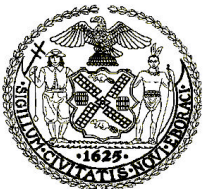


Mosquito Population Control Program in The Rockaways



New York City Department of Health
Bureau of Regulatory & Environmental Health Services
Office of Vector Surveillance and Control

April 2001

NOTICE

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EXECUTIVE SUMMARY

In response to community concerns about the health and well being of citizens in the Rockaways, the New York City Department of Health (DOH) has prepared a comprehensive plan for mosquito population control on the Rockaway Peninsula that can begin as early as March (depending on weather conditions) and continue until the first sustained frost (possibly October). This plan emphasizes source reduction and surveillance-based control. The plan's principal goal is to reduce significantly the mosquito population in the Rockaways through extensive surveillance, source reduction, aggressive and widespread application of larvicide, and targeted application of adulticide, when necessary.

To this end, DOH will rely on the following:

- Close communication and coordination with other city, state, and federal agencies, elected officials, and community and professional groups
- Public education campaign
- Larval and adult mosquito surveillance
- Larvicide application
- Targeted application of adulticides

The plan is comprised of the following three components:

Prevention and Control: The program calls for an intensive effort to eliminate mosquito-breeding sites by reducing areas of standing water. In collaboration with other city agencies, DOH will eliminate standing water in ditches, empty lots, roadside catch basins and sumps, tire piles, and other areas where water may accumulate. This effort will be augmented with application of larvicide to potential breeding grounds where water cannot be eliminated, and if necessary, application of adulticide to reduce the mosquito population if human health or quality of life is threatened. DOH will conduct these activities in compliance with all federal, state, and local regulations and guidelines. In the event that spraying of adulticides becomes necessary, DOH will monitor for adverse effects of pesticides in humans and the environment.

Education and Outreach: DOH will expand its education campaign to include occupational health and safety training for DOH employees and encourage communities to eliminate potential mosquito breeding sites in and around their neighborhoods. DOH will enhance the public's knowledge of ways to avoid contact with mosquitoes and what personal actions can be taken to eliminate breeding sites around their homes and immediate environment. In the event of an adulticide application, DOH will provide accurate and timely information about mosquito control activities.

Research and Evaluation: DOH will conduct ongoing assessments of the efficacy of source reduction and larval/adult mosquito control efforts in the Rockaways and research future strategies for mosquito control, focusing on the methods that have minimal impact on human health and the environment.

1. MOSQUITO SURVEILLANCE

Objective: To monitor the dynamics and density of the mosquito population in order to determine the necessity for control measures.

Background: Mosquitoes breed in both natural and artificial bodies of water and are especially plentiful in wetlands such as those found throughout the Rockaways. These areas are attractive as they offer plentiful breeding grounds and harborage. Collecting and evaluating information on both larval and adult mosquitoes is critical for decision-making on deployment of appropriate control activities. Larval surveillance can provide information on expected adult mosquito density and can indicate areas where efforts to eliminate mosquitoes at their source (e.g. source reduction, larviciding) should be targeted.

Surveillance data utilizing Geographic Positioning System (GPS) technology will be routinely collected and entered into a Geographic Information System (GIS) based database where it will be analyzed and used to direct field operations and assist in record-keeping and regulatory compliance. Close attention to surveillance data will ensure that control measures are effective and conducted in a manner that minimizes the possibility of any negative impact to the environment.

Surveillance Activities:

Larval Habitat Surveillance: Larval habitat information will be collected and updated throughout the season. Types of habitats to be monitored include: wetlands, saltwater marshes, freshwater ponds, ditches, catch basins and sumps, low-lying areas prone to ponding conditions, temporary pools as well as tire piles and other types of debris capable of holding water. These surveillance data will allow the DOH and other city agencies to remove container habitats and conduct standing water management in areas found to be mosquito-breeding sites.

Larval habitat data will be collected by DOH, the Department of Parks and Recreation, and other city agencies during site assessments, as well as from the general public who call in to report areas of standing water. DOH, through public outreach, will strongly encourage residents to call the Department's West Nile Virus Hotline to report the presence of potential mosquito breeding sites. Complaints will be entered into a database and will serve as a basis for targeted larval surveillance and control activities.

Larval Surveillance: Larval surveillance can begin in the Rockaways as early as March (depending on weather conditions). Water samples will be taken from predetermined sites throughout the peninsula and examined for the presence of larvae. Using information gathered during previous seasons, DOH will identify potential breeding areas that will be inspected by larval surveillance teams on a weekly basis. DOH will track species composition, abundance of different

developmental stages of immature mosquitoes (instars), and the population density of each species. Larval surveillance procedures and protocols have been developed by DOH to ensure consistency and quality of methodology and approach (See Appendix 3).

