THE TOWN OF
Highland Park
TEXAS

MOSQUITO CONTROL POLICY

Mosquito Control Cooperative

Preparation is the most important component of the Town's Mosquito Control Program. Achieving the most effective control of mosquito populations will necessitate the coordinated efforts of the Town and, just as importantly, its residents.

What the Town will do:

- Engage in an aggressive public information campaign for its residents;
- Develop an active year round program for assessing the numbers and types of mosquitoes found in the Town;
- Emphasize source reduction by focusing on the elimination or modification of mosquito breeding sites;
- Apply organic and, when necessary, EPA-approved larvicides to control and eliminate mosquito larvae; and
- Apply EPA-approved pesticides, meant for adult mosquito control, to quickly reduce the density of adult mosquito populations.

What the residents must do:

- Reduce the amount of water used in their yards;
- Eliminate any stagnant bodies of water in their yards; and
- **Notify** the Town of swarms of mosquitoes, dead birds, or stagnant bodies of water in parks or rights-of-way.

Executive Summary

The objective of the Mosquito Control Policy (the "Policy") is to attain an efficient and effective mosquito control operation that will provide the best results possible, and be consistent with all ecological aspects and the best interests of the Town. The Policy outlines strategies for the prevention and control of mosquito-borne diseases that pose a threat to public health. The Town of Highland Park's immediate priority is to prepare for, and take preventive measures, to reduce the potential of the West Nile Virus (WNV) and other mosquito-borne diseases. The Policy emphasizes a coordinated Integrated Pest Management (IPM) approach to minimize the public health threat from mosquito-borne diseases, by utilizing proven sound mosquito control techniques recommended by the Centers of Disease Control and Prevention (CDC). IPM utilizes a variety of control techniques and evaluation procedures that includes:

- Public education;
- Personal responsibility;
- Source reduction;
- Surveillance and monitoring; and
- Chemical control (larvicide and adulticide).

The prevention of any mosquito-borne disease is most efficiently accomplished by the residents knowing how to recognize potential mosquito breeding sites on their property, and taking appropriate actions to eliminate these breeding sites. This Policy outlines actions that citizens can take to help reduce the threat of an arbovirus, and eliminate potential breeding sites from their property.

All citizens must be active in personal protection and do their part to aid in the abatement process to protect themselves, their family, their homes, and their community. Providing the public with the most updated information is only one part in the control of mosquito breeding and disease prevention. Approximately eighty percent (80%) of land within Highland Park is private property; the Policy stresses the importance of personal responsibility. It is important for the residents to understand that the majority of mosquito breeding sites are developed due to the creation of artificial breading sites caused by excessive-watering of lawns and plant beds, pet bowls, birdbaths, and flower pots with saucers, buckets, gutters, catch basins, or anything that may hold water outdoors around their homes.

Additionally, the Town staff will promote personal protection responsibility year round through a public information campaign, and will stress personal protection responsibility during the peak mosquito season. The staff will identify potential partners to assure a continuous flow of consistent information. The Town will also utilize the CDC's "Fight the Bite" campaign to supplement its public information efforts.

On a year round basis, the Town will use source reduction and surveillance to track larval and adult mosquito populations, species types, and breeding locations to evaluate the potential for any arbovirus disease outbreak within the community on a year round basis. Knowing when and where a virus is likely to strike allows for precise targeting control techniques.

The use of larvicides and adulticides is a necessary component of mosquito control. Larviciding and adutlticiding is recognized by the CDC and other federal health authorities as critical program elements in reducing public health threats from mosquito-borne diseases. Given the relative importance and capabilities of source reduction and larviciding to reduce the breeding of mosquitoes, such activities will be undertaken before adulticiding. It is acknowledged that source reduction and larviciding cannot completely eliminate adult mosquito populations in the Town. Should surveillance data indicate increased mosquito population(s) and/or the presence of an arbovirus that poses a risk to public health, adulticiding can help reduce such populations over a large area in a relatively short period. Larviciding would only help reduce populations of future generations, but would not affect existing adult mosquitoes, which are infected or could be infected.

The Town will utilize organic larvicides, such as Bacillus thuringiensis israelensis (Bti), as well as other Environmental Protection Agency (EPA) approved larvicides. Larviciding is an important control mechanism since the objective of larviciding is to control the immature stages at the breeding sites before adult populations have had a chance to disperse, and to maintain populations levels at which the risk of arbovirus transmission is minimal.

It will be standard procedure for the Town of Highland Park to only use pesticides meant for adult mosquitoes as a last resort to control adult mosquito populations. The Town will only use adulticiding chemicals that have been tested, registered, and approved by the EPA. The Town's decision to use pesticides will be based the CDC's recommendation that mosquito adulticiding should only be used in situations where surveillance data indicates that it is necessary to reduce the density of adult mosquito populations quickly to lower the risk of WNV or other mosquito-borne diseases based on established set thresholds. These thresholds are:

- When a particular trap location has over 50 female mosquitoes in one night of trapping;
- When a mosquito pool (one trap's catch of mosquitoes) has tested positive for either WNV or St. Louis Encephalitis (SLE);
- When Dallas County Health and Human Services (Dallas County) or the Department of State Health Services (DSHS) reports a suspected human case of WNV or SLE in the Town;
- When Dallas County or the DSHS reports a confirmed human case of WNV or SLE in the Town; and
- On the recommendation by Dallas County or the DSHS for any public health reason.

