2021

SUFFOLK COUNTY

DEPARTMENT OF PUBLIC WORKS

DIVISION OF VECTOR CONTROL

ANNUAL PLAN OF WORK

Vector Control crews installing coir logs to aid filling of mosquito ditches as part of a wetland restoration project at Gardiner County Park in West Islip

Suffolk County Vector Control

Mission

Suffolk County Vector Control seeks to protect public health and welfare by reducing disease incidence and impacts caused by mosquitoes and ticks in an environmentally sensitive approach.

Governance

The Suffolk County Department of Public Works, Division of Vector Control is responsible under the County Charter to use every means feasible and practical to suppress mosquitoes, ticks and other arthropods which are vectors of human disease requiring public action for their control §C8-4(B). The Division's responsibility is to control infestations of mosquitos, ticks and other arthropods that significantly threaten public health, or create social or economic problems for the communities in which they occur. The Division meets its responsibilities in consultation with the Suffolk County Department of Health Services (SCDHS) and appropriate federal, state and local agencies.

Executive Summary

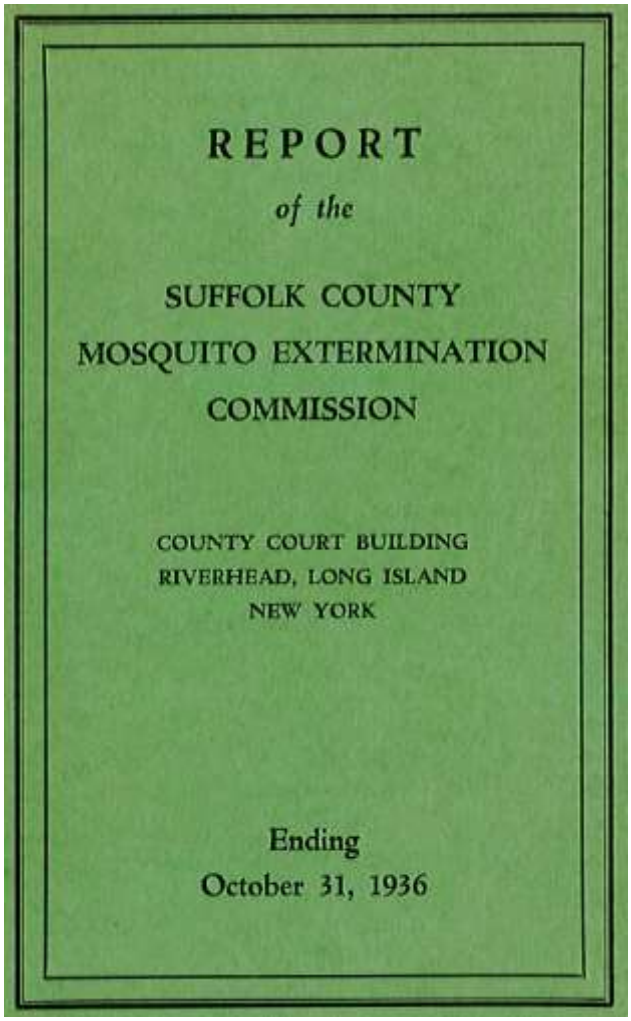
The Suffolk County Department of Public Works – Vector Control Division seeks to control mosquitoes and ticks of public health importance using integrated management techniques in an environmentally sensitive manner. Protection of Suffolk County resident and visitor's health who appreciate our picturesque towns and villages is carried out using best practices which are least impactful to the environment. This report reviews SCVC accomplishments for 2020 and presents its operational plans for 2021.

Using an integrated holistic approach need not only incorporate control or 'spraying' of the insect; but an understanding of the insect's life cycle and when and how to best to target the pest. The components of a successful integrated pest management (IPM) plan include biology of the species and its habitat, population surveillance and various control strategies using best practices during each stage of the insect's development. SCVC continues to monitor its control program and adopt new materials and techniques that best control the pest species in an environmentally judicious way.

The 2021 Vector Control Plan of Work has been developed to give the reader an improved understanding of the overall Suffolk County mosquito and tick control program. The Plan includes a summary of the 2020 season and issues of discussion that deserve mention. In addition, the 2021 Plan of Work will address future program goals during the upcoming year. This format returns to the early roots of Suffolk County's mosquito control program where an Annual Report was released that included a historical overview of the its yearly operations.

Background

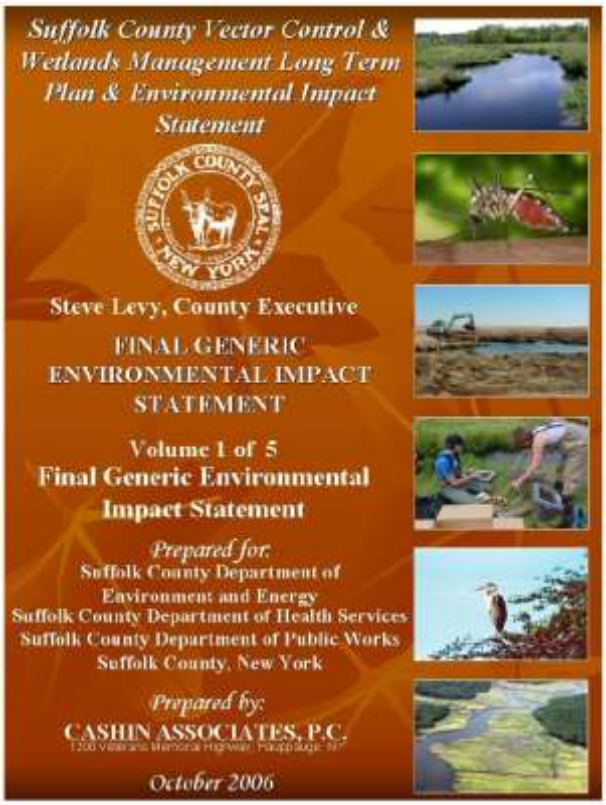
Suffolk County has a long history of mosquito control efforts that first began under the United States Department of Agriculture (USDA) in 1900 with experimental projects for malaria and salt marsh mosquito control. Additional control efforts were often undertaken by owners of large estates and resorts located along the coastline seeking control of salt marsh mosquitoes through private ditch construction. Demand for a structured mosquito control program grew in Suffolk as effective levels of mosquito control were seen in Nassau County, New York City and New Jersey through both wetland filling and the ditching of marshes. In 1933, a countywide mosquito control program began under the Suffolk County Emergency Work Relief Bureau, which provided jobs during the Great Depression. The Suffolk County Mosquito Extermination Commission was later created in 1934 to unite the individual town and private mosquito control efforts under a central agency. A significant increase in mosquito control efforts was further funded under the Federal Works Project Administration (WPA) in 1937 employing over 650 workers to assist the Suffolk County Mosquito Extermination Commission. It was during the years of 1933-1938 that the majority of our 9.5 million feet of mosquito ditches were created throughout Suffolk through these agencies. Mosquito control continued in Suffolk County through the Mosquito Control Commission from 1934 to 1974. The Commission consisted of the Mosquito Control Superintendent, a Board of Directors and included one representative from the Suffolk County townships through the Chair of the Board of Supervisors, as an ex-officio member of the Commission.



In 1974, the Suffolk County Charter was amended to transfer the mosquito control functions and authority from the Mosquito Control Commission to the Suffolk County Department of Health Services, Division of Public Health, Bureau of Vector Control. During 1992, due to budget deficits, the county legislature transferred Vector Control from Health Services to the Department of Public Works, Division of Vector Control where the program continues to reside today.

Annual Plan of Work Requirements

The Suffolk County Charter and New York State law requires an annual Vector Control plan of work for the succeeding year be submitted by resolution for legislative approval each year. This Plan of Work has been prepared pursuant to and in compliance with the Vector Control and Wetlands Management Long Term Plan and Generic Environmental Impact Statement (the Long Term Plan). The Long Term Plan was approved by the County Legislature as Resolution 285-2007 on March 20, 2007 and signed by the County Executive on March 22, 2007. The 2021 Annual Plan of Work is therefore governed by State Environmental Quality Review Act (SEQRA) Regulation 617.10(d)(1) which provides the following: "When a final generic EIS has been filed under this part (1) no further SEQR compliance is required if a subsequent proposed action will be carried out in conformance with the conditions and thresholds established for such actions in the generic EIS or its findings statement." This issue is also discussed in the Findings, appended hereto, pages 7 and 58. The 2015 Plan of Work added the use of a new active ingredient, prallethrin, which required a modification of the Long Term Plan. In accordance with the Findings, a SEQR review of prallethrin was conducted in order to allow the use of the new active ingredient. This review was completed with the issuance of a Negative Declaration as CEQ Resolution 34-2014 and the modification of the Long Term Plan approved by the Legislature as Resolution 706-2014.



This Annual Plan complies with the reporting requirements in Executive Order 15-2007 (Suffolk County Vector Control Pesticide Management Committee) and Resolution 285-2007 (which adopted the Findings Statement for the Long-Term Plan). The reporting requirements of Resolution 285-2007 are satisfied within this Annual Plan, and the Pesticide Management Committee submits a report to CEQ independently to satisfy Executive Order 15-2007.

Mosquito Control - IPM

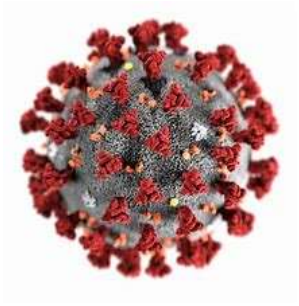
The Vector Control Division employs an integrated control program also referred to as integrated pest management or IPM. Control measures are employed in a hierarchical manner that emphasizes prevention of the pest species and is guided by an active surveillance program to ensure that control measures are only directed to address a clear need. Control proceeds from long-term, environmentally sound measures such as wetland management, to use of biological controls, use of highly specific larvicides, and only incorporates chemical control for adulticiding if other measures prove to be either insufficient or not feasible. This integrated approach is recognized as the most effective and environmentally sound manner in which to conduct a mosquito control program.

Because mosquitoes are of high public health importance, the Division works closely with SCDHS Arthropod Borne Disease Laboratory (ABDL). The ABDL concentrates its efforts on surveillance for mosquito-borne pathogens, primarily the arboviruses West Nile Virus (WNV), Zika and Eastern Equine Encephalitis (EEE). The Vector Control Division conducts laboratory work that concentrates on estimating populations of mosquito adults and larvae identification. The Division also conducts laboratory work related to special projects designed to improve the control program and to evaluate the impacts of wetlands management. The results of this surveillance are used to guide and evaluate the Division's ongoing control work.

During times of a declared public health threat, the Division comes under the operational control of SCDHS. However, these declarations are infrequent and are issued by the New York State Health Commissioner as was the case in 2019 with the finding of EEE in Manorville.

The New York State Department of Health (NYSDOH) provides important support to the program by analyzing mosquito samples for pathogens, providing technical advice and guidelines and determining when a public health threat declaration is required. NYSDOH also provides significant assistance with public education, as well as financial aid for vector surveillance and control. Because mosquito control involves work in environmentally sensitive areas and the use of pesticides, environmental compliance and protection are important components of the program. The Division is heavily regulated and subject to inspection under a series of New York State Department of Environmental Conservation (DEC) permits, as well as regulations pertaining to the use of pesticides and licensing of applicators. Close contact is maintained with DEC, United States Fish and Wildlife Services (USFWS), EPA and other agencies throughout the year to ensure that all work is conducted to a high environmental standard.

COVID-19 (SARS-CoV-2) Impacts on SC Vector Control



The finding of COVID-19 has had serious impacts on everyone, including Vector Control's program. The timing of the virus' arrival in Suffolk County occurred as Vector's field crews were busy working on a wetland restoration project. All field work was stopped on the project in mid-March and crews were told to remain on-call for new assignments. Within days, SC Fire Rescue and Emergency Services (FRES) reached out to Public Works seeking assistance and Vector's crews readily stepped up to help. Vector Control field staff assisted the SC Fire Marshal's Office to collect donated personal protective equipment (PPE) for redistribution to hospitals, nursing homes and other critical need programs throughout Suffolk. Office staff were tasked with assisting in making Covid notifications to residents who tested positive for the virus, contact tracing of potential exposures and other related tasks as required. Assistance at FRES continued till May 4th when Vector's staff resumed mosquito control operations. Vector Control's public health protection services from arthropod-borne diseases such as West Nile and EEE is designated as an essential service.

2020 Climate Summary and Impacts to Mosquito Populations

Climate can impact mosquito numbers in vast ways. From a lite summer rain storm that fills containers and causes an emergence of backyard mosquitoes to a hurricane that floods marshes and forests that result in massive floodwater mosquito emergences. Warm, dry summers can result in WNV ramping up with spillover to humans, while wet cool spring weather may favor swamp dwelling mosquitoes and result in EEE findings. Each year is unique, much like the winter snow storm events, with planning for the coming mosquito season is near impossible. An isolated shower in one part of Long Island may never impact other areas, but the lasting effects of that isolated shower may result in mosquitoes in the community for several weeks. Each year the Vector Control program can only prep for an average mosquito season and must respond accordingly as the season progresses. The following summary shows the climatic conditions leading into the 2020 summer season and how these events helped shape this year's mosquito season.

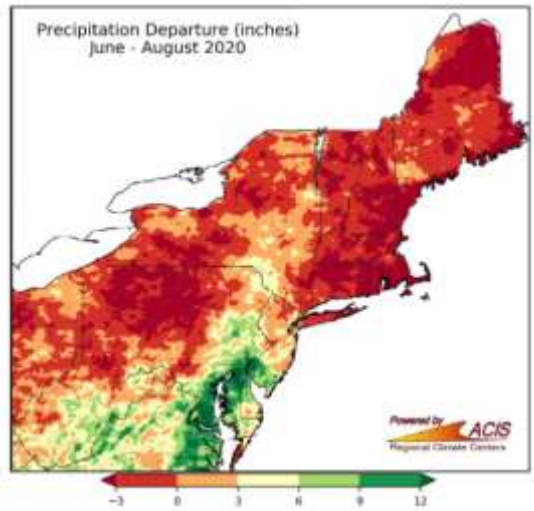
Spring 2020 (March – May)

The spring of 2020 was significantly drier than normal and mixed in terms of temperature. The total precipitation during the March to May Spring period was 9.99 inches which is 20% less (-2.57 inches) than the 30-year average of 12.56 inches. The March precipitation was 0.24 inches below normal while the 1.22 inches of precipitation during May was a significant 2.56 inches below normal.

The mean temperature for March was significantly above normal while the mean temperatures for April and May were both a bit below the normal 30-year averages for each month.

Summer 2020 (June – August)

The summer of 2020 was drier and considerably warmer than normal (Fig 1). The total precipitation was 9.96 inches, which is approximately 15% less than the 30-year average of 11.68 inches. The driest month was June with a large precipitation deficit of 2.71 inches. August was also on the dry side with a precipitation deficit of 0.73 inches. Precipitation was actually above normal during July with a surplus of 1.72 inches which is around 50% above normal. The above normal precipitation at Islip MacArthur Airport during July was due to patchy local thunderstorms that did not affect the county equally.



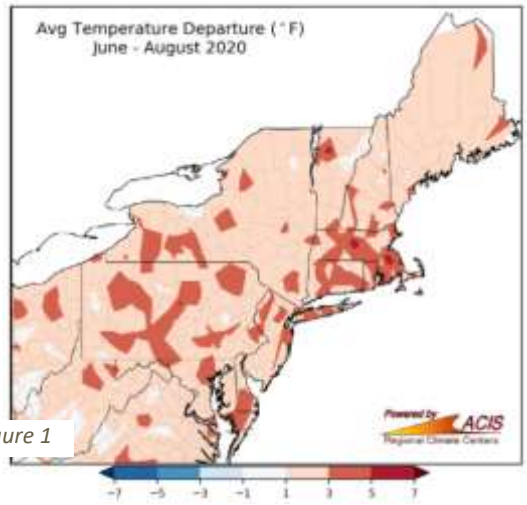


Figure 1

The mean temperatures for each of the three summer months were above the 30-year normal for the summer. July experienced temperatures that were significantly above normal. The average July temperature of 77.7 degrees F was a 3.8 degrees F above the normal July average temperature of 73.9 degrees F.