Adult Surveillance: Trapping of adult mosquitoes allows for the determination of mosquito density and level of host-seeking activity in aggregate and by species. It also helps to determine the effectiveness of larval and/or adult control. Starting in April, DOH will place CDC light traps and gravid traps for adult mosquitoes in pre-selected areas throughout the peninsula. Light traps are widely considered to be the standard tool for routine adult mosquito surveillance. The light trap primarily collects host-seeking females by using CO₂ in the form of dry ice as an attractant. Gravid traps, on the other hand, use a chamber of water to attract female mosquitoes looking for a suitable place to lay eggs.

The placement of traps, number of sites, frequency of trap placement, and number of traps per site will vary depending on where and when mosquitoes are most likely to be present. This determination will be based on larval habitat monitoring and surveillance data collected during the previous season. Adult surveillance procedures and protocols have been developed to ensure consistency and quality of methodology and approach (See Appendix 4).

2. MOSQUITO PREVENTION AND CONTROL

Objective: To reduce significantly the mosquito population in the Rockaways.

Background: The Rockaway Peninsula is bounded by the Atlantic Ocean on the south and Jamaica Bay (Rockaway Inlet and Beach Channel) to the north and west (See appendix 1). The western end of the peninsula is part of the federally owned Gateway National Recreation Area. The peninsula is home to a wide array of plant and animal species and consists of some of the most ecologically significant saltwater marshes on Long Island. Over the years, development and filling of marshlands, along with other types of ecological degradation, have restricted the natural flushing of the saltwater marshes and contributed to an increase in habitat for *Ochlerotatus sollicitans* (the major nuisance mosquito in the Rockaways) as well as other species.

To correct this ecological degradation, the New York District of the U.S. Army Corps of Engineers has tentatively scheduled habitat restoration in Bayswater State Park, Dubos Point, and Brant Point. Improvements are slated to begin in 2003 and will include construction of offshore breakwaters to accelerate the establishment of fringe salt marshes, removal of a damaged seawall, extending and/or unclogging tidal creeks to promote the free flow of salt water, removing unwanted vegetation, and fencing to prevent excessive drifting of sand.

Once restoration is complete, it will contribute to mosquito control as tidal movement is expected to eliminate pockets of standing water and allow fish to enter previously inaccessible areas close to shore where they can feed on salt marsh mosquito larvae. However, because of the immediate concern about health and well being, DOH will take appropriate measures to reduce the mosquito population of the Rockaway Peninsula so that quality of life is not adversely affected, until such time that ecological restoration eliminates the need for such control measures.

While there are over 25 species of mosquitoes in New York City, the primary nuisance mosquito identified in the Rockaways is *Ochlerotatus sollicitans*. *Culex pipiens*, a vector for West Nile virus, has also been identified in the Rockaways. Additional species found in the Rockaway Peninsula include: *Oc. canadensis*, *Oc. cantator*, *Oc. taeniorhynchus*, *Oc. triseriatus*, *Ae. vexans*, *Cx. restuans*, and *Cx. salinarius*.

Ochlerotatus sollicitans, or the salt marsh mosquito, is present from the spring until fall with major adult swarming occurring throughout the summer. This mosquito feeds primarily during evening or twilight hours, but if disturbed, can feed during daylight hours. The eggs of *Ochlerotatus sollicitans* usually hatch after high tide or heavy rainfall and develop within four to five days into mature adults.

Mosquito control activities include reduction of standing water, biological controls (e.g., mosquito-eating fish), and application of pesticides (e.g., larvicide and adulticide). Additionally, educating the public about the importance of reducing areas of standing water is critical to all of the City's control activities and will be addressed later in this plan. DOH invests considerable effort in larvicide applications in catch basins (curbside storm drains) and other known breeding habitats to prevent the development of larvae and pupae (i.e., pupacide) into adult mosquitoes. Larvicides approved for use in New York State include methoprene (e.g., Altosid), *Bacillus thuringiensis var. israelensis* (e.g., VectoBac), and *Bacillus sphaericus* (e.g., Vectolex). These larvicides have been shown to have minimal adverse impact on the environment.

The Department of Health, as part of the City Environmental Quality Review (CEQR), evaluated activities associated with the *Routine Mosquito Control Program* (which did not include application of adulticides) and determined that such activities are not expected to result in any significant adverse environmental impacts. Based on these findings, the DOH issued a Negative Declaration as part of the CEQR Environmental Assessment Statement. As part of DOH's *Comprehensive Mosquito Control Program*, impacts of insecticides targeted at adult mosquitoes (i.e., adulticides) are currently undergoing review in an Environmental Impact Statement (EIS). The final EIS will be completed in late Summer 2001.