Lastly, The CDC and the DSHS recommend that a mosquito control program should be supplemented with a risk response plan designed for mosquito-borne disease outbreaks. The response plan is not intended to replace a mosquito control policy, but to define human disease risk levels with specific recommended responses. The Policy identifies response actions to various levels of mosquito outbreaks, with specific recommended responses in accordance with the principles of IPM and the Policy's threshold management criteria.

1.0 INTRODUCTION

Mosquitoes are members of a family of nematocerid flies: the Culicidae, from the Latin culex, genitive, culicis meaning "midge" or "gnat". The word mosquito (formed by mosca and diminutive ito) is from the Spanish for "little fly". The female mosquitoes have modified mouthparts that form a long piercing-sucking proboscis, while male mosquitoes have mouthparts that are incapable of piercing skin. There are over 2,500 different species of mosquitoes that have been identified throughout the world, with approximately 150 species occurring in the United States (National Center for Infectious Disease). The DSHS estimates that there are approximately 82-84 mosquito species in the State of Texas, although only about 12 of these mosquito species have been implicated in the transmission of serious diseases. The two most common types of diseases in our region are the WNV and SLE.

WNV is maintained in nature in a manner similar to SLE, in a bird- mosquito cycle. Several *Culex* spp., including the common house mosquitoes, *Culex quinquefasciatus, Cx. pipiens*, and *Cx. salinarius*, and possibly also *Cx. restuans*, are the principal vectors to people. WNV appears to be most dangerous to the elderly or immune-compromised patient. Since WNV has been demonstrated to amplify in the Asian tiger mosquito in the lab, it is possible that this mosquito is also involved in WNV transmission. In contrast to other mosquito-borne viruses, WNV also kills many birds in the U.S., especially crows, blue jays, and raptors. Surveillance efforts to detect the presence of WNV, therefore, can target the reporting and testing of those three types of dead birds. WNV does not cause as serious illness as some other arboviral diseases. In fact, only one out of every 150-200 people exposed to the virus will become ill, and less than 10% of clinically ill patients will die. Still, the public's perception and reaction to local reports of WNV cases cause much anxiety and fear in communities.

The SLE virus circulates naturally among birds and is transmitted by *Culex* mosquitoes. Humans can become infected only if bitten by an infected mosquito. Humans are actually "dead end" hosts, meaning that the virus in human blood never reaches a level high enough to infect a biting female mosquito to continue the cycle. Not all people infected with the virus develop clinical disease. However, the virus may produce abrupt fever, nausea, vomiting, and severe headache in humans within 5-7 days after being bitten. Fatality rates range from 2- 20% with most deaths occurring in people 60 years of age or older. Outbreaks of SLE usually occur in midsummer to early fall. Since wild birds and domestic fowl are the reservoirs of this virus, urban areas where large bird populations, and abundant *Culex* mosquitoes are found together, are prime sites for a disease outbreak.

Female mosquitoes require still and stagnant water away from predators in which to lay her eggs. These areas can include, catch basins, gutters, birdbaths, tree holes, freshwater wetlands, and plant pots. Female mosquitoes will lay their eggs on the water surface either singly, or in a raft containing up to 300 eggs, and will hatch within about 24 hours. As adults, both the male and female adult mosquito feed on sugars from plants and from other insects that feed on plant sugars. This is the only source of nutrition for the males, as they do not feed on blood. The females use the sugar meals for energy and the blood meals for egg development (IFAS Mosquito Information, 2012).

Although only a small percentage of mosquito species are capable of transmitting diseases, mosquitoes are still considered to be a very important vector for disease transmission. Outbreaks of Yellow Fever have been recorded as far north as Philadelphia during the Colonial Period, and Dengue fever was prevalent along the Gulf Coast until the mid-1940s. At one time, malaria was well established in the continental United States, especially in the south. Other mosquito borne illnesses like Lacrosse and Eastern Equine Encephalitis are still threats in certain areas of the country. Although many of these historical mosquito-borne diseases have been eliminated or at least controlled, the introduction and subsequent rapid spread of WNV within the United States is a topic of current concern (Banks, 2009).

The Town's Policy is based on the best management practices of various local and national municipalities, and State and Federal public health agencies. Furthermore, the Policy reflects the recommendations from the CDC, Association of State and Territorial Health Officials (ASTHO), as well as, the National Center for Infectious Diseases-Division of Vector-Borne Infectious Diseases recommendations for creating sustainable state and local mosquito control programs, using IPM mosquito control strategies developed around sound biological, physical, and chemical science data (ASTHO, 2005). The IPM mosquito control strategies include:

- Public Information;
- Personal responsibility;
- Source reduction;
- Surveillance and monitoring; and
- Chemical control (larvicide and adulticide).

2.0 PUBLIC INFORMATION / PERSONAL RESPONSIBILITY

Public information relates to the development and maintenance of community-wide mosquito control activities and programs. Areas of individual responsibility relate to personal actions that residents can take to reduce personal risk from mosquitoes, such as eliminating breeding sites on their property, and using insect repellants (Banks, 2009).

