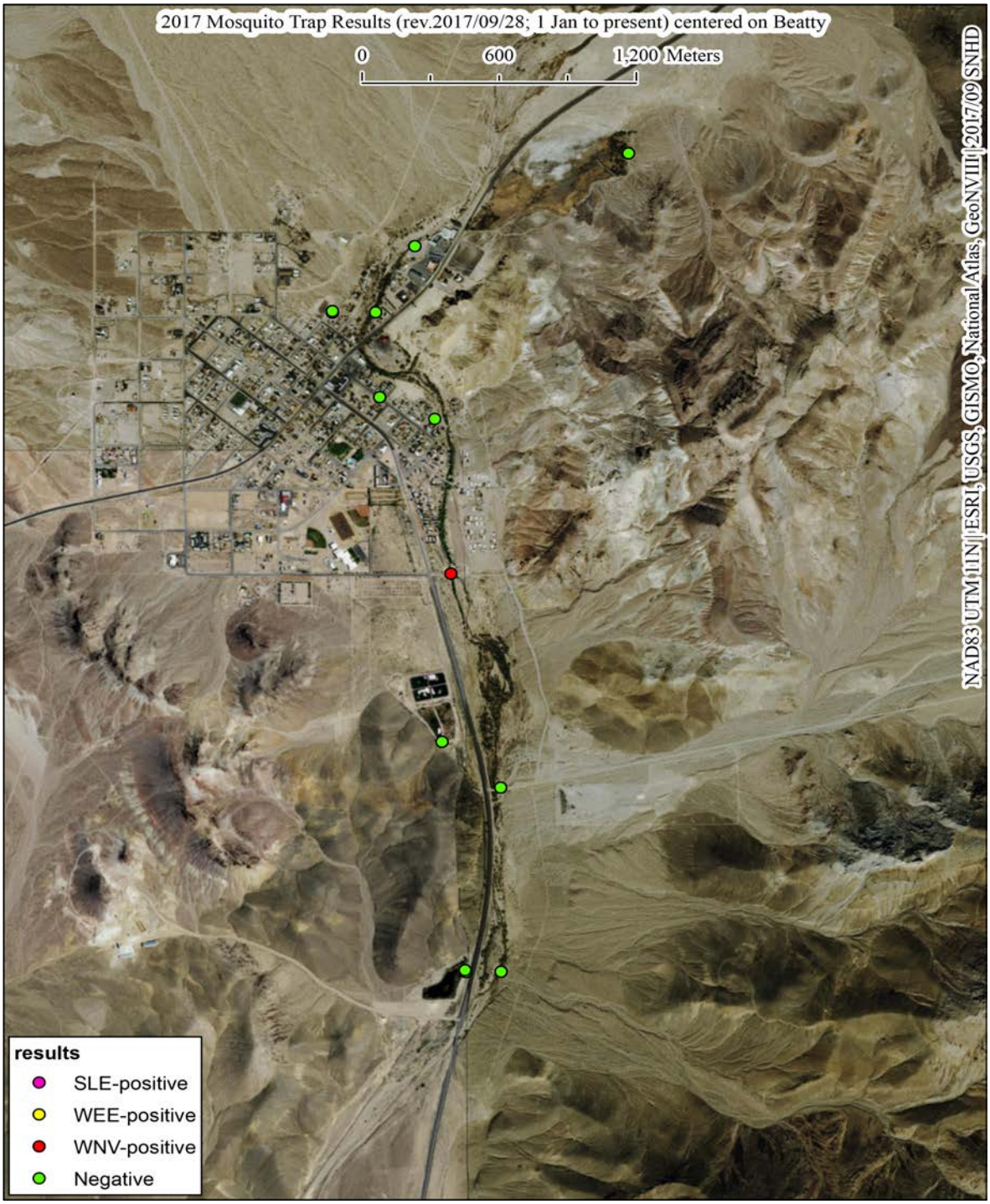
Map 8: Boulder City - Mosquito Surveillance Distribution and Results

City of Boulder City					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	35	231	0	0	0



Map 9: Beatty, NV (Nye County) - Mosquito Surveillance Distribution and Results

Nye County					
Year	Traps	Mosquitoes Tested	WNV + Mosquitoes	SLE + Mosquitoes	WEE + Mosquitoes
2017	133	7,517	21	0	0



Map 10: Pahrump, NV (Nye County) - Mosquito Surveillance Distribution and Results