Control Activities:

Source Reduction: The elimination of mosquito breeding habitat is the most effective method for the long-term control of mosquito populations. The Mayor's Office, DOH, the Department of Transportation, the Department of Environmental Protection, Department of Sanitation, Department of Parks and Recreation, and other city agencies are working closely together and with other large private property owners to eliminate artificial sources of stagnant water (e.g., tire piles, garbage, abandoned boats, etc.) as well as performing capital improvements to eliminate pooling along roadways and vacant lots. Private property owners that fail to comply with source reduction requirements will be issued Notices of Violation and associated fines and fees until they are in full compliance.

- **Capital Improvement Projects:** Under the direction of the Mayor's Office of Operations' WNV Task Force, DOH and other city agencies have identified areas of standing water. The Department of Transportation (DOT) is addressing surface grading problems and standing water associated with road construction and is working with the Department of Citywide Administrative Services (DCAS) to install fencing on vacant lots to discourage illegal dumping on these lots and abandoned buildings. The Department of Environmental Protection (DEP) is cleaning clogged sewers and catch basins as well as snagged waterways. The Department of Parks and Recreation (DPR) continues to improve existing parklands to remove artificial breeding sites and add new properties to its portfolio that have been cleared of debris and degraded areas where mosquitoes are known to breed. All city agencies have inventoried city-owned properties,

identified properties in need of mitigation, and have added these sites to the list of capital improvement projects slated for FY2001 and beyond.

- **Sanitation:** Abandoned lots are often conducive to mosquito breeding because they are prone to accumulations of tires and other items capable of holding stagnant water. Therefore, DOH will work with the NYC Department of Sanitation (DOS) to prioritize and enhance the enforcement of lot cleaning and to ensure an aggressive tire collection and disposal program. Public Health Sanitarians from the Department of Health will be charged with actively inspecting properties throughout the city to determine the presence of conditions conducive to mosquito breeding. Private property owners with tires and other debris capable of holding water who are found to be in violation of the NYC Board of Health Resolution regarding standing water may be subject to issuance of a Department of Health Notice of Violation that could result in civil and/or criminal fines, penalties, and forfeitures if a property owner fails to comply.
- **Waste Tire Disposal:** The design of tires makes them an ideal breeding site for many species of mosquitoes. Waste tires have been illegally accumulating in New York City over the last several decades and because most of them are scattered throughout the city, they are difficult to collect and remove. The Department of Sanitation has an active Waste Tire Disposal Program that encourages residents to bring in discarded tires to designated sites throughout the city and will dispose of a limited number free of charge. These and other tires collected by the Department of Sanitation are then shredded and properly disposed of. This program has already significantly reduced the number of tires in New York City and will continue to be an important part of the city's source reduction activities.

Permits: Acquisition of DEC permits to allow the application of specific larvicides in fresh water and salt marshes are required by the New York State Department of Environmental Conservation (NYSDEC). Permit applications for each specific larvicide product are submitted annually to DEC for approval.

Chemical Controls: If water management and other source reduction efforts are either not feasible or fail to effectively reduce breeding habitats, it may become necessary to utilize larvicides and adulticides to control both immature and adult mosquitoes. Specific procedures and protocols for the application of chemical control have been developed by DOH to ensure safety, consistency, and quality. These efforts are detailed below.

- **Larvicide Application:** Larval surveillance data will help to direct an aggressive larviciding campaign in targeted areas of the Rockaways. DOH will apply bacterial larvicide on the ground (by backpack) in targeted areas of the peninsula that are accessible by foot. Areas that are large in size, those not easily accessible by foot, or those that pose a health and safety risk to workers may require aerial application.

DOH will apply bacterial larvicide at the Department of Environmental Protection's water pollution control plant located on Beach Channel Drive, in all mapped catch basins, and at Department of Parks recreational properties when surveillance indicates the presence of larvae at the site. Larvicide applications may begin as early as April (depending on weather conditions) and will be repeated as needed throughout the mosquito season. DOH will reactivate the Standing Water Hotline (1-877-968-4692) to accept standing water complaints in April. DOH will respond to each complaint, conduct larval surveillance, and treat with larvicide if mosquito larvae are found.

It is important to recognize that federally owned lands (e.g., Gateway National Recreation Area) do not routinely use pesticides in natural habitats for the control of nuisance mosquitoes. Because federally owned property makes up a large percentage of the Rockaways, it is possible that adult mosquitoes may migrate from these lands to residential areas of the Rockaways. If this migration becomes a significant problem, the application of adulticides may become necessary to control the adult mosquito population in affected communities. The National Park Service, which administers the Gateway National Recreation Area, continues to partner with DOH to eliminate and/or apply larvicide to container sources of stagnant water and will continue to search for long-term strategies for effective mosquito control in the Rockaways.