2.1 PUBLIC INFORMATION

The Town will identify potential partners to assure a continuous flow of consistent information. Additionally, the Town will also utilize the CDC's "Fight the Bite" campaign to supplement its public information efforts. Effective risk communication campaigns are successful because they provide accurate, clear, and timely information. The prevention of any mosquito-borne disease is most efficiently accomplished by ensuring that prompt and accurate information reaches the public. If the appropriate information reaches the public in a timely manner, personal protective measures may be implemented without panic and confusion.

The Town will provide continuous information on the Town's website concerning arbovirus/disease frequently asked questions (FAQs), disease symptoms, personal preventative measures, and points of contact for additional information. If a sampled mosquito pool tests positive for arbovirus/diseases, information describing the location of the sampling event, the

date, and other pertinent information will be provided. Techniques used to disseminate information may include, but not limited to, the following:

- Utilization of the Town's website to post information on mosquito abatement activities, maps, surveillance reports, mosquito FAQ's, personal protection best practices, and mosquito control website links;
- Utilize the Town's electronic notification system to alert the community of any potential virus threat and adulticide control applications;
- Adding mosquito control tips on utility water bills;
- Letters, pamphlets, brochures, and/or door hangers to be distributed to residents, shopping areas, schools, and faith based organizations within the community;
- Presentations to community groups concerning mosquito breeding reduction and related activities;
- Press releases describing WNV response activities; and
- The development of a public service announcement to be provided to local media outlets.

2.2 PERSONAL RESPONSIBILITY

All citizens must be active in personal protection and do their part to aid in the abatement process to protect themselves, their family, their homes, and their community. Providing the public with the most updated information is only one part in the prevention of mosquito breeding and disease prevention. Since approximately eighty percent (80%) of land within Highland Park is private property, the Town will stress the importance of personal protection responsibility through its public information campaign year round. It is important for the residents to know that the majority of mosquito breeding sites are developed due to the creation of artificial breading sites around their homes. The following information will assist the residents, and help them to become more aware of mosquito breeding sites, and prevent the spread of WNV and other mosquito borne-diseases.

Backyard Inspection Program

The Backyard Inspection Program will allow the staff, at the request of the resident, to inspect residential property for potential mosquito breeding sites. This program will also provide an opportunity for the staff to inform residents about personal protection, and the relationship between irrigation management and mosquito abatement. Additionally, the program will increase public awareness of the Policy. At the time of inspection, the staff will provide the resident with a package of mosquito dunks (larvicide), and a packet containing mosquito control and water conservation information.

4-D's

- **Dusk / Dawn**: Dusk and dawn are the times of the day when mosquitoes are most active. During peak mosquito season, residents will be encouraged to stay indoors if possible or limit outdoor activity during these periods.
- **DEET**: Use repellants that contain DEET as the active ingredient for treating exposed skin areas.

- **Dress**: Dress to keep skin covered as much as possible, consider wearing loose, long sleeved shirts and long pants
- **Drain**: Drain any standing water on the property. This includes water from flower pots, bird baths, rain gutters, rain barrel, and pet dishes at least once a week.

Eliminate breeding sites for larvae

- Reduce all standing water around the property that provides breeding sites.
- Check the irrigation system to prevent excessive-watering of lawns and plant beds.
- Repair leaky pipes and outside faucets.
- Clean gutters every three (3) to four (4) months.
- Empty outside pet bowls when not in use.
- Clean and add fresh water to birdbaths once a week.
- Empty plastic wading pools weekly and store indoors when not in use.
- Use mosquito fish in decorative ponds and fountains.
- Fill holes or depressions in trees with sand or mortar, or drain them after each rain by drilling holes into the tree. .
- Use organic and/or EPA approved larvicide products following the direction on the product label.

Reduce adult mosquito populations

- Mow tall grass or reduce the amount of brush and other foliage on the property to reduce the resting sites for adult mosquitoes.
- For temporary relief in yards or high traffic areas, use organic and /or EPA approved fog treatments or surface treatments of insecticides that are labeled for that use, and apply them following the directions on the product label.
- Use screening in homes and pet kennels. Keep door and window screens in good repair, and be sure that they are properly sealed around the frames
- Protect pets with drugs that eliminate heartworm.

3.0 SOURCE REDUCTION

The elimination or modification of mosquito breeding sites is critically, and typically, the most effective and economical solution for long-term mosquito control. The American Mosquito Control Association (AMCA) states that source reduction efforts can often minimize and/or eliminate the need for mosquito larviciding in the affected habitat. Additionally, source reduction can greatly reduce the need for adulticiding (AMCA A. M., 2009).

The normal habitat for mosquito larvae in the community is produced by summer rain pools and stagnate water from over watering of landscapes. Small pools of water that are created by irrigation or heavy rains during the summer produce most of our nuisance species of mosquitoes. A summer rainfall of less than an inch can produce breeding grounds for mosquitoes. Almost anything, whether natural or artificial, that will hold water for about a week or more, may breed

mosquitoes. These insects have adapted to a wide variety of larval habitats, and it is important to check for larvae in any pools of standing water.