It should be noted that certain areas on the eastern end of Long Island had considerably less precipitation during the summer of 2020 which was noted by abnormally dry soil conditions in the agricultural areas on the east-end.

Overall Season - Spring and Summer 2020

Generally the six month period of March through August of 2020, in Suffolk County New York, was warmer and drier than normal. The months of May and June were very dry with a precipitation deficit of well over 5 inches at the airport. July was the wettest month with a precipitation surplus of 1.72 inches at the airport but these wet conditions were not noted in all sections of Suffolk County. Most areas east of the Islip MacArthur airport experienced less rainfall during July. As is very common during the summer months the western areas of Suffolk County received more rainfall than central and eastern sections.

Above normal summer temperatures were evident in all three summer months of 2020. With the six month spring/summer season experiencing above normal temperatures, with only April coming in 2.0 degrees cooler than normal and May averaging 0.9 degrees below normal.

Weather Impacts on Mosquito Control and Disease

Rainfall summary for the spring and summer of 2020 was quite different from the wet spring in 2019. The dry conditions were prime for West Nile virus amplification during May-June (Figure 2), a crucial time for virus development. We have found above average temperatures during

May and June, with below average precipitation events in Suffolk County to significantly increase West Nile development. While we had dry conditions during the summer of 2020, the April and May average temperatures were below normal, delaying WNV development and resulting in a low season for WNV positive mosquito pools and human cases in Suffolk County.

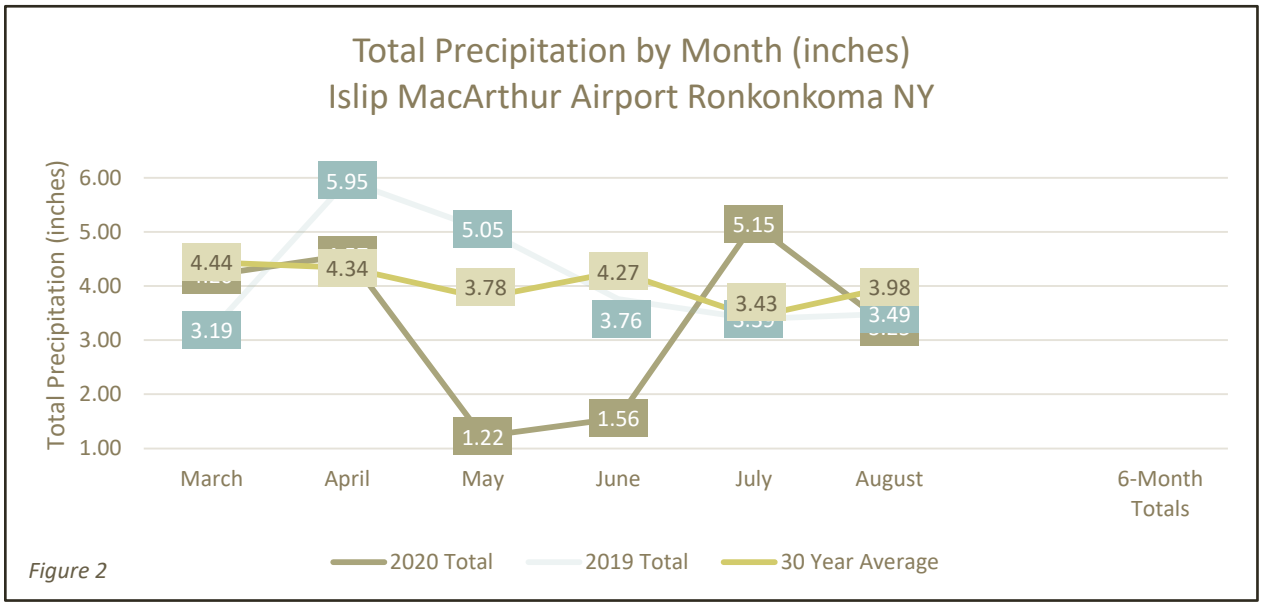


Figure 2

The dry spring weather, and drop in groundwater levels from 2019's elevated levels greatly impacted on our Eastern Equine Encephalitis (EEE) findings. EEE virus is predominately found in the red maple/cedar swamps that are the breeding ground for the *Culiseta melanura* mosquito. Melanura larvae develop in the root crypts under these trees in freshwater swamps, and their numbers are tied closely to fluctuating water levels. Because the larvae overwinter in these swamps, a wet winter/spring with high water levels in the swamps can cause these mosquitoes to emerge in great numbers in the spring. Dry winters, or areas with draw-down of impounded water (managed dams) over the winter can greatly reduce the numbers of *Culiseta melanura*.

Early reports of EEE virus findings in our neighboring States and upstate NY were concerning that 2020 would be a repeat of our 2019 EEE findings. Dry spring conditions in 2020, a low water table and a relatively dry winter/spring season resulted in low numbers of *Culiseta melanura* mosquitoes and greatly reduced potential for EEE findings here in Suffolk. While EEE can be a health concern through the first hard frost, trap data and cooler September conditions should minimize EEE findings for 2020.

USGS Groundwater Monitoring, Tides and Potential Mosquito Impacts

The 2020 mosquito season continued to trend as a relatively low year for much of Suffolk County, similar to our 2019 findings. A comparison to New Jersey's 2020 mosquito control program summary shows that NJ had salt marsh mosquitoes at or above their expected average levels, differing greatly from Suffolk's findings. While we did conduct aerial mosquito larval control of our salt marshes six times over the 2020 season, there were multiple weeks that did not produce extensive mosquito larvae in the salt marshes requiring aerial treatment. Spring moon

tides (full and new moon tides) for Great South Bay were generally lower during the summer for 2020 and did not flood the marshes as extensively. Peak tides for 2021 show the trend may shift next year to the summer months and could result in the return of significant numbers of salt marsh mosquitoes.

Groundwater levels during the summer of 2020 were below normal as seen from a USGS groundwater well at Smith Point in Shirley (Fig 3), which is in close proximity to several SCVC treated salt marshes. The prolonged low water table did help dry down the marshes, but spring tide events over the summer also trended below normal and may not have flooded the marshes long enough to support mosquito development. The combination of a low water table and reduce tidal flooding hastened the marshes draining and reducing the amount of standing water on the marsh required for larval development. The Groundwater well data also supports the observed absence of EEE activity in Suffolk County during 2020, with the low water table and drought-like conditions resulting in a less conducive environment for *Culiseta melanura* larval development in the freshwater swamps.

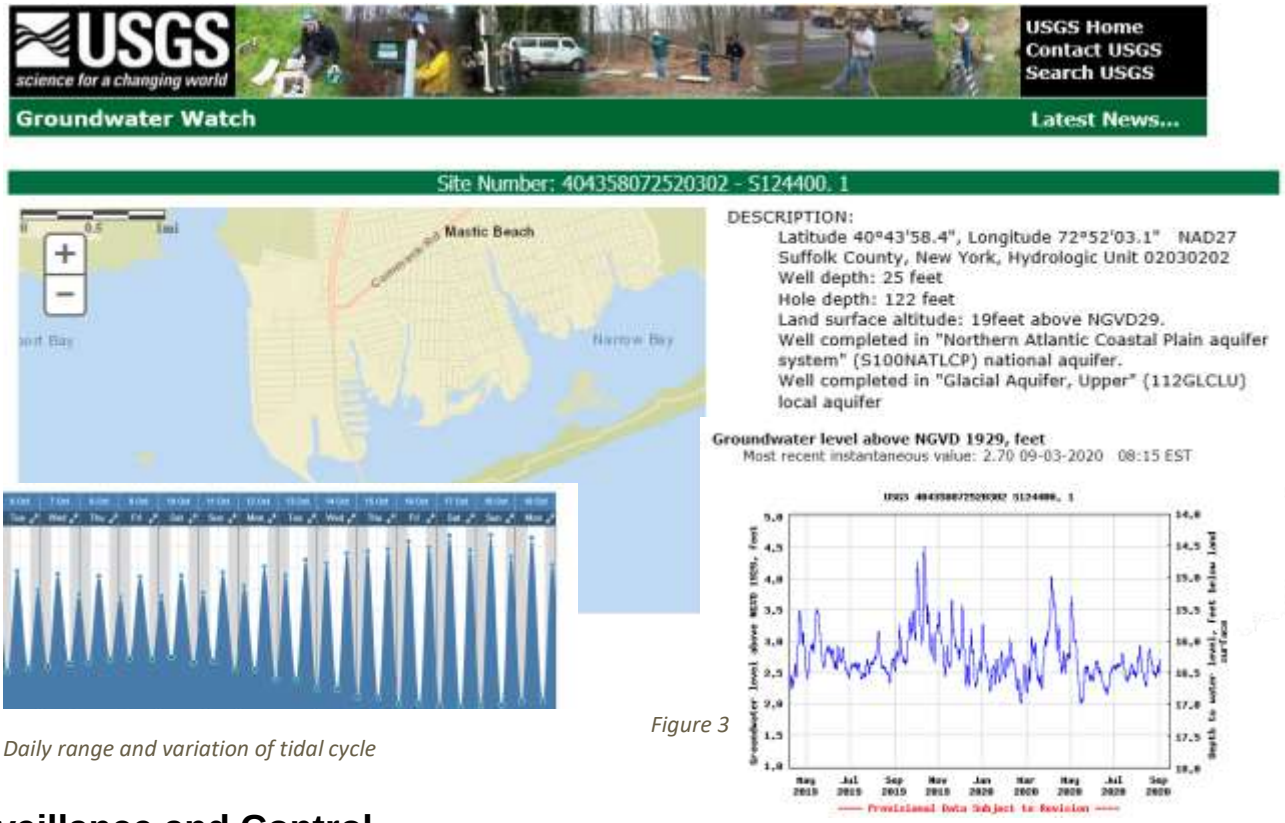


Figure 3

Daily range and variation of tidal cycle

Surveillance and Control

The Suffolk County Health Department's Arthropod Borne Disease Lab (ABDL) conducts surveillance for mosquito-borne viruses that pose a risk to human health. Activities performed include mosquito trapping and species identification for testing of mosquitoes and birds for disease, determining local areas of high risk, and providing surveillance information to assist SCVC in making control decisions. Efforts focus on WNV and EEE, which are the most common mosquito-borne viruses and pose the greatest public health risk in Suffolk County; but also includes monitoring for Zika and other introduced diseases.

West Nile

Virus isolations of what eventually was determined to be West Nile virus were first identified in NYC during the summer of 1999. Shortly after NYC's findings of WNV, including several human cases and deaths, Suffolk County also began to find isolations in mosquitoes and human cases of the disease. Virus isolations of mosquitoes carrying West Nile virus, reports of dead birds and human cases of WNV, has become an annual part of Suffolk County's Vector Control program. Vector Control in consultation with Suffolk County and NYS Health Departments reviews each year's virus isolations and on a weekly basis reviews risk to human health. The first years of WNV found clusters of mosquito isolations and human cases, but over the last several years WNV isolations and human cases have become more dispersed and haven't clustered in 'hot spots'.

Prevention is the key component to the limiting the number of human cases of WNV. Public education and larval source reduction or elimination of breeding sites is key to reducing risk. In addition, early larvicide of historic WNV breeding sites such as catch basins in high risk areas, and treatment of abandoned swimming pools and recharge basins/sumps help limit the number of *Culex* mosquitoes that amplify the virus. A major part of breeding source reduction involves community outreach and education to engage the help of the public. Preventing the mosquito larvae from emerging into adults is the easiest and most environmentally-sound way to reduce the number of mosquitoes that may transmit West Nile virus in Suffolk County. Larval habitats or breeding sources for WNV include stagnant water in artificial and natural containers: tires, birdbaths, tin cans, clogged gutters, puddles, pot holes, tree holes and to a more limited extent marshlands and other wetland habitats.

The need for responding to a Health Threat is determined under the New York State Department of Health West Nile Virus Response Plan and the County's Zika Action Plan, adapted for local conditions by staff experts at Vector and Health Services. Because of the persistent presence of WNV in the County, the County perpetually begins each year in Risk Category 2. The New York State Department of Health has determined that there is an ongoing threat to the public health from West Nile Virus, and no longer declares health threats each year. The determination of when the threat of west Nile rises to the level that requires adulticiding is made by the County Vector Control staff in consultation with the Health Commissioner and ABDL staff. As additional pathogenes including EEE, Zika, Dengue, Chikugunya viruses and malaria become established in the US; the CDC, NYS Health and Suffolk continually reevalute the risk to County residents. Currently, only travel related cases of Zika, Malria, Chikungunya and Dengue have been repoted in Suffolk County, but Health ABDL continues to monitor mosquitoes that have shown competence to carry these diseases. As of September 30th 2020 there have been no confirmed human cases of WNV infection in Suffolk County this year, although several potential cases are still being tested. Suspect WNV cases can take several weeks to be confirmed, but data suggests that 2020 will be regarded as a moderate to low WNV risk year.

The need for adulticiding in response to WNV varies greatly from year to year. An analysis of Suffolk County's WNV history during the years 2000-2020 indicates that most years, (12 of 20) the number of human cases of WNV was low, 0-4 cases. Under such conditions, the WNV human transmisson risk level is low, even when WNV is found in the County. In these low risk years, determining exactly where and when to adulticide is nearly impossible with limited data. As a result, in low years, area wide adulticiding is usually not warranted due to the difficulty in

delinating specific areas to target. High risk years are caused largely by environmental conditions favorable to virus amplification in birds and mosquitoes, such as a warm spring and a hot dry summer weather. These conditions manifest themselves in late June and early July through higher than normal numbers of positive mosquito samples and calculated infection rates. WNV history also demonstrates that, in years when WNV activity is higher than normal, human cases are more likely to occur in certain parts of the County than other areas. In years with early indicators of high risk, adulticiding targeted to these high risk areas can measurably reduce the risk of human transmission and is therefore warranted. When a high risk year is identified, these WNV applications generally take place in late July and August during peak tranmission. Responding to early indications of high risk is important, because adulticiding should occur before peak human transmisson occurs in the first 2-3 weeks of August. Waiting to see transmission results in actual human cases is not appropriate because by the time cases are detected, transmission has been ongoing for several weeks and it may be too late to prevent further transmission. Whenever a virus isolation or human case is identified, Vector Control crews are sent to scout the area and treat locations of standing water, including catch basins and recharge basins/sumps for mosquito larvae.

As indicators of risk of transmisson to humans accumulate, Vector Control and Health determines when control measures are best suited to the situation and which areas should be targeted for maximum benefit. The Commissioner of the SCDHS generally makes the final determination of the need for adult control in reponse to pathogens if a public health threat is declared. This strategy is consistent with the goal in the Findings to reduce the use of pesticides by a targeted tiered approach.

To ensure adulticides are used only when there is a clear need and a likely benefit, the criteria for conducting an adulticide treatment will include:

1. Evidence of high numbers of mosquitoes biting residents and visitors (Vector Control):

- Service requests from public - mapped to determine extent of problem.
- Requests from community leaders, elected officials.
- New Jersey trap counts higher than generally found for area in question (at least 25 females of human-biting species per night).
- Centers for Disease Control (CDC) portable light trap counts of 100 or more.
- Confirmatory crew reports from the problem area or adjacent larval habitat, with landing rates of over one biting mosquito per minute over a five minute period.

2. Higher than normal risk of human disease transmission that can be reduced by adulticiding (Health Threat):

- Indications of a higher than normal year for WNV activity County-wide as determined by such measures as infection rates and/or the number or proportion of positive mosquito samples, especially by late July or early August. In a year with normal or below normal levels of WNV activity, adulticiding is generally not indicated.
- In a high risk year, adulticiding may be warranted when there are indications of higher than normal levels of WNV risk (such as the number of positive mosquito samples, infection rates, vector species populations and history of human transmission) in particular areas. Adulticiding priority will be given to those parts of the County where WNV cases have occurred in multiple years and at high densities compared to the rest of the County.

- Zika, Dengue and other mosquito-borne disease responses will occur when positive mosquitoes are found in traps or local transmission by mosquitoes is suspected due to aquired cases without travel history.
- Adulticiding will be strongly considered if EEE is detected during July, August or September when human transmission is most likely.
- Adulticiding in reponse to other pathogens (such as dengue, chikungunya, malaria or other emerging pathogens) will be considered on a case-by case basis based on the vector ecology of the pathogen involved.