- **Adulticide Application:** DOH will carry out strategic applications of adulticide only as a last resort when necessitated by high numbers of mosquitoes in traps placed throughout the peninsula and/or upon receipt of a pattern of complaints from the public that indicate unacceptably high levels of biting activity that can be documented by DOH's entomologist or sanitarian staff. If adult mosquito control becomes necessary, it will be scheduled when mosquitoes are most active (between dusk and dawn) and weather conditions are conducive to spraying (e.g., effectiveness of Anvil is optimal when the temperature is above sixty degrees Fahrenheit and the wind speed is ten miles per hour or less). Adult control will be conducted in a hierarchical manner depending on the acreage involved and expected effectiveness of spray operations. With the program's emphasis on surveillance and targeted control measures, DOH expects to apply adulticide to specific localized areas of the Rockaways Peninsula via a truck-mounted cold aerosol generator. DOH will monitor and assess control activities for any potential environmental and health effects by pre- and post-spray environmental sampling and addressing complaints about pesticide exposure received by the Department. Protocols for pesticide exposure surveillance have been developed by DOH to ensure quality and accuracy of data collected.

Biological Controls: Biological control methods utilize live biological organisms or their by-products for control of mosquitoes and other pests. Biological controls are an important tool in mosquito control efforts and are generally host specific

and therefore have little impact on non-target species. Although biological controls are not feasible on a large scale, they are often very effective in localized areas.

- **Predacious Fish:** The NYC Department of Environmental Protection will obtain permits from DEC to continue the use of mosquito larvae eating fish (*Gambusia affinis*) or fathead minnows (*Pimephales promelas*) at the water pollution control plant located on Beach Channel Drive. DEC restricts the use of mosquito eating fish to contained waters where there are no other species of fish present.

Electro-Mechanical Controls: Mechanical controls are generally only effective within a limited radius of a device location. Although they are not effective in controlling widespread mosquito infestations, they are useful in targeted areas.

- **Mosquito Magnets:** DOH will deploy Mosquito Magnets® to trap mosquitoes from nearby areas as a limited control mechanism in selected sites on the peninsula that have reported severe mosquito biting activity.

Repellants: Repellants are contact materials that keep mosquitoes from biting when they touch the protective chemical coating with their mouthparts. Most repellants currently on the market offer protection for several hours against mosquitoes and other biting insects.

- **DEET:** Diethyltoluamide (N, N-diethyl-m-toluamide) is a self-applied liquid repellant that has a broad range of effectiveness. It is the active ingredient in most mosquito and other insect repellants. It is resistant to rubbing and removal by perspiration and water but can cause irritation, particularly to the eyes or mucous membranes.

3. EDUCATION AND OUTREACH

Objective: To improve the public's awareness of the need to report and/or eliminate potential mosquito breeding sites, prevent mosquito bites, and to provide timely and accurate information about control activities in the event of the need for pesticide application.

Background: Prime breeding habitats for many mosquito species include discarded tires, abandoned swimming or wading pools, or any exposed object capable of collecting water. DOH, through public outreach, will strongly encourage residents to report the presence of potential mosquito breeding sites found in their neighborhoods and will encourage them to actively eliminate breeding sites from their own properties and within their communities, where possible. DOH and other city agencies will address public property (e.g., abandoned lots, streets with ponding, etc.) with conditions conducive to mosquito breeding. In addition, large problem areas that require a multi-agency approach for resolution (e.g., a lot with several hundred tires) will be brought to the attention of the Mayor's Office of Operations' West Nile Virus Taskforce to coordinate an appropriate response.

The West Nile Virus Speakers' Bureau formed by DOH will be utilized to communicate information to community groups and local elected officials about mosquito breeding, the West Nile virus, and pesticide applications. The Speakers' Bureau has proven to be effective and successful in conveying information to the public. Speakers have met with Community Board 14, the Arverne Association, and the Queens Borough President's Office to discuss mosquito control issues on the Peninsula. Speakers will continue to be available to convey information about prevention efforts, mosquito surveillance, and control efforts.

Education and Outreach Activities:

Worker Education: DOH will provide occupational safety and health training and knowledge on mosquito biology and effective interventions to all DOH employees involved in mosquito surveillance and control operations. Additionally, DOH will require that all employees of contracted vendor be provided with such training as well as appropriate personal protective equipment (PPE).