The staff will practice source reduction year round by inspecting public facilities, infrastructures, and equipment to remove any potential mosquito breeding site. Additionally, the staff will develop a tracking program using Geographic Information Systems (GIS), and EPI-INFO. EPI-INFO is public domain statistical software for epidemiology developed by the CDC. The program allows for electronic survey creation, data entry, and analysis. The staff will use these resources to plot and record mosquito "hotspots" within the Town. This will allow the staff to respond to know areas of mosquito breeding sites after rain events, during seasonal irrigation periods, and during an outbreak emergency. Furthermore, by documenting these "hotspots," the staff will develop a record of history that can be used for future reference and measure program effectiveness. The staff will perform source reduction on public property that will include, but not limited to:

- The use of the Water Department's meter readers to identify "hotspots";
- Draining and/or filling of areas where shallow stagnant water can accumulate such as gutters, potholes, vehicle ruts along roads, and the Town's swimming pool cover;
- Proper storage of outdoor equipment;
- Continue to enforce current Town water conservation codes and ordinances;
- Monitoring the Parks irrigation systems for proper watering operations;
- Trim vegetated edges of the Town's lake and creek; and
- Treat culverts, catch basins, fountains, manhole covers, storm water inlets, and discharge areas.

4.0 MOSQUITO SURVEILLANCE AND MONITORING

The Town's year round surveillance and monitoring program will be used to pinpoint large mosquito populations in the community. The Town will survey and monitor adult mosquitoes using gravid traps. Captured mosquitoes will be sent to the DSHS for testing. Each sample will consist of mosquitoes that are collected at a single collection site. The information obtained from these surveillance efforts will be used to map mosquito populations, provide public information, and determine the occurrence of any mosquito-borne disease. The risk of mosquito-borne diseases depends on the size of mosquito populations and the incidence rate of disease. Mapping mosquito breeding habitat locations can help with source reduction, habitat disruption, larviciding and adulticiding activities, and strategically pinpoint target areas for community education efforts (NMVCA, 2003). All surveillance data and results will also be published on the Town's website.

Additionally, the Town will coordinate all surveillance data and results with the Town's Health Officer, City of University Park, City of Dallas, Dallas County, Highland Park Independent School District, Southern Methodist University, and the Dallas County Club.

The Town will use mosquito surveillance and monitoring by collecting adult mosquitoes to determine what control measures are to be used, and evaluate the potential for any arbovirus

disease outbreak within the community. The objective of the surveillance and monitoring program is to:

- Assess the threat of arbovirus exposure to citizens;
- Identify high risk adult mosquito population areas;
- Identify larval habitats that are in need of targeted control;
- Monitor the effectiveness of control measures; and
- Determine what level of control methods need to be implemented.

Typically, Dallas County and the DSHS surveillance programs are conducted May through November. During these months, Dallas County will only test for the WNV while the DSHS tests for WNV and other arboviruses, such as SLE. If chemical control measures are needed to control mosquito populations, mosquito traps may be used more frequently to assess the effectiveness of the control measures.

5.0 TRAPS

The purpose of using traps is to determine the relative human health threat due to WNV, and other mosquito-borne diseases, by detecting the presence of arboviral agents in female mosquitoes, primarily the Culex species. After the mosquitoes have been collected and counted, they will be sent to the DSHS for identification and arbovirus isolation. The traps will also be used to provide statistical representation of the population density and type of species in a given area.

The staff will monitor the surveillance program, which will be conducted year round. Mosquito trapping will be conducted every Monday of each week. The staff will divide the Town into four (4) quadrants using Preston Road and Beverly Drive as the dividing point. One trap will be placed on public property in each quadrant. The staff will use GIS to map trap location and publish the maps on the Town's website for public information. Depending on environmental factors such as freezing conditions, high winds, and rain, trapping efforts may be decreased.

Traps will be placed in areas that provide overhead cover to protect the trap and captured mosquitoes from extreme environmental conditions. Targeted sites are to include but not limited to, park areas, vegetation beds, easements, alleys, along waterways, reported areas of clusters of dead birds, and suspected areas that may support mosquito populations that may test positive for SLE and WNV.

Historically, the Town has contracted with Dallas County to collect and test trap(s) placed within the Town. Due to limited Dallas County resources, the Town will use their own traps to supplement surveillance efforts. The Town will continue to utilize Dallas County for trapping and testing, and will coordinate with Dallas County on trap placement within the Town.

Mosquito samples collected by the Town's traps will be shipped, by the staff, to the DSHS in accordance to the Arbovirus Field Surveillance Guidelines established by the DSHS, and the Texas Department of Health Bureau of Laboratories in Austin, Texas.

The information obtained from these surveillance efforts will determine the need for various control measures, conduct more effective searches for larval breeding places, assess the extent of the problem, and potentially gauge the effectiveness of control measures.

6.0 MOSQUITO CONTROL MEASURES

Mosquitoes may be controlled through an assortment of control practices. Such practices include physical control through source reduction; chemical control through the use of pesticides such as larvicide and adulticide; biological, through the introduction of natural predators in the environment, biochemical through growth regulation in the larval stage; and mechanical controls. It is critical that proven scientific methods drive the assessment of the Town's needs, strategies, design, and monitoring of its mosquito control program.

6.1 BIOLOGICAL CONTROL METHODS

Over the past few years, major advances have been made in the areas of biological mosquito control. Biological control strategies may include using natural predators and bacterial agents such as Bacillus thuringiensis israelensis (Bti). Each biological control agent has certain benefits and restrictions. These factors must be considered when choosing an appropriate control agent.