3. Control is technically and environmentally feasible:

- A target area can be clearly defined based on geographic features and the distribution of vector species and other risk factors.
- Weather conditions are predicted to be suitable for ULV application when mosquitoes are active. Aerial applications in response to WNV are particularly dependent on weather conditions, and near-ideal conditions of low wind combined with high temperatures and humidity are needed for truly effective results.
- The road network is adequate and appropriate when truck applications are considered.
- Legal restrictions on the treatment of wetlands, open water buffers, and no-spray list members in the treatment zone will not create untreated areas that would prevent adequate coverage to ensure treatment efficacy.
- There are no issues regarding listed or special concern species in the treatment area.
- Meeting label restrictions for selected compounds will not compromise expected treatment efficacy.

4. Likely persistence or worsening of problem without intervention:

- Considerations regarding the history of the area, such as the identification of a chronic problem area for biting mosquitoes or a history of virus transmission.
- Seasonal cycles of pathogen activity, such as whether or not the treatment is in time to prevent WNV transmission or whether it is too late and most transmission has already occurred.
- Determination if the problem will spread beyond the currently affected area absent intervention, based on the life history and habits of the species involved.
- Crew reports from adjacent larval habitats suggest adults will soon move into populated areas.
- Life history factors of mosquitoes present – i.e., if a brooded species is involved, determining if the brood is young or is naturally declining.
- Weather factors, in that cool weather generally alleviates immediate problems, but warm weather and/or the onset of peak viral seasons exacerbate concerns.
- Determining, if the decision is delayed, will later conditions prevent treatment at that time or not. Conversely, adverse weather conditions might reduce the threat of disease transmission.

Criteria 1 or 2 are necessary thresholds which should be met prior to a treatment being considered. While criteria 3 and 4 are factors that would determine the extent of the treatment or capability to meet the the goals of the control plan. Treatment will not occur unless criteria 1 or 2 are satisfied through a combination of surveillance indicators, although not all surveillance techniques may be feasible in every setting and situation. The County is not aware of any new data, studies or reports which contravene the research, reports and Findings of the Long Term

Plan with respect to adulticide treatment guidelines or thresholds. Therefore, those Findings remain valid and guide this Annual Work Plan.

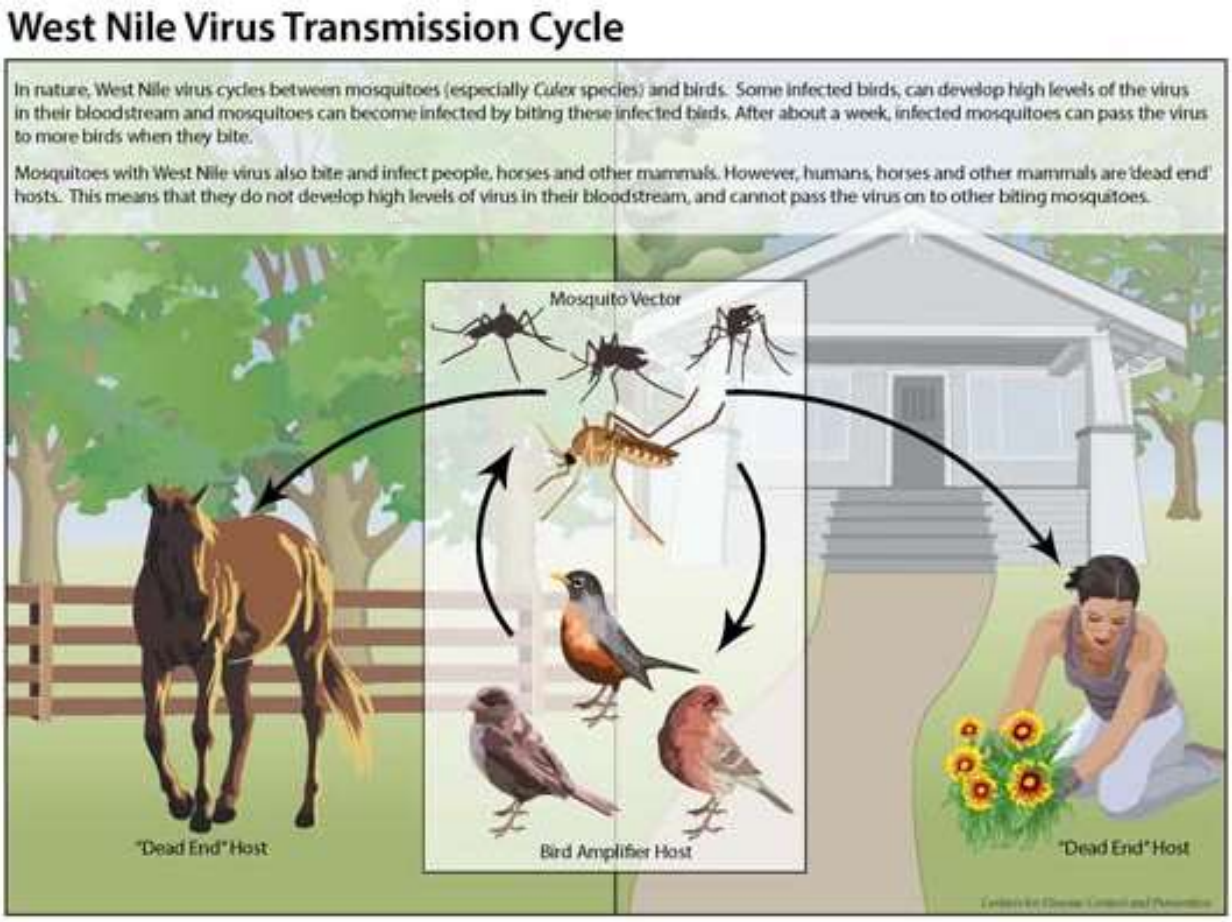


Figure 4. From CDC

Some key recommendations for preventing WN virus in humans include:

- People, especially those 50 and older or those with underlying health conditions, should take special care to prevent WN virus because they are more susceptible to severe WN virus symptoms
- Know the symptoms of diseases to receive early treatment
- If outside at dusk or dawn, or if mosquitoes are biting during the day, wear long pants, long-sleeved shirts and socks
- Consider the use of an EPA and DEC approved insect repellent containing: 2-undecanone, DEET, picaridin, IR3535, or oil of lemon eucalyptus according to the label's directions
- Make sure doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes
- Reduce the number of mosquitoes in your area by getting rid of containers with standing water that provide breeding places for the mosquitoes.

The CDC encourages surveillance programs to routinely incorporate a more informative index of relative virus activity, with the virus infection rate mosquito-based evaluation of local virus activity patterns. At the county level or below, weekly tracking of mosquito minimum infection rate (MIR) can provide important predictive indicators of transmission activity levels associated with elevated human risk. The graph below (Fig. 5) shows the 2020 WNV season started 3 weeks behind the highest WNV years and had a late peak (CDC week 35). 2020 MIR rates declined rapidly in the late season (2020 data shown in graph only reported to week 37) as rain and cool temperatures broke WNV cycling. 2010 and 2012 were high risk years for WNV due to the early findings, large number of mosquito positive isolations and the number of reported human cases.

Disease Risk – MIR based on the number of WNV isolations each [CDC] week

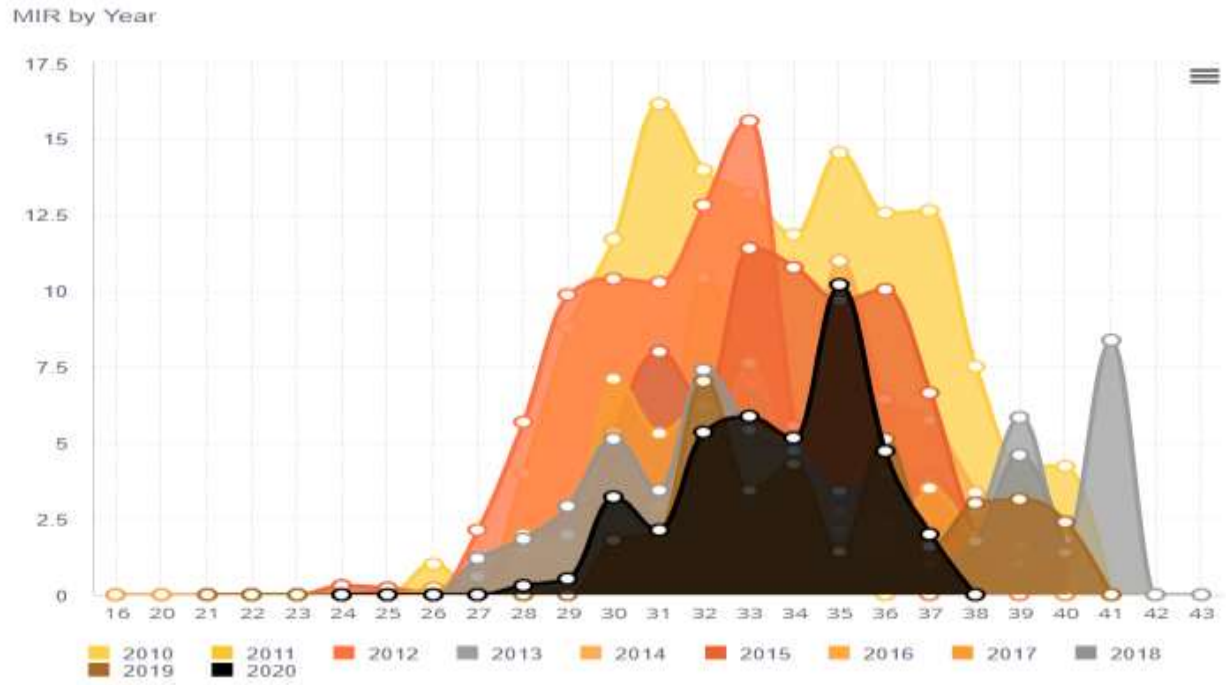


Figure 5 SC Health

Eastern Equine Encephalitis

Eastern equine encephalitis (EEE) virus is transmitted by a mosquito bite and that can cause severe infections (encephalitis) in humans with approximately a 30% mortality rate. Most at risk are children, especially those under age 15. The CDC states that symptoms of EEE infection (EEE, involving encephalitis, an inflammation of the brain) begin with the sudden onset of headache, high fever, chills, and vomiting. The illness may then progress into disorientation, seizures, and coma. Approximately a third of patients who develop EEE die, and many of those who survive have mild to severe permanent brain damage. In 2019 the EEE virus was again found in mosquitoes from the Manorville/Calverton area of Suffolk County in two traps near red maple swamps. This area is exceptionally conducive to the main mosquito that carries EEE - *Culiseta melanura* and the area has a long history of EEE virus isolations. This area was historically cranberry bogs with impoundments to control water levels adjacent to the Peconic

River. The old cranberry bogs have been displaced by the red maple swamps with the flooded root crypts the *Culiseta* mosquito inhabits (Fig. 6).

Figure 6 Culiseta melanura Red Maple Swamp Habitat for EEE

No mosquito pools, human or horse cases have been reported in 2020 (to date) for Suffolk County, while neighboring states of Massachusetts has reported human cases and in NJ there have been horse cases. While the risk of EEE virus extends to the first hard frost, SC Health mosquito traps have continued to be free of EEE virus findings well into late September 2020.

Mosquito-borne Viruses and Species Monitoring

There have been 51 species of mosquitoes documented in Suffolk County, with each unique species having its own habitat requirements and disease transmission potential. The following table shows some of the most common mosquito species in Suffolk County and the potential diseases they can transmit. Concern mounts for human health risk when species habitats and disease potential overlap.

Such is the case in EEE where freshwater swamps are the most likely locations for virus amplification and transmission to occur. If the swamp is in close proximity to a salt marsh, the disease risk to local residents increases significantly due to crossover of the virus to more aggressive human biting species with greater flight ranges. This list only covers some of the most common diseases found locally, with new introductions of mosquitoes and diseases occurring frequently now with globalization and rapid travel to previously isolated regions of the world. The following are just a few of the known arthropod-borne diseases with potential to spread into the United States and/or Suffolk County: Dengue, Malaria, Zika, Yellow Fever, Rift Valley, Murray Valley, Chikungunya, Japanese and Western Equine Encephalitis (Table 1).

Some common mosquito species in Suffolk County and the diseases they can carry and potentially transmit locally:

Scientific Name / Common Name	Diseases Transmitted	Habitat
Aedes albopictus - Asian Tiger mosquito (ATM)	*CHIK, ZIKA, WNV*	*Container, Tarp, Tire*
*Aedes canadensis W*oodland pool mosquito	*EEE, JCV, LAC, WNV*	*Swamps*
Aedes sollicitans Eastern Salt marsh mosquito	*EEE, DHW, WNV*	*Salt marsh*
Aedes triseriatus Eastern tree hole mosquito	*LAC, WNV*	*Treehole*
Aedes vexans Common floodwater mosquito	*WNV, EEE, DHW*	*Woodland puddles*
Anopheles mosquito species	*MAL, WNV*	*Pond edge, streams*
Coquillettidia perturbans Cattail mosquito	*EEE, WNV*	*Ponds*
Culex pipiens Northern house mosquito	*WNV, EEE, SLE, DHW*	*Containers*
Culex restuans	*WNV, EEE*	*Various fresh*
Culex salinarius Salt-marsh Culex	*EEE, WNV, SLE*	*Brackish swamps*
Culiseta melanura	*EEE, WNV*	*Red maple Swamp*

CHK – Chikungunya	WNV – West Nile virus
DHW – Dog Heartworms	ZIKA – Zika virus
EEE - Eastern equine encephalitis	SLE – Saint Louis encephalitis
JCV – Jamestown Canyon virus	MAL – Malaria
LAC – La Crosse encephalitis	

Table 1

Service Requests:

Residents and visitors can report mosquito issues directly to Vector Control. Request can include notifying us of high numbers of adult mosquitoes, reporting a location of standing water for breeding, catch basin or recharge basin/sump check, reporting abandoned swimming pools and for drainage issues that impact mosquito breeding. Service requests are completed as promptly as possible, usually in under a week depending on the volume of requests, staffing and weather conditions. To report an issue, residents can call the office at (631) 852-4270 Monday through Friday from 8am to 3:30pm, dial 311, send an e-mail to SCVector@SuffolkCountyNY.Gov or via the web: https://dpw.suffolkcountyny.gov/vectorcomplaint/ The information is logged into the database and is sent to the field crews to investigate the issue. For 2020, we received 1054 service requests (Fig 7); an increase from the 955 we responded to in 2019. Staff also received several hundred phone call and e-mail/web requests for adult spraying or 'fogging' not included in these service request totals.

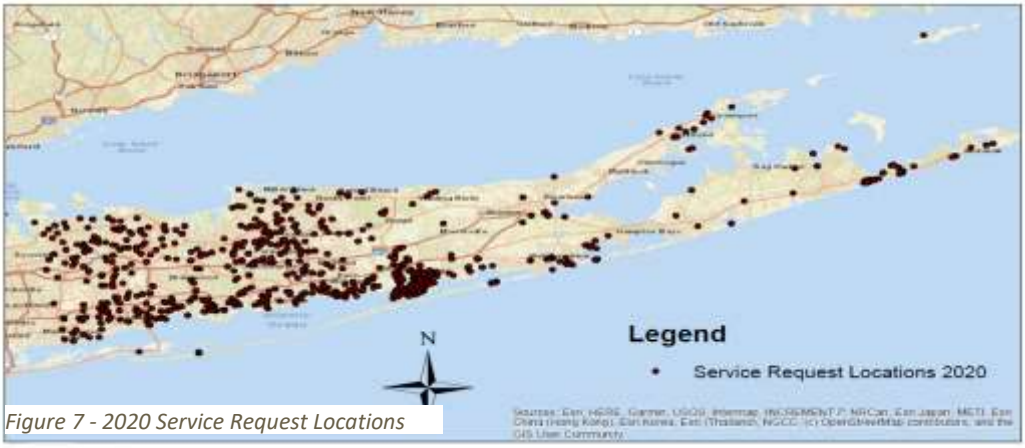


Figure 7 - 2020 Service Request Locations

E-mail and web app requests continue to serve the residents best, as these service requests can be sent 24/7 directly to the office.