Community Education: Brochures and fact sheets have been developed, translated into seventeen languages, and distributed to community-based organizations, community boards, elected officials, schools, elder-care facilities, libraries, outdoor activity sites, and other interested organizations in the Rockaways. These materials will continue to be made available for distribution. In addition, three posters, "Eliminate Standing Water", "Mosquito Proof NYC", and "How to Protect Yourself from Mosquito Bites", are available in English and Spanish, and will be placed throughout the Rockaways in transit shelters and on billboards and given to community organizations for distribution to the public.

Provider Education: A City Health Bulletin on the West Nile Virus and possible adverse effects associated with pesticides that may potentially be used in mosquito operations will be sent to all physicians in New York City. This bulletin will emphasize the identification and reporting of symptoms and suspected adverse reactions associated with pesticide exposure.

Internet Access: Beginning in April 2001, *The Mosquito Population Control Plan in The Rockaways* will be available on the DOH web page (www.nyc.gov/health). Specific information on how individuals and communities can control mosquitoes around their homes and neighborhoods will also be available through the Internet.

Notification Plan: In the event that adulticide spraying is scheduled, DOH will issue a press release, including maps of the spray zones, to local newspapers and television and radio stations to publicize control activities and any potential risk associated with adulticide exposure. Simultaneously, community boards and nursing homes in affected communities and elected officials will be sent a broadcast fax of the press release. DOH's website will be amended to include any spraying schedules for the peninsula. Multilingual flyers announcing scheduled spraying will be distributed in the Rockaways prior to any spraying activity. Additionally, NYPD officers will escort spray trucks, and will announce continually that spraying is occurring, and will warn pedestrians to enter or remain indoors, close all windows, and turn off air conditioners.

4. RESEARCH AND EVALUATION

Objective: To assess the efficacy of mosquito control measures and strategies.

Background: Some methods of mosquito population control, especially the application of pesticides for adult mosquitoes, can impact the environment and individuals with a heightened sensitivity to pesticides. If spraying in the Rockaways becomes necessary, DOH will use the recommended adulticides to control mosquitoes while still protecting the health of the public. All pesticide applications performed by DOH or its vendor will be reported to the NYS DEC.

All material, workmanship, or equipment shall be subject to inspections, examination, or tests by DOH at any time during the application of pesticides. DOH will have the right to reject defective materials, workmanship, or equipment.

Research Activities:

Research Promotion and Utilization of Research Findings: DOH will conduct basic and applied research into many aspects of vector control to increase the operational impact and cost effectiveness of control interventions. Findings, analyses, and conclusions will be disseminated to researchers and other mosquito control programs to highlight the benefits of research findings, improved technologies, and their application to proposed mosquito control activities.

Mosquito Biology: DOH will investigate mosquito biology and over-wintering capability in order to determine more effective methods to control populations without harming the environment. This research includes the identification and quantification of native mosquito species and those introduced from other parts of the world.

Efficacy Studies: DOH will evaluate the efficacy of specific larvicide and adulticide activities in order to determine the most effective control methods for the Rockaway Peninsula. These evaluations may involve comparisons between different products, application schedules, and methodologies. DOH will monitor pesticide products utilized by the mosquito control vendor to ensure they are applied at label concentration and appropriate droplet size. In addition, DOH will measure the quantity of pesticide used and determine if the quantity is consistent with the intended pesticide application. This testing will apply to both ground and aerial applications. The efficacy of adulticiding and/or larviciding activities will be evaluated by:

- **Caged adult female trials:** Mosquitoes are collected in carbon dioxide baited light traps from location within chosen treatment areas and transferred to clean cages for mortality monitoring. Control areas are

established away from the treatment areas using the same mosquito species diversity and trapping protocol identical to treated sites.

- **Assay of Natural Populations:** Carbon dioxide baited light traps are placed in strategic areas within the treatment sites 24 and 48 hours pre-treatment, and 2, 24, 48, and 72 hours post-treatment and compared with control area.
- **Measurement of Larval Density:** Larval density measurements will be carried out in representative sites before and after larvicide applications. The comparison of control and treated areas will be made to ensure that observed effects are due to larvicide interventions and not due to natural causes such as rains and other confounding factors.

Application Accuracy: DOH shall sample and provide pre- and post-testing of soil, sediment, and/or vegetation to ensure that ground and/or aerial applications performed by the mosquito control vendor were accurate and remained within the confines of the geographic areas targeted for pesticide application.

Non-target Effects: DOH has contracted the services of a consultant to assist in the preparation of an Environmental Impact Statement (EIS) that will include an evaluation of the impact of pesticide application to the Rockaway Peninsula ecosystem.