Purple Martin Birds

Mosquitoes are part of the Martin's diet; however, the behavior patterns of mosquitoes and Martins are such that most mosquitoes are not flying in the Martins' feeding area when Martins are active. Martins are daytime feeders, and mosquitoes are most active during the dusk and dawn hours of the day (Kale, 1990). The AMCA has reported that Martins often feed on dragonflies, known predators of mosquitoes. At night, when mosquitoes are most active, Martins tend to feed at treetop level, well above most mosquito flight paths (AMCA, 2012). Ornithologists state that Martins and other swallow like birds do not prefer mosquitoes and that mosquitoes make up less than 3% of their diets (NMVCA, 2003). During a high level outbreak of the WNV or SLE diseases, Martins are minimally effective and not recommended as a primary source for mosquito control within the Town.

Bats

Bats consume various types of insects such as flies, mosquitoes, and beetles. Research and scientific reports state that bats usually eat the majority of their daily nutritional requirements within the first hour of their nightly activities. Bats also eat in intervals much like humans. They tend to eat, rest, and eat. Bats are also very opportunistic when it comes to selecting a meal. Normally, bats will expend as little energy to benefit from a bigger meal like a beetle. In addition, they tend to consume their meals in selected territories. It is unlikely that a bat will search for food in many different locations, unless their current feeding ground is depleted of food. Furthermore, bats have to maintain energy for flight and protection. They will seek out the closest and biggest meal it can to maintain their energy balance, homeostasis, and fat concentration during hibernation.

Therefore, bats are usually as efficient as possible to limit their exposure time to predators and to gather more energy and fat than they lose (Corrigan, 2012). Additionally, the CDC discourages the use bats in urban areas due the risk of being exposed to rabies. This potential exposure, and the social stigma attached to bats, they are not recommended as a primary source for mosquito control within the Town.

Gambusia Affinis (Mosquito Fish)

Mosquito Fish are small freshwater fish that eat mosquito larvae. They are one of the most effective and natural methods of controlling mosquitoes. Mosquito Fish are ideal for controlling mosquito larvae in backyard ponds, birdbaths, fountains, unused swimming pools, and other standing water sources. According to Texas State University's Department of Biology, (University, 2012) Mosquito Fish should never be placed in any natural habitat such as lakes, streams, rivers, or creeks. They are greedy eaters, so, by placing them into natural waterways, they may destroy natural species and disrupt the ecological balance. Additionally, established bigger fish in natural waterways will feed on the Mosquito Fish. It is not recommended that the Town use Mosquito Fish as a primary source for mosquito control within the Town.

Mechanical / Backyard Controls

Texas A&M Agrilife Extension Service's (Service, 2009) research shows that mechanical and back yard controls sold for mosquito protection such has candles, bug zappers, ultrasonic mosquito repelling machines, and mosquito suction devices provide some relief from mosquito bites in the immediate area of the product. However, wind can limit the size of the protection zone for citronella candles effectiveness. Bug zappers provide little mosquito control and actually kill more beneficial insects than pests. Despite extensive research there is no proven evidence that that electronic sound repellants really work. Therefore, mechanical and backyard controls are not recommended as a primary source for mosquito control within the Town.

Bacillus thuringiensis israelensis

Bacillus thuringiensis israelensis (Bti), is a naturally occurring soil bacterium that produces a poison capable of killing mosquito larvae. Bti is considered ideal for mosquito larvicide management because of its specificity for mosquito larvae and because of the lack of toxicity to non-target organisms. These bacteria form asexual reproductive cells, called spores, which enable them to survive in adverse conditions. The endospores of Bacillus thuringiensis israelensis also contain crystals of an insecticidal protein toxin called delta endotoxin. Once ingested by a mosquito, the alkaline conditions of the stomach wall lining causing the cells to first swell then rupture. When enough stomach cells burst, the alkaline fluid of the midgut can enter the blood. This movement of stomach fluid increases the alkalinity of the blood and results in a general paralysis. Death typically occurs a few hours after digestion. The staff will spray, by use of backpack sprayers, Bti around the vegetative edges of the Town's lakes and creeks, storm

water inlets, and discharge areas. Additional, the staff will apply Bti briquettes (Mosquito Dunks) to areas of standing water that have the potential to breed mosquitoes. Bti, because of its biological make up, is highly recommended as a source for mosquito control within the Town.

6.2 CHEMICAL CONTROL METHODS

The CDC recommends that chemical control applications should be dependent on set threshold levels (CDC, 2003). This simply means that a certain defined risk needs to exist before particular chemical control measures are implemented. The most commonly used chemical control treatments are larvicide and adulticide. Larviciding and adutlticiding is recognized by the CDC and other federal health authorities as critical program elements in reducing public health threats from mosquito-borne diseases. Given the relative importance and capabilities of source reduction and larviciding to reduce the breeding of mosquitoes, such activities will be undertaken before adulticiding. It is acknowledged that source reduction and larviciding cannot completely eliminate adult mosquito populations in the Town. Should surveillance data indicate increased mosquito population(s) and/or the presence of an arbovirus that poses a risk to public health, adulticiding can help reduce such populations over a large area in a relatively short period. Larviciding would only help reduce populations of future generations, but would not affect existing adult mosquitoes, which are infected or could be infected.