Public Education:

Vector Control staff continue to give presentations to community associations and commercial pest control applicators on mosquito and tick issues including the expanding Asian Tiger mosquito and tick surveillance and control. Education of homeowners also occurs when field crews conduct inspections of private property advising residents on steps they can take around their home to reduce mosquito and tick encounters (Fig 8). If no one is home during an inspection, crews will leave an educational flyer on mosquito control to help inform

residents. Health Services staff also holds informative meetings on mosquito and tick issues, post to social media and updates the County website with information and findings on mosquito borne diseases, including steps homeowners can take and updating postings for mosquito spray events. While Covid restrictions have severely limited these types of events, requests for online presentations are becoming the new norm. E-mail and web service requests sent to us also have an automatic e-mail response informing the sender of steps they can take to combat mosquitoes around their home.

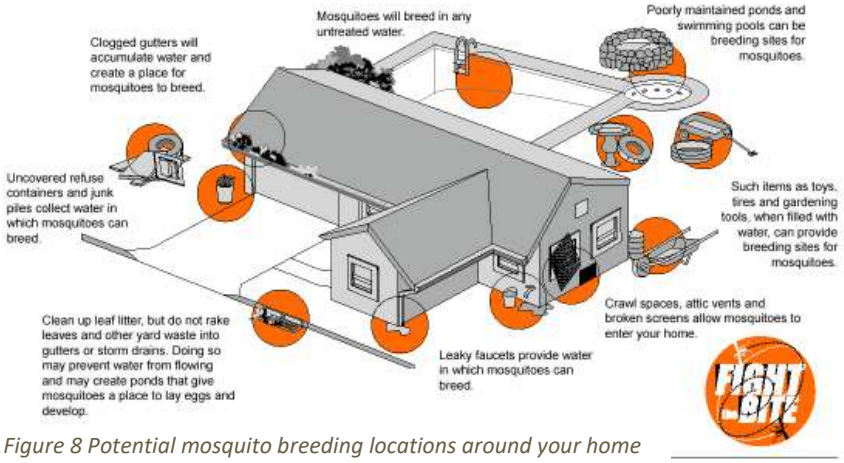


Figure 8 Potential mosquito breeding locations around your home

Surveillance

Spring tides and exceptional rainfall events are key factors driving floodwater mosquito populations and need to be understood to plan successful control. Spring tides occur around full and new moon events and can cause tidal flooding of salt marshes. These events often flood the upper fringe marsh where salt marsh mosquitoes are most common. Storm events with excessive precipitation/rain are also a trigger for freshwater flood mosquitoes. Low depressions in the forest floor can hold eggs dormant for long periods of time between rain events that trigger the eggs to hatch. These floodwater species can be quite aggressive but generally do not travel far from their breeding locations so the impact is more localized compared to salt marsh emergences. Most freshwater floodwater mosquitoes can carry several diseases of public health importance, so monitoring and control of these species is also of concern to SCVC crews.

Adult Mosquito Population Monitoring:

Of the 51 species of mosquitoes in Suffolk County, only a limited number cause issues with disease transmission or generate calls for mosquito control services to Vector Control. Without exception, the salt marsh mosquitoes are the most aggressive and prolific species in generating request for spraying to control biting mosquitoes. While these mosquitoes can be a considerable nuisance, they also can carry risk of disease transmission to humans and heart worm parasites to pets. Three salt marsh mosquito species made up 80% of the adult mosquitoes collected in our 31 NJ type light traps located throughout Suffolk. The remaining 20% of adult mosquitoes consisted of 27 species including freshwater/swamp, container and treehole breeding mosquitoes.

Aedes sollicitans: The mosquito of greatest turmoil to residents of coastal regions of Suffolk County is the *Aedes sollicitans* mosquito. This aggressive species breeds prolifically in the upper reaches of salt marshes and can travel several miles seeking out a blood meal from an animal or human. A salt marsh can produce millions of these mosquitoes, generally appearing 7-10 days after a lunar tide (full or new moon) event. Of our local waterbodies, the Great South Bay produces the majority of the *A. sollicitans* mosquitoes due to local tidal amplitude causing puddles/pannes on the salt marsh where this species lays its eggs. Eggs that are laid in the marsh by the female mosquito and can lay dormant for weeks, months or even years awaiting the next flood tide event to generate a new hatch. The aerial larvicide program in Suffolk County targets this species due to large acreage tracks of salt marshes where this mosquito lives. The following graph shows the 2020 *Aedes sollicitans* weekly population counts as compared to the 5 year average. From the graph we see salt marsh mosquitoes were down significantly compared to the 2014-2019 weekly mean for all traps (Fig 9).

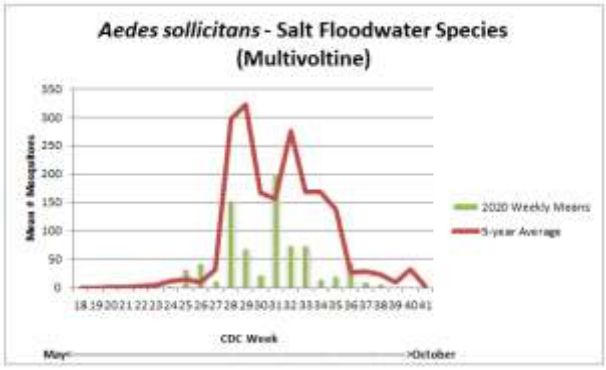


Figure 9

Figure

Culex pipiens/restuans complex: The *Culex* species of mosquitoes are container species with a strong link to West Nile virus cycling and potential transmission to humans. One of our predominant habitats for *Culex* mosquitoes includes catch basins that hold water for extended periods. Treatement of catch basins with larvicide in areas with active or historic WNV isolations and human cases is carried out in the early mosquito season in these hot spot locations. Larviciding the basins assists in breaking the WNV cycle and keeping mosquito populations low. In 2020, *Culex* numbers in our traps were well below average due to the drought like conditions that kept most catch basins dry through the season (Fig 10).

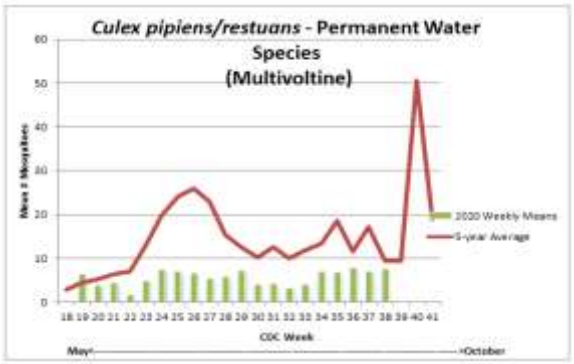


Figure 10

The Asian Tiger Mosquito (ATM) *Aedes albopictus*: is a prolific, aggressive, daytime biting mosquito that adapted rapidly to Suffolk County. This species is from Asia and now can be found throughout Suffolk County and has become a severe concern in areas that never before had to deal with mosquito issues. The ATM is a container breeder and a fierce daytime biter. The ATM usually will bite the ankles, legs and feet if not covered. Because this species breeds in buckets, tarps, bird baths and any small water holding container, having Vector Control check every yard on a regular basis would be impossible. Instead, public education directed to homeowners is the best way to remind residents to 'Dump the water' especially after rain events. This

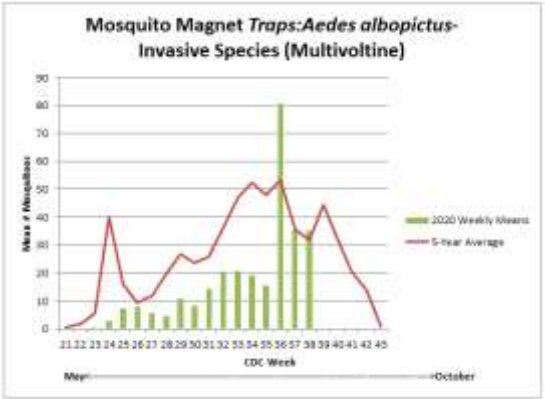


Figure 11

mosquito does not travel far, typically under 300 feet from where it emerged and generally will not cross open areas including roads. Residents with ATM issues should seek out the source in their yard, or try to determine if a neighboring property is the source. The ATM season peaks late summer and can continue their aggressive attack to the first frost. The 2020 data shows ATM numbers have tracked well below the seasonal average for most weeks, with a peak emergence after heavy rains in August due to Tropical Storm Isaias (Fig 11). Late season service requests for ATM control have been below past year's requests for September when populations often peak.

Resistance Monitoring:

Figure 10

Pesticide resistance is of great concern, so for the past several years we have begun monitoring resistance in several of our primary species of concern. In 2016 we began by using CDC bottle assays of our adulticide pesticides Anvil 10+10 ULV (sumithrin), Duet (sumithrin and prallethrin) and Scourge (resmethrin) of *Aedes sollicitans, A. albopictus A. taeniorrhynchus* and *Culex pipiens* (Fig 11).

Starting in 2019, we started resistance monitoring of our two primary larvicide products; Bti and Methoprene. Larvicide resistance tests, using Bti and Methoprene were performed on *Culex pipiens* (northern house mosquito) the primary vector of concern for West Nile virus by Vector in 2019. For 2020 we had larvae tested independently against our larvicides by the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD). No resistance was found in tested populations of the *Culex pipiens* mosquito larvae tests during 2019 and 2020. There have been several recent reports of *Culex* resistance to *Bacillus sphaericus* (Bsph) (now renamed *Lysinibacillus sphaericus*) from other mosquito districts in the US. Vector Control will continue to monitor use of this material for possible resistance locally and will only use Bsph in rotation with other larval control materials to avoid building resistance to the bacterial toxin in Bsph. When used in combination with Bti, mosquitoes have been shown to become more susceptible to the Bti through synergistic effects with the *Bacillus sphaericus* bacteria.

Larval Control:

All field personnel conduct larval control during the active mosquito season. Most crews conduct ground larviciding, while a heavy equipment crew also assists in helicopter larvicide applications. This component is conducted during the active mosquito season of May 1 to October 15. Larval control is required when water management has not been able to completely prevent mosquito production or is not appropriate for the site. Ground crews visit known larval

habitats, check for the presence of larvae, obtain larval specimens for identification in the laboratory and will apply larvicide when required. Field crews also eliminate larval habitats by unclogging culverts, dumping or removing containers or otherwise removing standing water. While the acreage of these sites is often small, their proximity to residential areas makes them important sources. Ground crews also respond to complaints from the public. The Division's most intense efforts are directed to the major salt marshes and large wetland complexes, which require use of the helicopter due to their substantial acreages. These large marshes are surveyed weekly, or after extreme flood tides. If larvae are discovered, a contract helicopter applies larvicide as directed by Vector Control. For salt marshes and similar habitats, either Bti (Bacillus thuringiensis israelensis), Altosid (methoprene), or a combination of materials are applied, based on larval stage, temperature, and weather conditions.

For 2020, crews perform approximately 6,000 inspections of larval sites. Checked and treat as required 9,829 catch basins in communities with past history of West Nile virus positive pools or human cases. Vector Control crews also investigated 182 abandoned swimming pools that were reported from the public and municipal agencies to be inspected by Vector staff.

Treated approximately 9,960 acres with the biorational larvicides: Bacillus thuringiensis israelensis (Bti), Bacillus sphaericus or methoprene. Material applied depends on mosquito stage of development, weather, coastal tides and virus findings [See table of pesticide usage on the last page of the Plan]. Improvements to the aerial larval control program through incorporating the product VectoPrime FG, a granule with a Bti/methoprene mix allowed for better targeted application sites with reduced drift issues compared to the liquid droplet products. The granules also allow applications over upland vegetated transition zones, where tree canopy cover makes liquid applications to water below the tree canopy difficult. VectoPrime FG is also a fast acting, non-residual product that does not persist in the environment. Cost per acre is more expensive using the VectoPrime FG, but savings are anticipated in the reduced need for follow-up adult control (ULV fogging) and through improved targeting of the larval breeding sites resulting in less material usage.

For 2020, VectoMax FG was also introduced to the larvicide program for freshwater locations. VectoMax FG is a combination product of Bti and *Bacillus sphaericus* two bacterial products that is best suited for semi-permanent waterbodies where potential for extended control is anticipated through natural recycling of the *B. sphaericus* bacteria. The cost of the material and high application rate make use of VectoMax ideal for remote locations where crews may have difficulty making more frequent site inspections, such as Fishers Island, Shelter Island and Fire Island.

The equipment to be used for larval control includes various trucks for crew transportation, samplers such as dippers and mosquito traps, truck-mounted hydraulic sprayers, backpack sprayers and granular blowers, plus specially-equipped helicopters for larvicide applications on areas too large or inaccessible for ground treatment. All pesticide applications use USEPA and NYSDEC registered materials and are conducted under appropriate Article 15 Protection of Waters and Article 24 Freshwater Wetland DEC permits and in accordance with label directions and other relevant State and Federal laws.

The Division has developed technical guidelines for larval surveillance and control that determine where and when larvicides are used and what materials are best selected for a particular situation. These guidelines emphasize the use of bacterial products when possible and reserve methoprene for those situations where bacterial products alone are unlikely to be as effective. As per the Findings for the Long Term Plan and Executive order 15-2007, the Pesticide Management Committee has reported on the results of its review of literature on methoprene and potential impacts, as well as on research sponsored by the County. The Committee found no significant new concerns regarding the use of methoprene. The County is committed to implementing a Pesticide Reduction Action Plan, which will seek to further accelerate pesticide reduction. As part of this Pesticide Reduction Action Plan, the County will continue to work with technical experts to further refine protocols related to larval monitoring and larvicide usage, consistent with the Long-Term Plan and GEIS. The County is not aware of any new data, studies or reports which contravene research, reports and Findings of the Long Term Plan with respect to larval treatment guidelines or thresholds. Therefore, those Findings are still valid, and govern this Annual Plan. In 2019, the County contracted with SUNY Stony Brook researchers to undertake a pesticide literature review for the products used by the Vector Control program. This review will encompass any new findings since 2010 when the last literatre review was completed. Release of the final SUNY Stony Brook methoprene literature review was delayed due to Covid, but Stony Brook has stated its review it will be ready for attachment with the Plan and presented at the CEQ and Legislature meetings.

Adult Control:

Vector Control will conduct adult treatment, spraying or ‘fogging’ when infestations are severe and widespread and/or necessary to respond to the presence of mosquito-borne pathogens. Community-wide requests for adult control were limited in 2020, with the notable exception of the communities of Mastic, Mastic Beach and South Shirley that border the Fire Island National Seashore and William Floyd Estate. While marshlands within the neighboring US Fish and Wildlife Refuge at Wertheim allow for regulated mosquito control activities under a special use permit, the National Park Service does not allow Vector Control to treat their land holdings, except under tiered conditions for virus response. This creates unique hardships on the neighboring communities to these Fire Island Seashore lands from immense numbers of biting mosquitoes migrating into these areas. The extreme numbers of biting mosquitoes results in the need for repeated adult ULV spraying of adjoining residential areas. Many parts of the Mastic Beach community are also within

NYSDEC mapped freshwater wetlands restricting our ability to undertake adult control treatments for residents living within areas adjacent to these wetlands.

Adult control can be deemed to be necessary under two separate operational scenarios in the GEIS. One is defined as a "Vector Control" (public health nuisance) application, the other is defined as "Health Emergency" application. Vector Control adulticide applications are made to reduce excessive numbers of human biting mosquitoes that could impact public health and quality of life by their biting activities. These high populations also represent potential vectors if a pathogen is present or appears in the area. Health Emergency applications are made when an unacceptably high risk of disease transmission to humans is detected, based on the ongoing presence of pathogens in mosquitoes. In either case, pesticide use decisions are only made on the basis of scientifically-determined surveillance data.