Environmental Sampling: DOH, in cooperation with NYS DEC, will select bodies of water and wetlands within each spray zone that may be impacted by adulticide application, as appropriate. Adulticiding will not occur within one hundred feet of open water. From selected water bodies, DOH will collect pre- and post-spray water samples for transport to a contracted laboratory for tests to determine the presence of adulticides.

Pesticide Exposure: DOH will monitor and conduct follow-up telephone calls received by the NYC Poison Control Center (PCC) for exposures related to the use of mosquito population control products. DOH is exploring other methodologies to track pesticide exposure in humans and domestic animals (with and without symptoms).

Program Evaluation:

Operational Evaluation: The planning and implementation of effective vector control requires the creation or modification of infrastructure, managerial expertise, financial resources, data management, and capacity for community education and outreach. DOH has reorganized the managerial and operational structure of the Vector Surveillance and Control Program to ensure a comprehensive approach to mosquito control that has led to improved delivery and application of control methods. These methods incorporate selective and targeted intervention and effective planning to minimize associated environmental and economic consequences.

Performance Indicators: DOH will evaluate resource utilization relative to expected outcome to determine whether mosquito control activities continue to be effective. Monitoring and evaluation will be performed before the introduction of interventions and during their operational use. Quantitative indicators include measures such as larval and adult mosquito population densities and coverage (i.e., percentage of mosquito breeding sites treated in relation to the total number of breeding sites within a given area). Qualitative measures may include complaint volume.

5. GLOSSARY

Adulticide: an insecticide designed to kill adult mosquitoes.

Biological Controls: mosquito control methods that utilize live biological organisms or their by-products to control mosquitoes.

Breakwaters: a barrier that protects a harbor or shore from the full impact of waves.

Catch basins: a reservoir for collecting surface water drainage or run off.

CDC Light Traps: a lightweight battery-operated mosquito trap that uses a light source to attract mosquitoes and an impeller that sucks the insects into a bag. These traps are useful in making live mosquito catches for virus isolation studies.

Coverage: the percentage of mosquito breeding sites treated in relation to the total number of breeding sites within a given area.

DEET: liquid insect repellent that has broad range of effectiveness and is the active ingredient used in most mosquito repellents.

Egg rafts: eggs laid by certain mosquito species in the shape of a raft.

Gravid traps: traps that attract female mosquitoes who are searching for suitable medium to deposit eggs; typically trap contains water with decomposing organic material contained within a pan.

Harborage: shelter, habitat.

Larvae: the newly hatched, wingless, often wormlike form of many insects before metamorphosis.

Larvicide: an insecticide designed to kill larval pests.

Multilingual: expressed in several languages.

Pesticides: chemicals used to kill pests, especially insects.

Pooling: to form pools, to accumulate standing liquid.

Predacious fish: fish that live by eating other organisms (e.g., mosquito larvae); predatory.

Pupacide: an insecticide designed to kill the mosquitoes in the pupal stage of their development.

Pupae: non-feeding stage of development, between the larva and adult, in the metamorphosis of certain insects, during which the larva typically undergoes complete transformation to adult within a protective cocoon or hardened case.

Repellants: contact materials used to prevent mosquitoes and other insects from biting.

Source Reduction: reduction of mosquito breeding areas, e.g., standing water, tire piles, etc.

Stagnant water: foul or stale standing surface water, typically high in decomposing organic material, which serves as food source and habitat for mosquito larvae.

Standing water: accumulation of water in any given area.

Sump: a cesspool that often provides ideal breeding habitat for mosquitoes.

Surface film: chemical solution applied to surface water that spreads and forms a thin film that make it difficult for mosquito larvae and pupae to attach to water surface, causing them to drown.

Surveillance: the act of observing or the condition of being observed.