Larvicide

The Town will utilize organic larvicides as well as EPA approved larvicides that will be applied according to the manufacturer's directions. Larviciding is an important control mechanism since the objective of larviciding is to control the immature stages at the breeding sties before adult populations have had a chance to disperse, and to maintain populations levels at which the risk of arbovirus transmission is minimal

The staff will utilize a larviciding program year round in combination with surveillance and source reduction to control mosquito larvae before they develop into biting adults. The staff will inspect (on a continual basis throughout the year) locations that are known to have the potential to hold water and breed mosquitoes. The staff will first attempt to remove any and all standing water; however, if such water cannot be removed it will be treated with larvicide.

This strategy is the most effective, economical, and safest method for mosquito control because mosquito larvae are minimized, thus reducing the need for adult mosquito control, and subsequently reducing the impacts of control measures on non-target organisms. The Town's larvicide program will include the use of organic larvicides such as Bacillus thuringiensis israelensis (Bti) and/or the organic bacterium Bacillus sphaericus (Bs), which are considered to be the among the most environmentally acceptable commercially available biological control agents because of their relative specificity for mosquitoes and negligible toxicity for other organisms (Rishikesh, 1983), and EPA approved larvicide agents such as Methoprene. Methoprene treated larvae will be unable to successfully change from a pupa to the adult insect. This breaks the

biological life cycle of the insect preventing recurring infestation. The staff will apply larvicides to areas of standing water that have the potential to breed mosquitoes.

Using larvicide controls also minimizes the chance of pesticide resistance in mosquito populations because the product is either organic, a naturally occurring compound, or in the case of Methoprene, it is structurally identical to a naturally occurring compound. As recommended by the DSHS, the earliest larvicide agents will be applied to water identified to contain mosquito larvae is three (3) days after a rain event when the water stops flowing. Therefore, because of their organic properties, and the fact that it is of little or no threat to other organisms it is recommended that larvicide agents are to be used as a primary source for mosquito control within the Town.

Larvicide efforts will include, but not be limited to, the following mosquito breeding sites on public property:

- Curb and gutter;
- Tree-holes and rock-pools;
- Vegetated edges the Town's lakes and creeks;
- Culverts, catch basins, ornamental fountains, pools; and
- Manhole covers, storm water inlets, and discharge areas.

Adulticide

It will be standard procedure for the Town to only use pesticides meant for adult mosquitoes as a last resort to control adult mosquito populations. The Town will only use adulticiding chemicals that have been tested, registered, and approved by the EPA. The Town's decision to use pesticides will be based the CDC's recommendation that mosquito adulticiding should only be used in situations where surveillance data indicates that it is necessary to reduce the density of adult mosquito populations quickly to lower the risk of WNV or other mosquito-borne diseases.

Adulticiding is the application of pesticides to kill adult mosquitoes. The ability to control adult mosquitoes is an important component of any IPM program. The Town will use chemical control measures in accordance with the CDC and the DSHS recommended thresholds based on the analysis of either larval or adult mosquito surveillance, or other available field data. These thresholds are:

- When a particular trap location has over 50 female mosquitoes in one night of trapping;
- When a mosquito pool (one trap's catch of mosquitoes) has tested positive for either WNV or SLE;
- When Dallas County or the DSHS reports a suspected human case of WNV or SLE in the Town;
- When Dallas County or the DSHS reports a confirmed human case of WNV or SLE in the Town; and

- On the recommendation by Dallas County or the DSHS for any public health reason.

When Dallas County or the DSHS reports that the Town has a confirmed human case of WNV, SLE, other arboviral diseases endemic to Texas, or when a mosquito pool has tested positive for these arboviruses, the staff will utilize EPA approved adulticide applications to control mosquito populations. The Town will use the following guidelines, as recommended by Dallas County, when applying adulticides:

- Spraying shall be conducted between the hours of 10:00 p.m. and 5:00 a.m.;
- Notify, the citizens in the quadrant(s) being sprayed;
- When weather conditions are inappropriate for spraying a new notification must be issued;
- Publish spraying area(s) information on the Town's website;
- Only the quadrant(s) that tested positive shall be sprayed;
- In the case of an arbovirus event, the quadrant(s) of the positive site shall be sprayed a minimum of three times;
- Dependent on weather, the application should occur on consecutive nights;
- Do not spray if the wind speed is below 1 MPH, or exceeds 10 MPH;
- Do not apply pesticides just before or during a rain even;
- Provide a copy of the pesticide label and MSDS in the spray truck; and
- Spray truck emergency lights must be operating while spraying

The CDC has reported that many mosquito control programs have relied heavily upon using chemical agents for mosquito control. Those mosquitoes that are exposed constantly to chemical applications are genetically able to resist higher pesticide concentrations. Eventually, the pesticide becomes less effective as resistance increases in the mosquito populations. The CDC states the onset of resistance can be minimized through:

- Using doses that are no lower than the lowest level rate to avoid genetic selection;
- Using less frequent applications;
- Using chemicals of short environmental persistence;
- Avoiding the use of slow release formulations;
- Avoiding using the same class of pesticides to control both adults and immature stages; and
- Applying pesticides to only hot spots. (Area-wide treatments should only be considered during imminent public health threats).

The effects on human health are primary factors considered in the regulation of adulticides. The CDC reports that pesticides that can be used for mosquito control, and have been approved by the EPA, do not to pose an unreasonable risk to human health. The CDC recommends people who are concerned about exposure to chemicals, such as those with chemical sensitivity, or breathing conditions such as asthma, can reduce their potential for exposure by staying indoors during the application period (CDC, 2012).