The Long-Term Plan proposed a general reliance on resmethrin, a synthetic pyrethroid, as the primary adulticide pesticide. However, the Federal and State re-registration for resmethrin products was recently terminated by the manufacturer and this material can no longer be used for mosquito control. Sumithrin, a similar pyrethroid, was proposed by the Long Term Plan to be the primary back-up to resmethrin, and the primary pesticide for hand-held applications. Sumithrin has now become the Division's primary adulticide material. Sumithrin, like resmethrin has been found to be an effective pesticide for mosquito control, can be used for ultra-low volume (ULV) applications for truck and aerial delivery, undergoes rapid decay in the environment, and, as discussed below, has few identified non-target effects when applied as proposed under the Long-Term Plan. The Division has also begun use of Duet, with the Long Term Plan modified to include Duet and its active ingredients, sumithrin and prallethrin. Duet is similar to the Division's primary sumithrin product, Anvil, in that both products contain sumithrin and the synergist piperonyl butoxide (PBO). However, in addition to 5% sumithrin and 5% PBO, Duet also contains 1% prallethrin. This amount of prallethrin is not sufficient to control mosquitoes, but it does induce them to fly, a phenomenon known as "benign agitation". Benign agitation causes mosquitoes that are resting to fly so that they will encounter the aerosol droplets and increase the likelihood mosquitoes would be exposed to a lethal dose of sumithrin. Duet has been shown to be particularly effective against mosquitoes that tend to rest during the optimal time of the day for aerosol treatment, that is, at night. The primary use for Duet will be against the Asian Tiger mosquito (ATM), *Aedes albopictus* and may be used for control of other active daytime species including salt marsh mosquitoes. The ATM is an introduced species that inhabits containers and tends to bite during the daytime, making it a significant biting pest that is difficult to control because it is less active at night.

The Long-Term Plan also identifies two other pyrethroids, permethrin and natural pyrethrins, as potential adulticide compounds. Neither is preferred, as permethrin is a widely available product that is manufactured for many homeowner pest and farm uses that may have caused increase mosquito resistance to the material. Natural pyrethrins are identified as a potentially useful compound because its label allows for use over agricultural areas, and while the pesticide is

organic, pyrethrin can cause allergic reactions to sensitive individuals and non-target impacts, including toxicity to fish and aquatic invertebrates.

In addition to the pyrethroids, malathion, an organophosphate pesticide, was identified as a potential adulticide. Malathion would only be considered for use under very specialized conditions, such as in Zika response if a thermal fogging application was required, emergency daylight applications were called for, or if resistance testing indicated pyrethroid applications would be ineffective in meeting the goals for public health protection.

All of these pesticides are EPA and NYSDEC registered, applied at the label rates, used in the best way of achieving effective mosquito control and to avoid development of pesticide resistance. The adulticides included in this Annual Plan have been fully evaluated in the GEIS for the Long-Term Plan, and this Annual Plan is fully consistent with the attached Findings Statement. Vector Control continually reviews available pesticides and alternatives, including emerging materials and application techniques for the most environmentally suitable control methods.

PUBLIC NOTIFICATION AND THE "NO-SPRAY" REGISTRY:

In 2000, the County passed new laws to improve required public notification for adult mosquito control. As a result, there is now an increased use of the media and extensive outreach to local officials. The Health Services and Vector Control websites are used to post spray notices and maps of the treatment area. For each adulticide application, over e-mails and faxes are sent to various officials and other interested parties. Newsday and News12 often post spray schedules and maps but are not consistent in covering spraying events. Health has begun posting spraying updates to social media including Facebook and Twitter. It is important to recognize that adulticide applications are very sensitive to the weather, especially aerial applications. The need to inform the public needs to be balanced with the need to conduct operations promptly, within weather windows and before the problem spreads and more acreage needs treatment. It is usually not appropriate to provide more than 24 hours' notice in most cases, because beyond that time, weather forecasts are not very reliable. Attempts to provide more than 24-hour notice often result in aerial spray operations being announced and then cancelled. These cancellations are confusing to the public and difficult to reschedule. Despite these difficulties, the County provides 48-hour notice for aerial adulticide applications

whenever possible for non-virus response.

In addition to the previous public notification procedures, the County has implemented a County law, passed in 2010, requiring the use of its "Code Red" automated calling and messaging system to provide more thorough public notice for adulticiding. This system allows automated phone calls to be placed to all landline telephones in an area designated for treatment. These messages provide basic information about the operation, such as spray hours, and refer the recipient to additional sources of information. The system ensures that nearly everyone in the area knows about the operation. Use of the Code Red system has been very successful and provides a new level of public information for the program. Residents can also register their cellphones or e-mail addresses to receive the Code red updates through FRES.

The Division also maintains a "no-spray" registry of residences where adult mosquito control is not desired. During ground applications the application unit is shut off 150 feet prior to passing such a residence and not turned on until 150 feet after. This registry represents an effort to balance the desires of those residents who want control of adult mosquitoes with those who oppose the use of pesticides. In 2020, the "no-spray" registry listed 212 properties, including 36 for health concerns, 28 beekeeper hive locations and 28 were organic farms locations including backyard gardens and 118 opposed to pesticide use. When control is required to deal with a public health threat, the Commissioner of SCDHS can override the list. Even then, list members are contacted prior to applications in their area through the Code Red system or called directly. In addition to this legally required registry, the Division maintains on the list beekeepers and organic farms who register. Beekeepers' properties are generally avoided and beekeepers are notified via Code Red before treatments so that they can take any additional actions they may deem necessary to protect their hives. In addition, several steps are taken to avoid impacts to bees including timing of applications to the evening hours when bees are not foraging. Vector also uses mosquito control materials least likely to impact bees and through adjustment of spray equipment and technique using an ultra-low volume (ULV) droplet size that will impact mosquitoes, but not injure larger bodied insects, including bees. Certified organic farms are avoided and a buffer zone around the farm is included.

The County also provides public notification for aerial larviciding. An e-mail notice of the marshes to be treated by helicopter is sent each week to Legislators, local governments and other interested parties. In addition, a list of marshes to be treated is posted each week on the County Web site and on the Health Department's social media pages.

Mosquito Surveillance and Research:

All control mosquito operations are based on information obtained from surveillance and research. This is a cooperative effort between Vector Control staff in the Department of Public Works and the Arthropod Borne Disease Laboratory in the Department of Health Services. Knowledge of mosquito populations, species composition and arbovirus activity is used to guide and evaluate control measures. Arbovirus surveillance allows the Division, in cooperation with the County and State Health Departments, to gauge the potential for disease transmission and to take appropriate action.

New Jersey Light Trap

Mosquito population surveillance: Larval and adult mosquito surveys are analyzed each year for species abundance and location. These surveys are necessary for locating infestations, directing control efforts and evaluating the effectiveness of those efforts. The mosquito species that breed in various locations are determined from larval samples. Adult mosquitoes in residential areas are estimated from a network of approximately 31 New Jersey style light traps in fixed locations throughout the County. New Jersey traps provide staff with ongoing population trends and are compared with service requests in a community to assist in determining the need for adult mosquito spraying. In 2020, over 41,000 mosquitoes from these traps were identified to species and counted (Fig 12). This tedious work is conducted by the Vector Control mosquito entomologist. In addition, Vector maintains an array of specialized Mosquito Magnet type traps to monitor seasonal cycles and long term trends in populations of the introduced exotic, container-breeding species *Aedes japonicus* and *Aedes albopictus* (The Asian Tiger Mosquito).

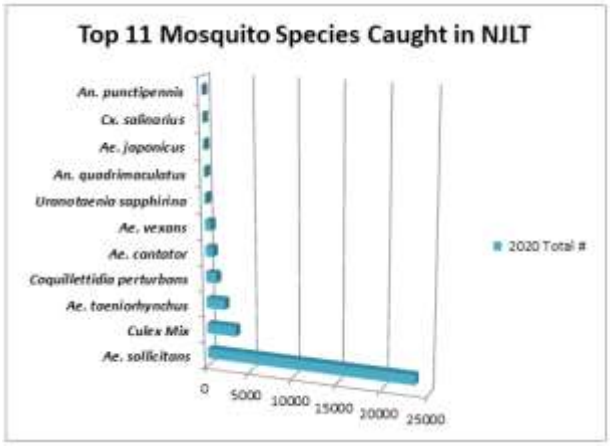


Figure 12

Arbovirus surveillance in mosquitoes: Viral surveillance is conducted primarily by the ABDL and will be directed primarily at the main pathogens, WNV, Zika and EEE. Surveillance is conducted according to the latest CDC and State DOH guidelines, modified for Suffolk County's unique environment. To monitor virus activity, ABDL staff set CDC light traps and gravid traps on a weekly or rotating basis at various locations throughout the County. These sites are chosen based on their history of viral activity or the presence of viral indicators such as the finding of birds with WNV in the area. The ABDL collects and process approximately 50,000 live, adult mosquitoes annually for viral analysis (Fig 13). Mosquitoes collected are sorted by species, frozen, and sent to Albany for arbovirus analysis in the State DOH laboratory.

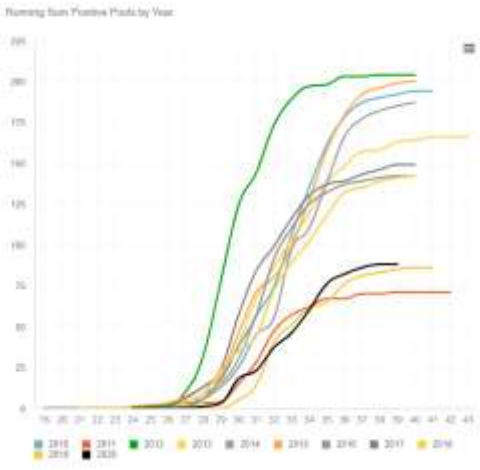


Figure 13 Total WNV Positive Mosquito Pools by Year

Human, avian and other surveillance: SCDHS, State DOH, DEC and CDC monitor other WNV and EEE indicators such as unusual bird deaths or the number of dead birds sighted in an area. The presence of WNV-positive birds is an indicator of virus activity in an area, and ABDL picks up selected dead birds for WNV testing. ABDL conducts a rapid RNA test (the RAMP test) to check for WNV in dead birds. There are also indications that the number of dead bird sightings in an area is a surrogate indicator of risk. SCDHS and NYS also monitor hospitals, blood banks and outreach to physicians to quickly detect human cases of Zika, WNV and other emerging vector borne illnesses.

Efficacy monitoring: While the Division has always monitored the effectiveness of the control program in a variety of ways, there has been an increased effort in this area, based on trial work to develop methods conducted in 2007. In particular, trapping of adult mosquitoes before and after adulticide events is conducted using carbon dioxide baited CDC light traps, NJ traps or reviewing service request logs. In addition, indicators of virus activity before and after treatment are followed to be sure the desired effect is achieved. The number of adult mosquitoes in New Jersey type traps compared to historic averages (Fig 14) and the number of service requests in a community are key indicators of the overall success of the larval control program.

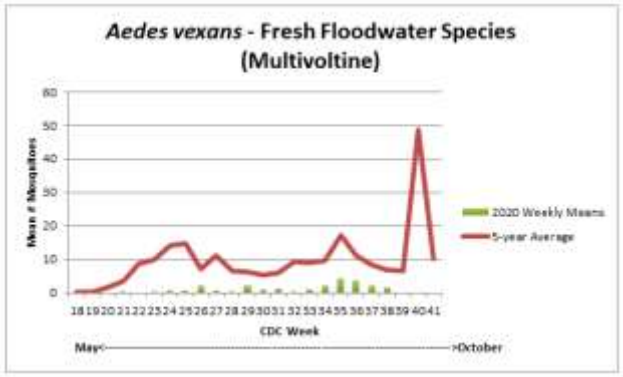


Figure 14

Special surveys and field investigations: Vector's Control staff conduct special surveys to determine the source of mosquito problems when these turn up in places where they are not expected. Special surveys of problems that appear early in a season can allow larval crews to prevent further trouble through the summer. Given the somewhat unpredictable ways mosquitoes can cause problems for residents of and visitors to the County, it is important that the Division retain a flexible ability to investigate issues as they are identified.

Support for Wetlands Restoration/Stewardship activities: Vector Control continues to provide support for monitoring and other investigations related several wetland restoration activities. In particular, Division staff assist in the ongoing monitoring of the Integrated Marsh Management (IMM) projects at Wertheim and Seatuck National Wildlife Refuges. In addition, the Division will assist the Wetlands Stewardship Program in identifying and evaluating prospective sites for future IMM projects, particularly those that will help meet Long Term Plan goals for pesticide use reduction. With the completion of the Wetlands Stewardship Strategy and the availability of grant funding, this component of the program will continue in 2021 with several grant funded restoration projects.

COOPERATIVE EFFORTS AND OUTREACH:

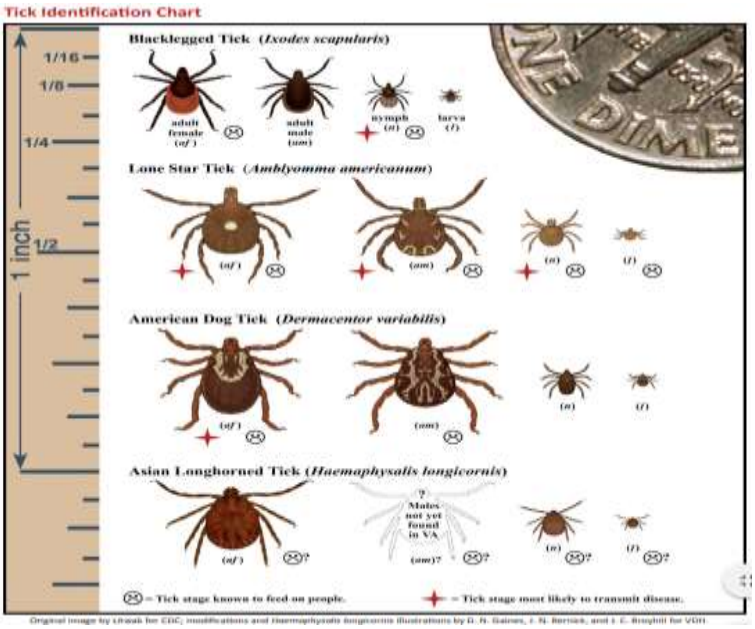
Other provisions of the Work Plan notwithstanding, Vector Control may participate in research, monitoring, and demonstration projects in cooperation with other levels of government such as the State, Towns or Federal agencies such as the US Fish and Wildlife Service or Army Corps of

Engineers. These activities may be subject to separate DEC permitting and SEQRA compliance, and to CEQ and Wetlands Stewardship Committee review as well.

Vector Control will also continue to work with the various local governments, including the cooperative effort with East Hampton Town to provide a framework to develop, plan and construct wetland restoration projects that will restore wetland functions and values, and lead to a reduction in pesticide use, while still protecting human health and quality-of-life through reduced mosquito numbers.

TICK RESEARCH SURVEILLANCE AND CONTROL:

On October 17, 2013, the County approved Resolution 797-2013 requiring this Plan of Work to include a section on the "steps being taken to reduce the incidence of tick-borne diseases in Suffolk County". Accordingly, the 2021 Plan of Work includes a section on current tick surveillance, research and control activities. For 2021, these steps will continue to be focused on planning, information gathering, outreach, technical assistance, and small scale tick control trials and as such will be Type II actions under SEQRA Section 617.5 (c) (20), (21) and (27). In 2013, the Division began work under Resolution 797-2013 to determine how the County might best be able to reduce the impact of tick-borne diseases. This was a follow-up to the Tick Management Task Force (TMTF) report that was submitted to the Legislature in May of 2008 in response to Resolution 1123-2006. In addition, Resolution 132-2014 created the Tick Control Advisory Committee (TCAC) to advise Vector on tick control planning. Any large scale effort to reduce the number of ticks on a countywide landscape, such as those described by the TMTF, would have the potential for adverse impacts on the environment and would need full SEQRA review. While no large scale control efforts can be undertaken prior to an environmental review of tick control under SEQRA, and potentially an EIS tick control supplement to the plan, several interim actions are underway.



The development of a Tick Control Plan and environmental review, therefore, is a major effort that has yet to be funded. In 2015, the County took the first step and created a new tick entomologist position for tick-related surveillance activities. This full time entomologist is devoted to tick research and control and has been a major step forward in understanding the tick issues in Suffolk. Re-establishment of the TCAC under Resolution 1668-2016 is also assisting the County to develop a plan of action and identify the resources needed going forward to fully develop a

County-wide environmentally sound tick control plan.