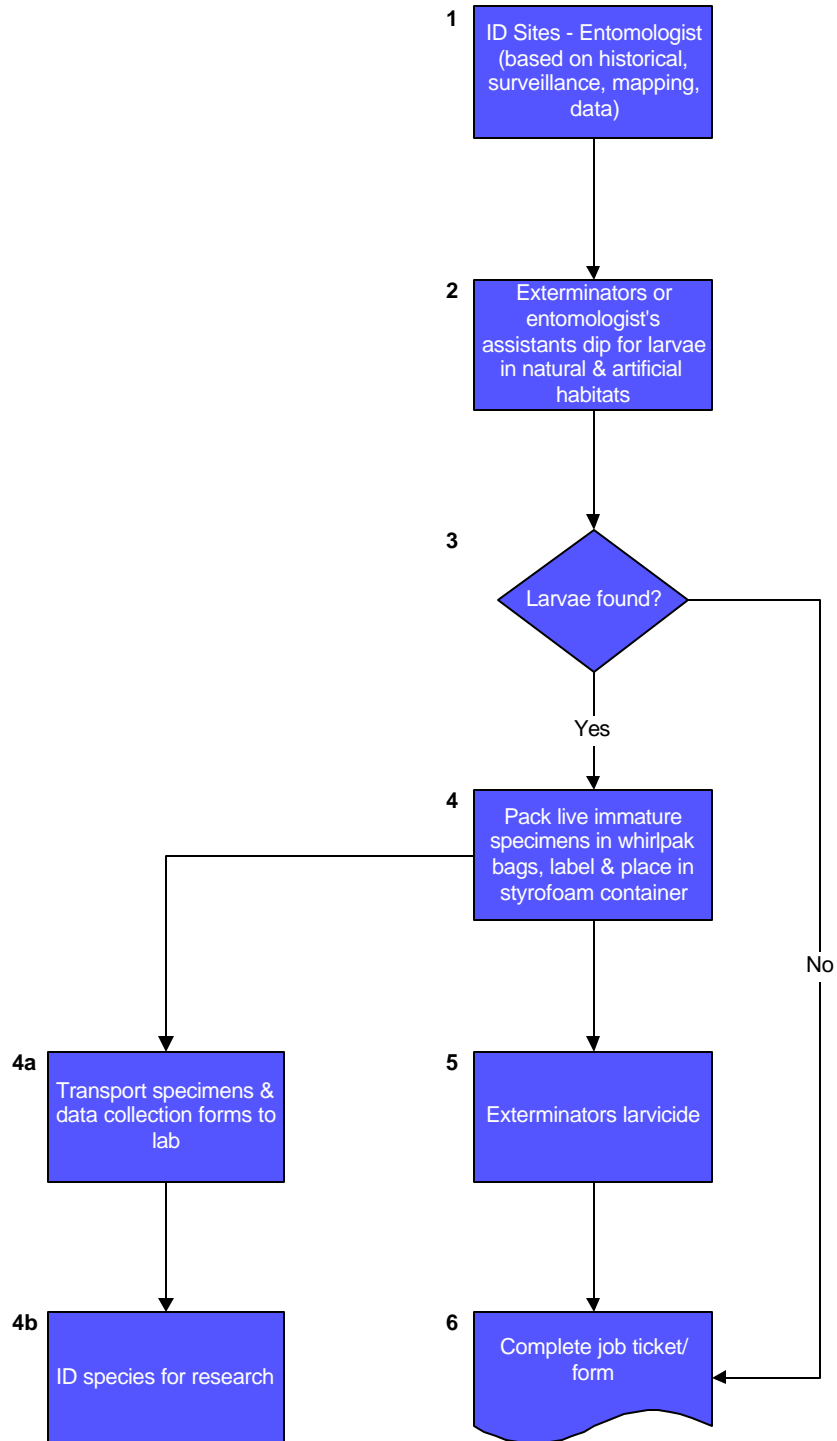
Tidal creeks: creeks affected by tides that are often the habitat for salt-marsh mosquitoes.

ULV: method of spraying mosquito adulticide that involves ultra low volume cold aerosol application.

APPENDIX I: MAP OF THE ROCKAWAYS

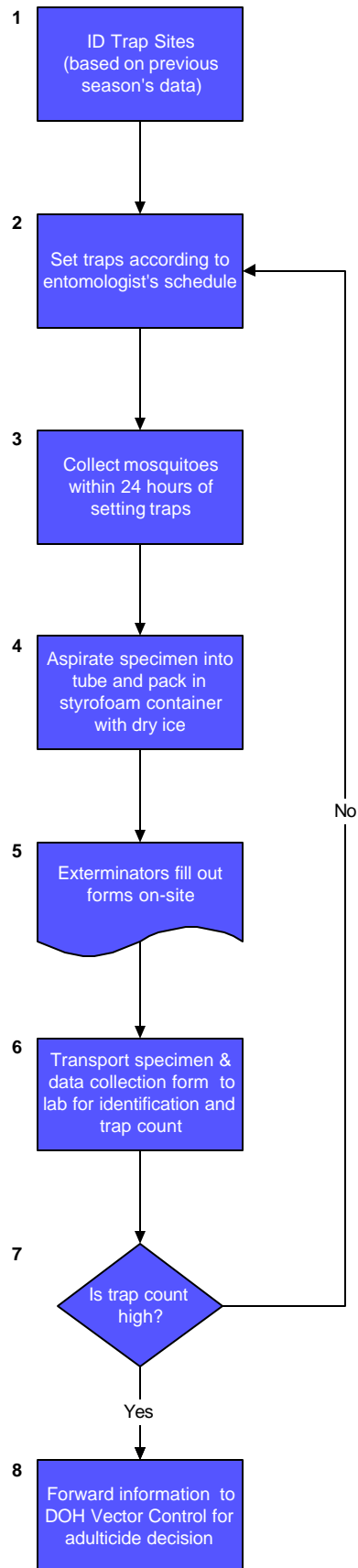
APPENDIX 2: LARVAL SURVEILLANCE FLOWCHART