In addition, the CDC posted a report that examined illnesses in nine states associated with exposure to pesticides used to control mosquito populations from 1999-2002. This study found that "application of certain insecticides poses a low risk for acute, temporary health effects among person in areas that were sprayed, and among workers handling and applying chemicals" (CDC, 2012). Currently, there is no concrete evidence to show that any pesticides for mosquito control are completely safe. Therefore, it is recommended that EPA approved adulticides should only be used when CDC and DSHS thresholds are met, and be used in accordance with the DSHS application recommendations as stated in this section.

7.0 TOWN OF HIGHLAND PARK'S RESPONSE PLAN

The CDC and the DSHS recommends that a mosquito control program should be supplemented with a risk response plan designed for mosquito-borne disease outbreaks. The response plan is not intended to replace a mosquito control plan, but to define human disease risk levels with specific recommended responses in accordance with the principles of IPM and threshold management criteria. The purpose of the response plan is to:

- Minimize human illness through public education and vector control;
- Map the density of mosquitoes and the incidence of the virus within the Town;
- Identify areas where the incidence of disease is high and post the appropriate warnings to the community; and
- Identify the key vector species that carry diseases within the Town.

Risk level 1 **Normal Response**

Condition: Probability of human outbreak is none.
Trigger: Normal mosquito activity with no evidence of arbovirus/disease detected.

Recommended Response:

Surveillance:
Continue normal mosquito surveillance and testing activities as recommended in Section 3.0 of this policy. Under the normal response, mosquitoes are considered only a nuisance without a significant influence on public health.

Public Information / Education:
Use public information to promote source reduction and personal protection. Publicize methods for mosquito reduction and personal protection prior to the main season for mosquito activity, and outdoor human activities.

Control Measures
If there is not a probability of human outbreak, continue normal source reduction activities as recommended in Section 3.0 of this policy.

Risk Level II **Enhanced Response**

Condition: Probability of human outbreak is low.
Trigger: Normal mosquito activity with little or no evidence of arbovirus/disease detected

Recommended Response:

Surveillance:
Continue normal mosquito surveillance and testing activities as recommended in Section 3.0 of this policy.

Public Information / Education:
Continue to use public information to promote source reduction, and personal protection, prior to the main season for mosquito activity and outdoor human activities.

Control Measures
If outbreak is low, continue normal source reduction activities, and start larvicide applications as recommended in Section 6.2 of this policy.

Risk Level III **Public Health Concern**

Condition: Probability of human outbreak moderate.
Trigger: A mosquito isolated from a single trap collected during trapping activities tests positive for an arbovirus/disease.

Recommended Response:

Surveillance:
Increase surveillance in area where the positive sample was collected. Use GIS to plot the location of the positive sample.

Public Information / Education:
Notify the Mayor, Town Council, and the Town's Health Officer of positive test results. Increase public education emphasizing source reduction, personal protection, and disease symptoms. If a mosquito pool has tested positive for an arbovirus/disease in a nights trapping notify the residents, in the affected area, of surveillance and test findings and adulticide spraying schedule. Publish all information including surveillance and test findings, maps, and adulticide spraying schedule on the Town's website.

Control Measures
If a mosquito pool has tested positive for arbovirus, continue source reduction activities, increase larviciding applications, and conduct adulticide spraying only within the quadrant of the specific trap according to the recommendations as stated in Section 6.2 of this policy.

Risk Level IV **Public Health Warning**

Condition: Probability of human outbreak is high.
Trigger: Multiple mosquito pools collected at different times and locations test positive for arbovirus/disease. Probable human cases supported by laboratory testing.

Recommended Response:

Surveillance:
Increase surveillance in areas where positive samples were collected. Use GIS to plot the location of positive samples and confirmed cases.

Public Information / Education:
Notify Mayor, Town Council, and the Town's Health Officer of positive tests results. Increase public education emphasizing source reduction, personal protection, personal mosquito control methods, and disease symptoms. If multiple mosquito pools collected at different times and locations test positive for an arbovirus/disease, notify all residents of surveillance and test findings and adulticide spraying schedule. Publish all information including surveillance and test findings, maps, and adulticide spraying schedule on the Town's website.

Control Measures
If multiple mosquito pools collected at different times and locations test positive for arboviruses, continue source reduction activities, intensify larvicide applications, and conduct adulticide spraying only within the quadrant(s) of the specific positive trap(s) according to the recommendations as stated in Section 6.2 of this policy.

Risk Level V **Public Health Alert**

Condition: Human outbreak is confirmed.
Trigger: Multiple human cases within a short (1-2 week) timeframe, or clustered human cases. Cases must be confirmed by laboratory testing.

Recommended Response:

Surveillance:
Increase surveillance Town wide. Use GIS to plot the location of positive samples and confirmed cases.

Public Information / Education:
Notify Mayor, Town Council, and the Town's Health Officer of confirmed outbreak. Intensify public education emphasizing source reduction, personal protection, personal mosquito control practices, and disease symptoms. If an outbreak is confirmed, notify all residents of surveillance and test findings and adulticide spraying schedule. Publish all information including surveillance and test findings, maps, and adulticide spraying schedule on the Town's website.