In 2021, Vector Control will continue to work on developing a County-wide tick control plan with the limited resources available. Current studies on tick control efforts are restricted to research activities that do not require full environmental review under SEQRA. Vector is also working to improve the technical basis for control efforts and provide practical information to the various public and private entities currently undertaking localized tick control programs. These cooperative efforts can help leverage the County's limited resources through partnership and collaborative efforts, including our involvement in the Shared Services program.

Tick Seasonal Activity Surveillance

Bi-weekly site surveillance, initialized in 2015, has continued through 2020 to more accurately track seasonal activity, population density, species distribution, and environmental characteristics which drive tick activity within the County. Due to Covid-19, there was limited ability for early season surveillance efforts. Collaborative surveillance with New York State Parks has continued from 2018 through 2020 in tracking the efficacy of the State's 4-poster programs at Connetquot, Wildwood, Heckscher and Robert Moses State Parks. This additional data has bolstered the surveillance network within the County at no additional burden on County resources.

A clear species gradient has been observed across the County with western locations having higher densities of deer ticks, while Lone star tick densities increase in an eastward direction. This species gradient aligns with environmental conditions more supportive to one species or the other. The collected tick activity data collected for *I. scapularis* and *A. americanum* nymphs and adults (Fig 15) will be updated periodically.

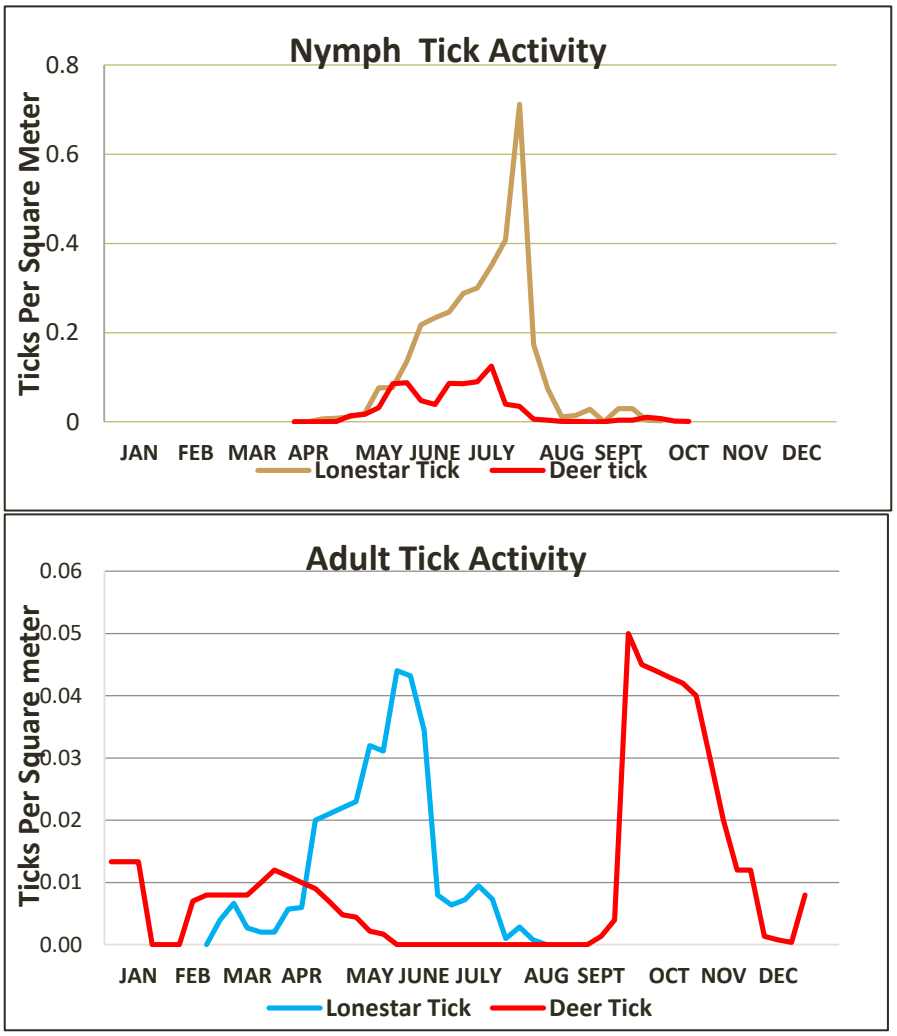


Figure 13

Asian Longhorned Tick Surveillance Efforts

The invasive Asian longhorned tick has now been found at several locations in Suffolk County. This species has been documented to feed on a wide range of animals, including occasionally on humans. Vector staff acquired reference samples in 2018 of this tick to aide in confirmation of species identification. Larvae and nymphs were collected from an Ocean Beach location, nymphs were collected off of a white-tailed deer from the William Floyd Estate in Mastic Beach and a single adult female was collected in Lloyd Harbor. At this time we have yet to encounter multiple tick stages at a single location, which would confirm an established breeding population. It is likely, as our surveillance efforts increase, we will encounter established populations within small localities throughout the County.

Technical Advice and Guidance on Tick Mitigation

Vector staff continue to provide technical advice and guidance for landowners, government agencies, municipalities and civic groups that are conducting tick control or are considering doing so. These activities will continue to provide further opportunities to learn what techniques local entities are interested in adopting, currently using, or which may be useful to the County and other entities.

Advisory Committees and Working Groups

We continue to work with the Tick Control Advisory Committee (TCAC) to explore tick control strategies and potential funding opportunities. Most importantly, the TCAC will allow for the continued input and feedback from stakeholders needed to gauge what options might be feasible and acceptable for implementation at each local level. This is a significant task, since each of the available control options have their own unique local benefits and drawbacks. Public acceptance of various tick control options may also vary considerably across Suffolk County.

In 2019, the Tick Advisory Group (TAG) was organized through the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD). This working group was established to provide advice to local towns and villages seeking guidance on tick surveillance and management related efforts as part of the SuffolkShare Public Health Partnership. Vector Control staff also participate on the Tick Working Group (TWG) organized through NEVBD due to a growing need for guidance on tick surveillance, disease, tick control, outreach and education for the broader northeast regional community. Due to Covid-19 these two committees have met much less frequently, but discussions are underway to resume the groups' efforts.

We continue to reach out to local and nationally recognized tick experts for their advice and input on research and control strategies. Staff attend regional seminars and conferences to discuss emerging diseases, introduced species and new developments. These efforts have already proven very helpful in gaining knowledge that may not be published but is highly valuable and have allowed the fostering of mutually beneficial collaborations and potential funding sources.

Non-County Funding Awards and Grants

For a third year, Vector Control was awarded a student internship though CCE and Cornell University which greatly enhanced tick related efforts with no County costs. There is an opportunity to continue this program for a student internship award for 2021. Students in the program actively assist in all phases of the tick research program and develop an independent poster project to be presented to their advisors upon return to Cornell University. Due to Covid-19 related concerns in 2020, we implemented protective strategies and protocols which allowed the internship to move forward following Covid-19 safety protocols.

In collaboration with Cornell University's Northeast Regional Center For Excellence in Vector-Borne Diseases and the Suffolk County Cornell Cooperative Extension the joint proposal: "Novel Evaluation of Control and Prevention Strategies for Ticks and Tick-Borne Diseases" was awarded a three year grant supported by the Deployed Warfighter Protection Research Program (DWFP), a Department of Defense sponsored research grant administered by the Armed Forces Pest Management Board (AFPMB). This collaborative research effort will include evaluating numerous tick management strategies, products, and application methods along with developing guidelines for management initiatives to reduce tick-borne disease incidence (Fig 16). Vector Control's role will be evaluating several natural oil and traditional acaricide/pesticide products that have potential application for use in Suffolk County. Resulting data will directly assist with the design of and choice of acaricide products and application methods for developing best management practices in a tick control program. This funding allows Vector to purchase required equipment for the development of the Tick Laboratory facility at Vector Control.

Chart of Tick Species and Tick-borne Diseases

Illness or Condition	Vector Tick Species	Tick Stage(s) Transmitting Disease	Minimum Feeding Time for Disease Transmission
Acquired Red Meat Allergy	Lone Star Tick	Larva, Nymph, Adult	Unknown
Anaplasmosis	Blacklegged Tick	Nymph, Adult	24 Hours
Babesiosis	Blacklegged Tick	Nymph, Adult	36 hours
Borrelia miyamotoi Disease	Blacklegged Tick	Larva, Nymph, Adult	24 Hours
Ehrlichiosis	Lone Star Tick	Nymph, Adult	24 Hours
Heartland Virus	Lone Star Tick	Nymph, Adult	Unknown
Lyme Disease	Blacklegged Tick	Nymph, Adult	36 Hours
Powassan Virus	Blacklegged Tick	Nymph, Adult	15 minutes
Rickettsia parkeri Disease	Gulf Coast Tick	Adult	Unknown
	Lone Star Tick	Larva, Nymph, Adult	
Rocky Mountain Spotted Fever	American Dog Tick	Adult	2-20 hours
	Brown Dog Tick	Nymph, Adult	
	Lone Star Tick	Larva, Nymph, Adult	
Southern Tick Associated Rash Illness (STARI)	Lone Star Tick	Nymph, Adult, ?	Unknown
Tularemia	American Dog Tick	Adult	Unknown
	Lone Star Tick	Nymph, Adult	

Figure 14 Virginia Department of Health

Capital Request – Capital Project No. 8739 Tick Control Plan

The prevention of tick-borne diseases in the County is a difficult and complex issue. It is particularly difficult because the biology of these vectors and their associated diseases are significantly linked to deer overpopulation, expansion of their range and limited management opportunities in a densely populated suburban landscape. In addition, tick control technology suitable for large scale application is not as well developed as mosquito control techniques. A proper plan with concurrent SEQRA compliance would require additional resources to undertake an EIS, beyond those currently available to Vector. However, tick-borne diseases and the adverse impacts ticks have on the ability of County residents to utilize the outdoors, and even their own property, are important issues that need continued investigation.

Beginning in 2018, capital funds were requested for the review of best management practices and to initiate a County Park based pilot program to inform and further develop a Tick Control Plan and related State Environmental Quality Review Act (SEQRA) environmental review. In addition, the resulting Tick Control Plan could be utilized by other municipalities through the SuffolkShare Public Health Partnership. Capital Program 8739 was passed by the Legislature in November of 2019 and provided funding for phase 1 of the pilot program. Due to financial difficulties arising from Covid-19, funds were not released for 2020. We will continue to move forward on plans for developing the Tick Pilot Project and environmental review.

Field Efficacy Trials

Continued field testing of 25(b) Exempt and traditional tick control products has continued to yield novel information on the efficacy of these products when applied to park like environments (Fig 17). In addition, we have identified a more realistic total level of control that 25(b) Exempt products can provide when used for tick control. Environmental conditions appear to play a direct role in the overall efficacy of these products as does the activity of the tick population during the time of application. These products also were found to have no effective residual action on ticks.

Control rate comparison between two natural oil products (in green) and two commonly used traditional tick control pesticides based on field testing.

Control Product	Deer Tick		Lonestar Tick	
	Nymphs	Adults	Nymphs	Adults
Essentria IC3	43%	8%	46%	42%
Cedar Safe	55%	32%	54%	29%
Maverik Perimeter	83%	79%	69%	97%
Talstar Granular	92%	73%	28%	51%

Arena setup for field efficacy trials.

Figure 15

2021 Suffolk County Tick Control Advisory Committee

Recommendations to Vector Control

Suffolk County Government continues to support county efforts of addressing ticks and tick-borne illnesses by funding two entomologist positions and two capital programs for tick-borne pathogen surveillance and tick management. The Suffolk County Legislature directed the creation of a "Tick Control Advisory Committee (TCAC) to advise the Division of Vector Control in developing a successful plan to reduce tick-borne illnesses in Suffolk County." The development and funding of the plan should be noted as demonstration of an increased commitment to the challenge of reducing tick-borne illness, which can be built upon in future years. To this end, the TCAC has developed the following recommendations to guide and support Suffolk County Division of Vector Control with their yearly Plan of Work to reduce tick-borne illnesses in Suffolk County.

The Tick Control Advisory Committee recommends the following for the 2021 Vector Control Plan of Work:

- Collaborate with Suffolk County Department of Health Services for a countywide program addressing tick management and tick-borne pathogens
- Collaborate with other agencies, local governments and committees when necessary
- Continue participation in the Suffolk County Shared Services Initiative (i.e. SuffolkShare Public Health Partnership) which is a partnership of more than 100 local governments that cooperate on data sharing, providing or bartering goods or services, joint procurement, coordinating activities and collaborative problem solving
- Include language that supports a commitment to studying and implementing tick and host management techniques
- Support and maintain dedicated staffing to effectively address tick and tick-borne diseases
- Continue the commitment and efforts for developing integrated strategies for managing tick populations through the County Park Pilot Program
- Provide data to enable policy makers the ability to properly prioritize budgetary decisions
- Continue focus on the Asian longhorned tick with concern on residents, pets, wildlife and livestock
- Share information and best practices with interested parties including county elected officials and municipalities
- Maximize efforts in education and public outreach, using public messaging (e.g. public service announcements) especially the at-risk populations
- Maximize efforts in research whenever possible and to collaborate with municipal and private efforts that undertake research that benefits committee and county objectives
- Continue to conduct new and replicate field trials on efficacy testing of minimum risk, conventional and other pesticides
- Continue to conduct tick surveillance and surveillance at bi-weekly surveillance sites
- Seek funding wherever possible to increase resources for staff, equipment and other necessary items

- TCAC should remain active and continue to assist Vector Control as it addresses the reduction of tick-borne illnesses in Suffolk County

These recommendations are based on Vector Control having sufficient staff and resources to undertake the tasks listed above. Vector Control is committed to continue working with the TCAC and seeking out best management practices for the control of ticks and tick-borne disease in Suffolk County.

Water Management and Wetland Restoration

Water Management:

Field personnel conduct this component from January 1 to April 30, and October 1 to December 31. Water management during the winter months is a functional way to reduce the need for pesticide applications during the summer, by keeping mosquito ditches and creeks free of blockages. The Division expects to conduct water management in each of the County's ten towns, as needed. Highest priority is assigned to larval habitats where adult mosquito infestations have the greatest potential for negative impact. In particular, areas that had virus isolations or showed unexpectedly high infestations in 2020 will have high priority over the coming winter. Water management activities will be carried out in such a manner so that the primary goal of the work will be to protect the health of the marsh, while also reducing mosquito numbers.

Water management minimizes mosquito production through maintaining or improving systems of tidal channels, ditches, culverts and other structures that drain off surface water and/or allow access to potential larval habitats by predatory fish. In some cases, the current ditch system has become an important component of the wetland as it exists today, and maintenance of the system is necessary to maintain tidal flow, fish habitat, or existing vegetative patterns. Much of this is maintenance work that may not require a permit, but is nonetheless conducted after consultation with the New York State Department of Environmental Conservation (DEC) to ensure consistency with conservation of the wetland. More extensive work to rehabilitate wetlands in a manner that restores and preserves resource values while also reducing mosquito production is now underway under the umbrella term Integrated Marsh Management (IMM). In accordance with the Long Term Plan, all water management activities are conducted with appropriate notification to and oversight by the Council for Environmental Quality (CEQ), as outlined in the Findings Statement of the Suffolk County Legislature that was adopted by Suffolk County Resolution 285-2007.

The Wetlands Stewardship Committee completed its work in establishing standards for wetlands Best Management Practices (BMP's) and a Wetlands Stewardship Strategy was issued by Executive Order 01-2015 on July 13, 2015. With that Strategy in place, plans for 2021 include continuing work on several grant sponsored marsh restoration projects. These are projects that restore and enhance the natural resource values of the wetlands while also reducing or

eliminating the need for pesticides to control mosquitoes. All work is planned in partnership with the landowner and NYSDEC, USFWS and other natural resources agencies and undergoes SEQRA/CEQ review as required.