LARVAL SURVEILLANCE FLOWCHART



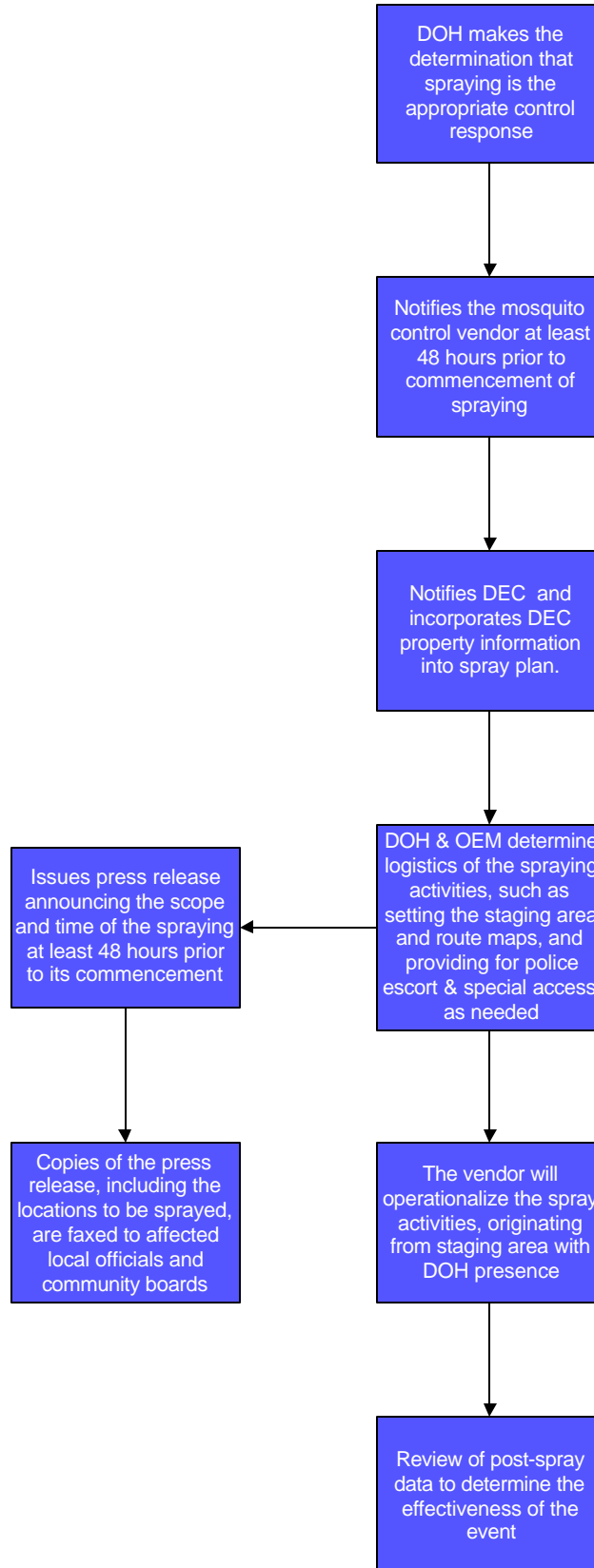
APPENDIX 3: ADULT SURVEILLANCE FLOWCHART

ADULT SURVEILLANCE FLOWCHART



APPENDIX 4: ADULT CONTROL FLOWCHART

ADULT CONTROL FLOWCHART



APPENDIX 5: TIMELINE

ID	Task Name	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	Larval Surveillance					■	■	■	■	■	■	■	■
2	Adult Surveillance (Trapping)					■	■	■	■	■	■	■	■
3	Catch Basin Applications						■	■	■	■	■	■	■
4	DEP Treatment Plant Surveillance & Control	■	■	■	■	■	■	■	■	■	■	■	■
5	Treatment of Standing Water					■	■	■	■	■	■	■	■
6	Spraying for Adult Mosquitoes								■	■	■	■	■
7	Board of Health Resolution				■	■	■	■	■	■	■	■	■
8	Enforcement				■	■	■	■	■	■	■	■	■
9	Permit Applications	■	■	■									
10	Mosquito Magnet Program						■	■	■	■	■	■	■
11	Education & Outreach	■	■	■	■	■	■	■	■	■	■	■	■
12	Research & Evaluation						■	■	■	■	■	■	■

TIMELINE