Control Measures
If an outbreak is confirmed, continue source reduction activities, intensify larvicide applications, and conduct adulticide spraying only within the quadrant(s) of the specific positive trap(s) according to the recommendations as stated in Section 6.2 of this policy. If public health emergencies are declared at the County or State level, the recommended responses associated with the declaration will take precedence over this Policy.

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Glossary

AMCA	American Mosquito Control Association
ASTHO	Association of State and Territorial Health Officials
CDC	Centers for Disease Control and Prevention
DCHHS	Dallas County Health and Human Services
DSHS	Department of State Health Services
EPA	Environmental Protection Agency
EPI-INFO	Epidemiology Information (Software Package)
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GPS	Global Positioning System
HSR	Health Service Region
IPM	Integrated Pest Management
NMVCA	Northwest Mosquito Vector Control Association
ROG	Response Operating Guidelines
SMOC	State Medical Operations Center
SLE	St. Louis Encephalitis
SOC	State Operations Center
TDA	Texas Department of Agriculture
WNV	West Nile Virus

Adulticide: A type of pesticide designed to kill adult mosquitoes.

Arbovirus: shortened form of **ar**thropod-**bo**rne **virus.** A virus that is transmitted by arthropods.

Arthropods: A group of animals that do not have a backbone and have jointed walking appendages, such as insects.

***Bacillus sphaericus*:** A species of bacteria used as a larvicide against many mosquito species.

***Bacillus thuringiensis israelensis* (BTi)**: a type of biological pesticide used to control mosquito larvae in water (mosquito larvae die after ingesting this material).

Bridge vector: For West Nile Virus, an organism (mosquitoes) which serve as a major viral transmission mechanism between the reservoir (birds) and humans.

DEET: The active ingredient in many insect repellant products (N,N-diethyl-metatoluamide).

Eastern Equine Encephalitis (EEE): A mosquito-borne viral disease that causes inflammation of the brain similar to West Nile Virus.

Encephalitis: Inflammation of the brain, which can be caused by numerous different bacteria and viruses, including West Nile Virus.

EPI-INFO: A public domain statistical software for epidemiology developed by the CDC.

Gravid traps: mosquito traps designed to attract pregnant female mosquitoes.

IPM: Integrated pest management. The use of all available methods to control mosquitoes or other pest species, within an ecological context, in such a manner that economic damage is avoided and adverse side effects are minimized. The acronym IMM (Integrated Mosquito Management) is also occasionally used to describe IPM in mosquito control.

IR: Infection rate (also MIR—minimum)

Landing rate counts: a measure of the number of adult mosquitoes landing on an individual's body during a predetermined time interval. Used to assess the abundance of host-seeking mosquitoes.

Larvae: Immature mosquitoes that live in water; the stage after the egg hatches but before pupation.

Larvicide: A type of pesticide used to control immature or larval mosquitoes

Meningitis: Inflammation of the lining of the brain and spinal cord that can be caused by a virus or bacteria

Methoprene: a type of insect growth regulator used to control larval mosquitoes; growth regulators prevent mosquito larvae from developing into mature adults.

Mosquito breeding site: a location where mosquitoes lay eggs; usually stagnant water with high organic content.

Mosquito pools: A group of mosquitoes of the same species, collected in the same area, which are combined in the laboratory to test for West Nile Virus and related diseases.

Outbreak: A rapid increase in the frequency or distribution of a disease.

Pesticide: A substance used to kill pests such as insects, mice, and rats; an insecticide is a form of pesticide.

Source reduction: The removal or reduction of larval mosquito habitats.

St. Louis Encephalitis (SLE): mosquito-borne viral disease that causes inflammation of the brain. Very similar to West Nile Virus.

Surveillance: In public health and vector control, surveillance encompasses the collection, analysis, and dissemination of data, usually with the intent of using the data in the decision-making process (see box on page

Vector: An organism (usually an insect) that is capable of carrying and transmitting a disease causing agent from one host to another.

Viral: Of, or relating to, a virus

Viral encephalitis: Inflammation of the brain caused by a virus.

WNV: West Nile Virus**.** A mosquito-transmitted virus introduced into the U.S. in 1999, now distributed throughout the U.S., southern Canada, Mexico, and Central America.

ATTACHMENT I

Larvicide Mosquito Larvicide Dispersal Log

Town of Highland Park

Mosquito Larvicide Dispersal Log

DATE _____

LOCATIONS_____
_____
_____

Name of Applicator _____

Time Started _____ Time Stopped _____

PRODUCT USED: _____

EPA No:_____

Application Rate:_____

Total amount of Product Applied _____

ALWAYS FOLLOW LABEL DIRECTIONS ON PRODUCT BEING APPLIED

ATTACHMENT II

Mosquito Adulticide Spray Log

Town of Highland Park
Mosquito Adulticide Spray Log

DATE _____ LOCATION_____

Name of Applicator & DSHS License Number _____

Time Started _____ Time Stopped _____

Wind: _____ @ _____ mph Temperature: _____ ^{0} F

Product:_____ EPA No._____

Flow Rate:_____ Application Rate:_____

Road Speed:_____ Equipment #:_____

	Time	Mileage	Location
Start			
End			
Start			
End			
Start			
End			
Start			
End			

Total Miles Driven _____

Total Volume of Product Applied (time sprayed x flow rate) _____

ALWAYS FOLLOW LABEL DIRECTIONS ON PRODUCT BEING APPLIED