Integrated Marsh Management - Wetland Restoration Projects:

National Fish and Wildlife Foundation (NFWF) Sandy Resiliency Wetland Restoration Grant:

This $1,310,000 NFWF grant with a County match of $688,849 was awarded for Coastal Resiliency via Integrated Salt Marsh Management. The goals of the project include coastal resiliency and wetland restoration, with natural mosquito control through habitat adaption and killifish access as secondary goals. Work on the marsh restoration project at Gardiner SC Park east and the larger west side was over 90% completed in spring 2020 when Covid shut down work on the project. Beginning in October 2020, crews will complete the remaining work at Gardiner Park. Wetland restoration at West Sayville County Park and Timber Point NYSDEC wetlands are scheduled for winter 2020-2021 using funds secured through the NFWF grant. The DEC permits for each project has been secured, with an allowance for ongoing field modifications with DEC approval for greater ability to meet project goals.

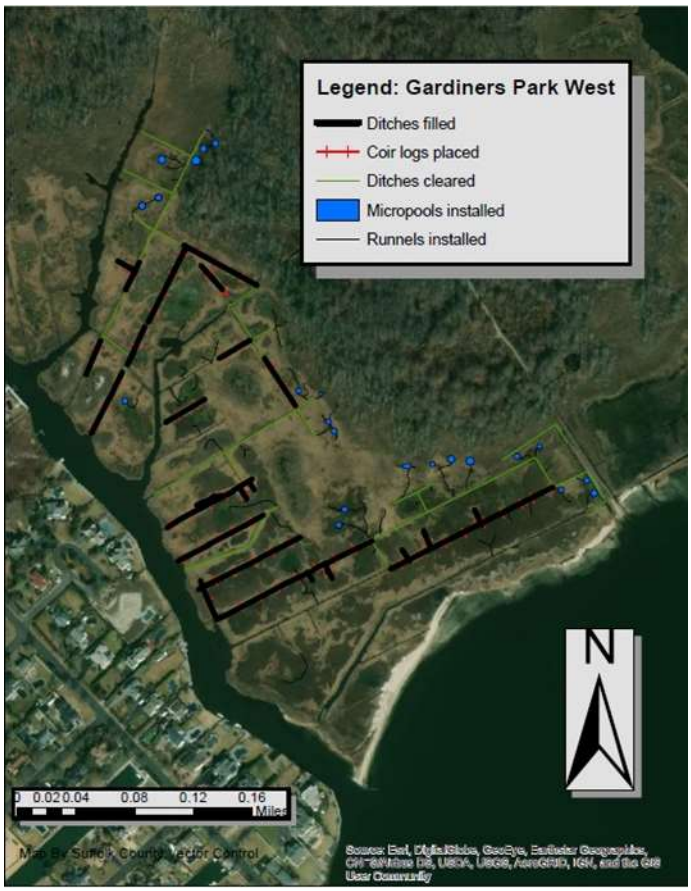
Suffolk County Community College student interns were previously hired as consultants to monitor site conditions including vegetation, mosquito breeding, water quality and fish usage of the marshes. Due to Covid restrictions for hiring the SCCC interns, Vector Control staff continued monitoring the sites during 2020; although at a reduced capacity.

The Nature Conservancy (TNC) was retained to help assemble a team of coastal wetland experts who reviewed the project plans and gave guidance on wetland restoration projects undertaken in their jurisdictions. These wetland scientists gave field visits to their sites and/or presentations on projects from work on marshlands including restoration work in CT, DE, NJ, RI and NYC. A key component of this project was the Regional Technical Workgroup (RTW) Report of saltmarsh restoration practitioners across the Sandy-impacted region which provides a forum for the exchange of ideas, experiences and best practices regarding saltmarsh restoration. TNC submitted the final report of recommendation to the County in the spring of 2020.

Summary of Work on the Gardiner NFWF Project: From October 2019 to March 2020 marsh restoration work

Figure 16 Marsh restoration of Gardiner Park West

was undertaken at Gardiner County Park in West Islip under the NFWF Coastal Resiliency grant. The marsh had been historically grid-ditched and was undergoing marsh loss along the bay front and had extensive panne formation. Without the ditches being maintained on a regular basis, large segments of the marsh became severely waterlogged and the marsh edge developed into prime mosquito breeding habitat. The waterlogged marsh has additional deleterious effects on overall marsh health, including the impounded water causing die-back of marsh vegetation. To reduce mosquito breeding habitat, foster a healthier marsh environment and return the marsh to a more "natural" state, IMM (Integrated Marsh Management) was implemented at Gardiner County Park. Integrated Marsh Management is "a comprehensive approach to ecological restoration and mosquito control", and had been used successfully by the county to restore 95 acres of Wertheim National Wildlife Refuge marshlands in Shirley. Due to vegetation and wildlife use of the salt marsh over the summer months, NYSDEC imposes a season winter work window (October 15 – March 30) when the restoration activities can occur.



A Watershed Designed for Proper Tidal Exchange – Single Channel

Prior to the restoration there were multiple interconnected 'grid' ditches that drained to the bay, which decreased effectiveness for tidal exchange in the marsh. A single, well planned tidal channel serving a watershed allows ponded floodwater to leave the marsh during low tides, and during high tides greater exchange and nutrient cycling to the marsh (Fig 18).

This is due to the increased hydrological pressure of the single channel, which is even more pronounced in the micro-tidal environment of the Great South Bay. To correct for the tidal exchange, some existing ditches were cleaned and new tidal channels were created. To create one primary drainage channel in each "phase" connecting 'grid' ditches were filled. Small micro-channels or runnels were installed to connect pools of standing water in marsh pannes to the new drainage channel. Installation of runnels allows surface water in the pannes to drain during low tides to reduce marsh vegetation die-back in the flooded areas. At the Gardiner marsh, due to sea level rise and panne formation, large sections of the marsh were being lost at an exorbitant rate.

Left; Marsh surface prior to drainage channel and runnels, Right Surface after drainage channel and runnels installed, note all the new vegetation growing in previously flooded pannes. Bottom; Filling of ditches with coir logs and covered with marsh peat.

Increased tidal exchange is when more water comes onto, and leaves the marsh every low/high tide cycle. When supplemented with runnels, a host of benefits is brought to the marsh including:

Removal of consistent stagnant water: There were many areas that had consistent stagnant water. These areas had the capacity to be mosquito breeding habitat, and prevented new vegetative growth. By removing the stagnant water, mosquito habitat is removed and new vegetative growth can begin.

Increased Sediment deposition: As the tide comes in it brings along with it sediment, very fine particulate matter made of sand, eroded rocks and organic matter. This sediment would normally then also go out with the marsh, but as the tide goes out sediment is blocked by vegetation, and the sediment gets caught on the marsh. Over time this sediment gradually becomes the marsh surface, and increases elevation of the marsh. As such, a healthy marsh's elevation level will constantly rises due to sediment deposition. If a marsh cannot accrete sediment at a rate equal to or greater than sea level rise it will be subject to erosion. This is why proper drainage, tidal exchange and removal of stagnant water are so important. Removal of stagnant water allows new vegetation to grow, which in turn gathers more sediment and "builds" the marsh faster.

With improved tidal exchange, a greater volume of sediment is brought onto the marsh to be deposited.

With sea-level-rise as a continuing threat, it is important to ensure our marshes keep up with the rising tides. If our marshes accrete material slower than sea level rises, we will lose an important ecosystem that provides us with many benefits such as storm protection, erosion protection and habitat for protected species. Based on a collaboration done by Suffolk County Vector Control and Stony Brook University, Gardiner Park marshes were not keeping pace with sea level rise and include panne formation and loss of marsh edge (Fig 19).

Figure 19 Comparison of Gardiner Park marsh edge loss along Great South Bay from 2012 to 2020.

Filling of historic ditches

Pre-existing ditches that would disrupt the new planned drainage pattern were filled with a combination of reuse of material from the local marsh, and coir logs. Coir logs are fibrous biodegradable logs made out of coconut fiber. Once a ditch was slotted to be filled, the coir log was staked into the ditch and marsh material from cleaned tidal creeks was placed on top of the coir log. Coir logs will degrade over time, but will give vegetation time to grown over the ditch, restoring a resilient marsh environment.

Extensive sampling was done prior to the start of the project to ascertain where the mosquitos were breeding. In areas with the heaviest breeding, micro-pools were installed. Micro-pools are small ponds, less than 10 feet by 10 feet with shallow runnel connecting the pond to a tidal creek. The goal of these micro-pools is to both remove the area where mosquitos breed, and provide a habitat for fish who then hunt mosquito larvae. Weekly pre and post-project sampling shows that throughout the entirety of 2019 no mosquito larvae were found in Phase 1 section of Gardiner Park, while hundreds of larvae were found in this same marsh in prior years to the restoration work.




From Left to right: 1. Coir logs placed inside a pre-existing ditch. 2. Material taken from cleaned out ditches being placed on top of a coir log to fill a ditch. 3. Excavator cleaning tidal creek and placing the sediment for transport to fill a ditch. 4. Cleaning a tidal creek. All machines are rated for amphibious use and have less than 2-psi and are less damaging to the marsh surface than someone walking on it.

Below: A finished fish micro-pool with a shallow connecting runnel.

Federal Emergency Management Agency (FEMA) Sandy Resiliency Wetland Restoration Grant:

This federally funded project again has the goals of coastal resiliency and wetland restoration, with natural mosquito control through habitat adaption and killifish access as secondary goals. The Smith Point Marsh in Shirley is approximately 90 acres of wetlands to be restored using the same techniques as the NFWF projects. All NYSDEC and ACOE permits are in place for the implementation phase and NEPA review completed. FEMA/NYS DOHS have successfully secured funds for restoration, and the County and FEMA grant funding agreement was finalized so that the field work can begin on the restoration. This project is scheduled to begin in 2021, after work on the NFWF projects have been completed.

Indian Island Wetland Restoration Grant:

NYS DEC funding has been extended for restoration of this dredge spoil filled former wetland. Restoration would reconnect the site for regular tidal exchange and assist in natural mosquito control by use of native predacious killifish. The site is now regularly treated by Vector Control via aerial larvicide. DEC and County agencies continue to review and revise restoration plans dealing with dredge material and the overall scope of the project.

Beaverdam Creek

The Beaverdam Creek County Park in Brookhaven Hamlet is being studied for the re-establishment of a wetlands complex at a dredge spoil impacted marsh. This project is a cooperative undertaking between several County agencies and the Post Morrow Foundation. SC Parks is lead agency on this project, but with Vector staff involvement in the planning. Vector Control marsh equipment would be used to restore the dredge filled site to a tidal wetland. Preliminary site plans were drafted and are under review. SC water quality program is funding the consultants and the restoration work would be undertaken by County staff. The goal of this restoration project is to return tidal circulation to a diked marsh that is a mostly phragmites and several low areas that breed salt marsh mosquitoes. A tidal creek will be created through the dike to allow for the return of salt marsh vegetation, phragmites control and a reduction in mosquitoes by allowing killifish access to the low areas of the site.

Mastic Beach

A USDA/NRCS grant of $795,000 was awarded to DPW for demolition of three homes destroyed during Sandy and restoration of impacted wetlands on these properties. Funding agreements between Suffolk and USDA are being finalized, with assistance from Parks. Work on environmental permits and demolition agreements should begin in 2021, with wetland restoration anticipated in 2022. There are 25 adjoining parcels the County DEEP program is actively purchasing and once the acquisitions are complete restoration can commence.

Due to the Covid-19 pandemic, all of our wetland restoration projects have been delayed. Staff reassignments for assisting in Covid response by Suffolk County and NYSDEC has limited our

ability to hold meetings and field visits. We do however remain committed to continuing with this essential work on restoring our marshes for coastal resiliency and reducing pesticide usage.

Accabonac Cooperative Project 2017-2020:

Summary of the 2020 season saw continued reduction in pesticide use at Accabonac Harbor through the cooperative project (Fig 20). Data collected in 2020 confirms many previously identified hot spots for mosquito breeding along the west side of the harbor in the marsh's upland fringe, which was treated on five dates over the 2020 summer season.

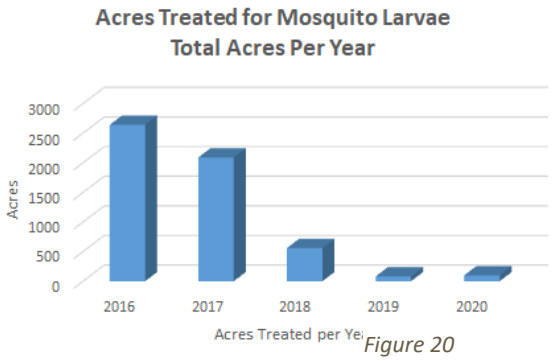


Figure 20

A joint project was initiated between Suffolk County Vector Control (SCVC), East Hampton Town Trustees (EH) and the Nature Conservancy (TNC) in 2017 with the goal to reduce pesticide applications to Accabonac Harbor. The basis of the pesticide reduction program was to undertake a more targeted approach to mosquito larvicide treatments through detailed GIS mapping of mosquito breeding locations. In 2017, a pilot project covering 5 weeks was initiated and focused on 2 spray blocks in the southern section of Accabonac Harbor. The 2017 trial allowed the partners to see if this method could be a feasible approach to achieve the end goal of cutting pesticides applied. Due to the success the group achieved in the 2017 trial where spray blocks were reduced greatly in size, the program was expanded for 2018 and continued through 2020 due to the success of the program. The survey team collects several thousand GIS data points over the summer, identifying positive dip locations. Dip data taken by the team includes GIS location (lat/long), larval stage (1-4 & pupae) and total number of each stage, count of pupae present and any notes of the sampler. Information collected by the team was sent to Vector Control for review. Vector staff GIS map the larval distribution and review the dip data for a treatment decision. If treatment was necessary, a revised map would be sent to the helicopter pilot to adjust the spray blocks at Accabonac Harbor to only target those 'hot spots' identified within the treatment block (Fig 21).

Figure 21 'Hot Spots'


Figure 22 Dip Locations

Data from the EH team continues to allow Vector to cut the spray blocks dramatically. The reduction of treatment block acres allows the County cost savings from less pesticide applied and reduced helicopter flight hours treating the site. The identified points by the team showed breeding was predominantly along the upper marsh edge moving the applications further away from the harbor water's edge (Fig 22).

The next step is for TNC, EH and Vector to take the mosquito data, aerial imagery and other data sources and develop wetland restoration plans where natural mosquito control via killifish and

habitat modifications, such as runnels, can further reduce or eliminate the need for pesticide applications at Accabonac Harbor.

APPENDIX Description of Pesticide Materials SCVC 2021:

The mosquito larval control products to be used in 2021 and the conditions under which they are used are described as follows:

Altosid Liquid Larvicide Concentrate (methoprene, EPA 2724-446) – Aerial application to tidal and freshwater marshes.

Altosid Liquid Larvicide (methoprene, EPA 2724-392) – Ground application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Altosid Pellets (methoprene, EPA 2724-448) – Ground application to intermittently or permanently flooded areas such as freshwater swamps, catch basins, drainage areas and recharge basins, provided that they are not fish habitats.

Altosid XR-G (methoprene, EPA 2724-451) – Ground or aerial application to tidal wetlands; ground application to intermittently flooded freshwater areas; aerial application in freshwater areas in response to Eastern Equine Encephalitis (EEE) or West Nile Virus (WNV) with required separate approval by NYSDEC.

Altosid XR Briquets (methoprene, EPA 2724-421) – Catch basins and other drainage or artificial structures that are not fish habitats, swimming pools.

Aquabac 200G (Bti, EPA 62637) – Ground application to intermittently flooded freshwater and tidal areas.

Sphaeratax SPH (50G) (B. sphaericus, EPA 84268-2) – Ground application to freshwater and brackish areas that hold stagnant water such as ditches, impounded marshes, swamps, puddled areas, sewage lagoons; late season application to catch basins.

Valent BioSciences VectoBac 12 AS (Bti, EPA 73049-38) – Aerial application to tidal and freshwater marshes; ground application to intermittently flooded areas such as tidal and freshwater marshes.

Summit B.t.i. Briquets (Bti, EPA 6218-47) – Catch basins, ground depressions, artificial sites.

Fourstar Briquets 90 (Bti plus B. sphaericus, EPA 83362-3) – Catch basins, ground depressions, artificial sites, swimming pools

Valent VectoPrime FG (Bti and methoprene EPA 73049-501) – Ground and aerial application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Valent VectoBac WDG (Bti EPA 73049-56) – Ground and aerial application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Valent VectoMax FG (B. sphaericus and Bti, EPA 73049-429) - Ground and aerial application to freshwater marshes, as well as other semi-permanent flooded sites.

Valent VectoMax WSP (B. sphaericus and Bti, EPA 73049-429) –Catch basins, swimming pools and other small flooded areas of standing water.

Any new larvicide material to be considered for incorporation into the 2021 program can only include the three active ingredients: Bti, B. sphaericus and methoprene as approved in the Long Term Plan and GEIS and would be used under a NYSDEC permit. New active ingredient pesticide materials would require SEQRA review and be included as a supplement to the GEIS.

Vector Control Pesticide Labels and SDS:

Pesticide labels and SDS safety sheets for all materials in use by Vector Control are posted on the Suffolk County Government website under Public Works – Vector Control at:

https://suffolkcountyny.gov/Departments/Public-Works/Vector-Mosquito-Control/Vector-Online-Form

2021 Suffolk County Vector Control Program Summary:

Ticks: Vector Control will continue to work on developing tick control strategies and will follow the TCAC recommendations for developing the tick control program in Suffolk. Work continues on developing a potential pilot project at a County Park and environmental review control strategies and review of emerging research.

Education/Outreach: In cooperation with SC Health, Vector Control will continue to work on public education on tick and mosquito issues, avoidance and control options for residents, commercial applicators and municipalities within Suffolk.

Resistance Testing: Vector Control will continue to monitor and test mosquito populations for pesticide resistance and will continue to work with the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD) Pesticide Resistance Lab. Resistance testing of ticks will be investigated in cooperation with work being developed by the NEVBD. Investigate alternatives to pesticides currently in use for resistance management.

Public Notification: Vector Control will continue the use of Code Red for adult spraying alerts, work with Health on press releases and social media messages, County website updates and phone hotline.

Pesticide Reduction: Vector Control is fully committed to implement pesticide reduction strategies whenever possible. Work on wetlands management and Integrated Marsh Management (IMM) with cooperators will continue, as IMM is the best management practice for reducing aerial larvicide applications to the greatest acreage consistently. Pesticide reduction

through IMM not only greatly benefits the environment, but saves the County financially in reduced pesticide material requirements and in staff time checking and treating these sites.

Virus Response: Vector Control will continue to work closely with SC Health in safeguarding residents from mosquito-borne viruses including WNV, EEE and working on the control of tick-borne pathogens.

Adult and Larval Mosquito Control: Pesticides employed for adult and larval mosquito control will only be used if they are EPA and NYSDEC registered. Crews must follow label conditions and any applicable NYS permits for application. All active ingredients (AI) will match those reviewed and approved for use in the Vector Control Long Term Plan/GEIS unless a supplemental study is undertaken for new AI.

The Suffolk County Department of Public Works – Division of Vector Control
2021 Plan of Work was prepared by:
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Department of Public Works – Vector Control
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Jonathan Sokol – Weather graphs

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Suffolk County Vector Control Pesticide Acreage Estimates for 2020

Pesticide	Active Ingredient	EPA#	Amount used	Units	Amount in use units	Units	Dose (units / acre)	Air/Ground Application	Total 2020 Acreage	Change in Acres +/- from 2019
Ground Larvicide										
Altosid 5%	Methoprene	2724-392	1.7	GL	217.6	fl	4	Ground	54.40	-586
Altosid pellets	Methoprene	2724-448	18	LB	18	lbs	5	Ground	3.60	-44
Altosid XRG	Methoprene	2724-451	0	LB	0	lbs	5	Ground	0.00	-32
Bti briquets - Summit	Bti	6218-47	203	EA	203	ea	435	Ground	0.47	-2
Fourstar 90 briquets	Bti/*B.sphaericus*	83362-3	180	EA	180	ea	435	Ground	0.41	-6
VectoBac 12AS	Bti	73049-38	17.314	GL	2216.192	fl	16	Ground	138.51	-750
Aquabac 200G	Bti	62637-3	387.99	LB	387.99	lbs	10	Ground	38.80	-195
VectoPrime FG	Bti/Methoprene	73049-501	2210.08	LB	2210.08	lbs	4	Ground	552.52	458
Spheratax 50G	*B.sphaericus*	84268-2	267.5	LB	267.5	lbs	15	Ground	17.83	-302
VectoMax FG	Bti/*B.sphaericus*	73049-429	1049.03	LB	1049.03	lbs	15	Ground	69.94	70
VectoMax WSP	Bti/*B.sphaericus*	73049-429	1359	EA	1032	ea	871	Ground	1.56	2
Altosid XR briquets	Methoprene	2724-421	7594	EA	7594	ea	218	Ground	34.83	-6
Ground Larvicide Total Acres:								Ground Total	912.87	-1,394
Aerial Larvicide:										
VectoPrime FG	Bti/Methoprene	73049-501	34840	LB	34840	lbs	4	Aerial	8,710.00	5
VectoMax FG (*EEE Site*)	Bti/*B.sphaericus*	73049-429	5040	LB	5040	lbs	15	Aerial	336.00	336
Duplex Altosid 20% &	Methoprene	2724-446	0	GL	0	fl	0.75	Aerial	0.00	-1,750
Duplex VectoBac 12AS	Bti	73049-38	0	GL	0	fl	18	Aerial	0.00	
Aerial Larvicide Total:								Aerial Total	9,046.00	-1,409
Total Larvicide Acreage:								Total Larval	9,958.87	-2,804
Adulticide:										
Anvil 10+10	Sumithrin	1021-1688-8329	64	GL	8192	fl	0.6	Ground/Air	13,653.33	-491
Duet	Sumithrin+Prallethrin	1021-1795-8329	0	GL	0	fl	0.75	Ground	0.00	0
Mavrik Perimeter (Tick)	Tau-fluvalinate	2724-478	0.5	GL	65.0	fl	21.78	Ground	3.00	3
Adulticide Acreage:								Adulticide:	13,656.33	-488

Note: Mavrik Perimeter was applied on behalf of Parks Department to control ticks at the Flight 800 Memorial at Smith Point SC Park.

Supplement to the 2021 Vector Control Annual Plan of Work – Adult Mosquito Control

PFAS and Anvil 10+10 Findings

This supplement to the 2021 Annual Plan of Work was requested by the Suffolk County Legislature due to concerns of Per- and polyfluoroalkyl (PFAS) found in samples of the pesticide Anvil 10+10 taken in Massachusetts. Anvil 10+10 has been the preferred adult mosquito control pesticide for Suffolk County Vector Control due to the favorable findings of the Long Term Plan for using this product. Alternative products identified in the Annual Plan of Work are further reviewed here for potential use, if the Anvil 10+10 product were not available in 2021.

In January, 2021 the PFAS contamination was traced by the manufacturer and US EPA to the containers used by pesticide company to store and ship the product. The fluorinated HDPE containers are treated by the container manufacturer to prevent changes in chemical composition to the plastic container from the pesticide. Due to the confirmed findings of PFAS in the packaging of the Anvil 10+10 container, the manufacturer (Clarke Mosquito Control Inc.) has decided to exchange all of Vector Control's inventory of Anvil 10+10 in PFAS treated containers and will supply replacement material in containers free of PFAS.

This document will review the leading alternative materials Suffolk County Vector Control has identified in the Long Term Plan and GEIS as potential substitutions to the Anvil 10+10 pesticide. Issuance of new material in PFAS-free packaging should allow Anvil 10+10 to remain the preferred adult mosquito control pesticide. Alternative pesticide products that will be reviewed contain the active ingredients permethrin, a synthetic pyrethroid and pyrethrin, a natural pyrethrum.

All pesticides selected by Suffolk County for adult mosquito control under the Long-Term Plan are appropriately suited for ultra-low volume (ULV) treatments. The quantitative risk assessment and modeling (based on EPA guidance documents) indicates no, to little, detectable human health impacts and all have comparatively minor ecological impacts when applied according to the USEPA/NYSDEC approved label. The ecological impacts are further mitigated by the focused applications to problem areas, proper timing of applications and avoiding areas NYSDEC has identified of environmental concern. The probability model, based primarily on laboratory testing, also builds in buffers to overestimate the concentrations of pesticides. Material actually delivered, including to aqueous environments, is overestimated by several factors, based upon testing conducted in association with Vector Control Long Term Plan/GEIS.

In the Suffolk County Vector Control and Wetlands Management Long-Term Plan, two pesticide active ingredients are identified as suitable alternative materials permethrin and natural pyrethrum, pyrethrin. Alternative formulations generally will rely on the use of piperonyl butoxide (PBO) as a synergist to increase the pesticides effectiveness. Permethrin is a widely consumed product, both for homeowner and commercial applications, increasing the risk for mosquito resistance. Natural pyrethrum products may include label clearances for use over cropland, although application to cropland is typically not required for mosquito control.

Permethrin had higher ecological risks associated with its use, and also has label setback requirements that make it less practicable for use in shoreline settings. Natural pyrethrum, generally considered an

organic pesticide, did not receive as extensive a review as the synthetic pyrethroids in the quantitative risk assessment. Pyrethrins are natural pesticides harvested from some chrysanthemum plants (mainly Chrysanthemum cinerarnaefolium). Chemically, pyrethroids are esters of specific acids (e.g., chrysanthemic acid, halo-substituted chrysanthemic acid, 2-(4-chlorophenyl)-3-methylbutyric acid) and alcohols (e.g., allethrolone, 3-phenoxybenzyl alcohol). Pyrethrum does show a similar risk profile to the synthetic pyrethroids. It also degrades very rapidly, giving it a margin of error with regard to potential risks. Pyrethroid label often will allow for application over crops, which is not the case for some pyrethroids. It can be more expensive (as compared to other pyrethroid products), and in the past has sometimes not been readily available.

The pyrethroids are synthetic pyrethrin-like materials widely used for insect control. Pyrethrins and pyrethroids have a similar mode of action, where they work on the nerve axons by keeping open sodium channels used to propagate signals along a nerve cell. Initially, they cause nerve cells to discharge repetitively; later, they cause paralysis. These pesticides affect both the peripheral and the central nervous systems. When applied alone, pyrethroids may be swiftly detoxified by enzymes in the insect. Thus, some pests will recover unless the pesticide's effect is augmented. To delay the enzyme action so a lethal dose is accomplished for pest control, a synergist (e.g., piperonyl butoxide) is generally added to pyrethroid formulations to improve efficacy.

One potential problem due reliance on any of these materials alone is that they are all low volume production pesticides, with a limited niche market. The manufacturer can discontinue these products for many reasons, without advance notice. The recent loss of Scourge (Resmethrin) was one such case, where the product was cost prohibitive for the manufacturer to maintain on the market and was eventually discontinued. The recent findings of PFAS in Anvil (Sumithrin) resulted in a stop use order for the pesticide. Therefore, alternative active ingredients were identified as meeting the needs of the County in the Long term Plan/GEIS, including permethrin and pyrethrin.

Sumithrin (Anvil):

Sumithrin (phenothrin) trade name Anvil is currently used in truck, helicopter and hand-held adulticide applications. Sumithrin is a broad spectrum pyrethroid insecticide registered for use against mosquitoes in swamps, marshes, and recreational areas. Sumithrin can also be used to eradicate pests in transport vehicles such as aircraft, ships, railroad cars, and truck trailers, and for institutional non-food use, use in homes, gardens, and greenhouses, and on pets for flea/tick applications. The risk assessment concluded, at the concentrations sumithrin is applied in Suffolk County, no significant increase in risks for health or ecological effects would follow from its use. As with all of the pesticides considered by the risk assessors, the risk assessment found there might be impacts to night-flying insects. To further mitigate the potential for any impacts, the smallest treatment area required should be considered.

Permethrin:

Permethrin is a broad spectrum pyrethroid insecticide which is used against a variety of insect pests. It is used in greenhouses, home gardens, and for termite control. It also controls animal ectoparasites, biting flies, and cockroaches. Permethrin is additionally used to control insects on a variety of food and non-food products, including on nut, fruit, vegetable, cotton, ornamental, mushroom, potato, and cereal

crops. It is also the active ingredient in several topical anti-parasitic formulations used in human and veterinary medicine including Lice control.

There are four isomeric forms, two cis- and two trans-, of technical permethrin. Product formulations can vary greatly in isomeric content. The risk assessment concluded, at the concentrations of permethrin Suffolk County would apply at, no significant increases in risks for health or ecological effects would follow from its use. Permethrin was found to have some potential to impact aquatic invertebrates, and setbacks from aquatic environments need to be reconsidered. Sophisticated ecological modeling found that the loss of certain invertebrates would not have any greater ecological impacts (i.e., the effects did not propagate up the food chain). Additionally, longitudinal modeling suggested rapid recovery for any affected species, so that full ecological recovery would be expected by spring following any application the previous year. These results are somewhat expected, given that permethrin is not persistent in the aquatic environment and does not bioaccumulate to any significant degree. To further mitigate the potential for any impacts, the smallest area requiring treatment by permethrin use should be considered.

Pyrethrum:

To add to the selection of pesticides available for County use, and to ensure the County has a product that is registered for use in agricultural areas should treatment there be required, pyrethrum was reviewed and added to the list of approved products in the Long term Plan/GEIS. Pyrethrum is a natural, botanical pesticide that is an extract of flowers from certain chrysanthemum species. The flowers are either dried or powdered, or their oils are extracted. The resulting pyrethrum extract or powder is composed of individual pyrethrins; including pyrethrin I and pyrethrin II, cinerins and jasmolins, which are the components that have insecticidal properties. Most of the pyrethrin pesticide products that are available also contain a synergist, such as PBO. Pyrethrin is somewhat costly, however, and can be difficult to acquire during high demand periods.

Natural pyrethrum was not as closely reviewed in the Long Term Plan as the synthetic pyrethroids. However, indications are that it is somewhat less toxic than the synthetic pyrethroids. This suggests that, at the concentrations it would be applied in Suffolk County, no significant increases in risks for health or ecological effects would follow from its use.

Formulations generally contain five percent pyrethrins with PBO at a one to five ratio. They are applied as a ULV application, and are rather expensive compared to other products, and sometimes difficult to obtain because demand outstrips supply. Pyrethrum can be used for resistance purposes, and over agricultural areas, if required. All pesticide product labels used by Suffolk County Vector Control, including the natural pyrethrums contain the EPA signal word “CAUTION.” A potential pyrethrin based material Vector Control may consider would be EverGreen 5-25 Ground ULV (MGK), a synergized pyrethrin formulation for ULV adulticide applications. The oil based ground formulation contains 0.365 lb Pyrethrins and 1.824 lb of synergist (Piperonyl Butoxide) per gallon. EverGreen 5-25 Ground ULV is labeled for aerial and ground ULV treatment in a broad range of use sites. EverGreen 5-25 Ground ULV is approved for urban, rural, residential, agricultural areas, cropland (not certified for organic crops), wetland and recreational areas.

PBO:

PBO is a derivative of piperic acid and, as discussed, is generally utilized as a chemical synergist in pyrethroid formulations. Pyrethroid products containing PBO are used to control mosquitoes in outdoor residential and recreational areas, as well as indoors to control insects such as fleas, ticks, and ants. Formulations of pyrethrins containing PBO are also used as a pediculicide to control body, head, and crab lice. PBO, in and of itself, at the concentrations modeled to result in the County from applications of PBO-containing pesticide formulations, was found by the risk assessment not to cause significant increases in risks for human health or environmental impacts. The pyrethroid/pyrethrin results of the risk assessment reported above included additive effects that may result because of PBO use as a synergist.

Summary:

Anvil 10+10 will continue to be the primary pesticide for adult mosquito control, pending replacement of existing stock with new PFAS-free Anvil. The manufacturer is working closely with the US EPA to use new packaging, replace existing stock and assures us of replacement material in time for our mosquito season. We also continue dialogue with the NYSDEC and have kept their Pesticides program informed on the Anvil PFAS developments. NYSDEC has placarded and quarantined our existing Anvil 10+10 stock while we await its replacement. If circumstances prevent Vector Control from continuing to use Anvil 10+10, the primary back-up pesticide would be use of a natural pyrethrin with a PBO synergist such as Evergreen 5-25 ULV, or a product of similar composition. A permethrin based product would be the second alternative pesticide. This is due to resistance concerns and permethrin's ability to lasting longer in the environment, with potential for greater non-target impacts.