

**DISTRICT OF CENTRAL SAANICH,
TSAWOUT FIRST NATION
AND
CAPITAL REGIONAL DISTRICT**

**Integrated Pest Management Plan
PMP # 825-0004-21/26**

**Mosquito Population Management and Control Program
2021 – 2026**



Adult mosquito, *Aedes sp.*

Plan Prepared by
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Prepared for
The District of Central Saanich and Tsawout First Nation
Saanichton, BC
and
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1.0 PEST MANAGEMENT PLAN SUMMARY

The District of Central Saanich has significant recreational and environmental value, providing residents and visitors with many outdoor summer activities and employment. Walking, running, cycling, bird watching, outdoor sports, golfing and gardening are just a few of these. Adult mosquito annoyance can often conflict with these activities and potentially impact public health. Besides the negative impacts on the lifestyle and well-being of residents, there can also be considerable economic impact from mosquito annoyance on local businesses. An integrated pest management (IPM) approach to mosquito population management and control can reduce overall annoyance levels and co-exist with these valuable resources.

The annual Mosquito Population Management and Control Program provided by the District of Central Saanich, Capital Regional District (Parks) and the Tsawout First Nation, collectively referred to in this document as 'Central Saanich', would continue to employ a comprehensive, Integrated Pest Management (IPM) approach to control. This approach focuses on the timely detection and treatment of larval mosquito populations using biological control products and methodologies. Where possible, and appropriate, physical or cultural controls (preventative) are recommended, and implemented, that reduce larval habitat and enhance, or conserve natural mosquito predators. Where required, larval mosquito populations would be controlled using the bio-rational larvicide product VectoBac® 200G (*Bacillus thuringiensis* var. *israelensis*, PCP #18158) and VectoLex (*Bacillus sphaericus*, PCP # 28008, 28009). All treatments would be completed in accordance with the methodologies and procedures prescribed in the BC Ministry of Environment-accepted Pest Management Plan for Mosquito Population Management and Control, prepared by *Duka Environmental services Ltd.*, on behalf of the District of Central Saanich, the Capital Regional District and the Tsawout First Nation for the years 2021-2026.

Mosquito control services are provided to residential and rural property owners, businesses, municipal and regional parks, sports fields, campgrounds, golf courses and other outdoor recreational and tourist facilities located within the District of Central Saanich, CRD Parks and Tsawout Band lands. The goal of the annual mosquito control program is to reduce the potential for widespread adult mosquito annoyance for the benefit of residents, workers and visitors to Central Saanich.

The mosquito control program proposed for the years 2021-2026 is largely unchanged from that of past seasons and focuses on larval control and reduction of populations. This PMP meets all the requirements of the *Integrated Pest Management Act* and will replace the previously approved, and soon to expire (2021), PMP # 825-0003-16/21.

This Pest Management Plan (PMP) reviews mosquito biology, the types of larval mosquito habitats affecting the program area and the local mosquito species complex. An integrated PMP approach to mosquito population management and control can reduce overall adult mosquito annoyance

levels through education, prevention and biological controls. This PMP outlines the procedures and methodologies which will reduce local mosquito populations for the purpose of preventing mosquito annoyance for area residents and visitors.

1.1 Geographic Boundaries of this Pest Management Plan

The District of Central Saanich (Central Saanich) is located approximately 20 kilometres north of Victoria, between the District of Saanich and the District of North Saanich, on Vancouver Island. It encompasses a total area of some 41.42 km² and a population in excess of 15,750. The District contains two main community centres, Saanichton, a near-continuous developed area along the East Saanich Road, and the second community centre on the east coast of the Saanich Peninsula, at Brentwood Bay.



The Tsawout First Nation is a distinct community adjacent to the municipal boundaries of Central Saanich, with its main village located in Saanichton on the East Saanich Indian Reserve #2. The population is approximately 1600 people, with 1/3 being registered band members and others being residents who are leasing lands from the landowners. East Saanich IR #2 is approximately 241 hectares in total area (www.Tsawout.com). The Capital Regional District (CRD) manages the large Island View Beach Regional park (some +57 hectares) located directly to the south of, and contiguous with, the East Saanich Indian Reserve #2.

The Tsartlip First Nation's main community is located on the South Saanich Indian Reserve #1 in Brentwood Bay. It has a total area of 333.8 hectares and an on-site population of approximately 650 members. The Tsartlip FN do not participate in the annual Mosquito Population Management and Control Program.

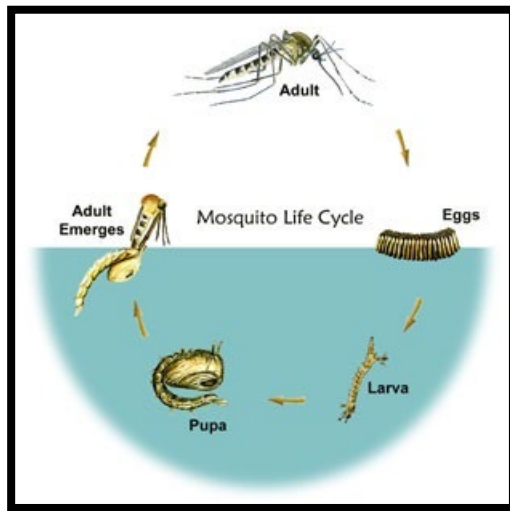
The Central Saanich area, including the CRD and Tsawout, contain a unique mixture of farmlands, forested areas, creeks, swamps, ponds, coastal beaches and salt marshes. Over 80% of the District is zoned as Agricultural, Park, Rural or First Nation lands. These economic, recreational and natural resources enhance the outdoor enjoyment of residents, businesses, workers and visitors to the area. Recreational summer activities include organized sports, camping, hiking, fishing, boating, bird watching, sight seeing, photography, cycling and golfing. Widespread annoyance from adult mosquitos detracts from outdoor enjoyment and worker safety.

1.2 Mosquito Biology

Mosquitos are found world-wide in standing water of all possible descriptions. Mosquitos belong to the order Diptera, along with other pests such as the common house fly and the black fly. There are over sixty species common to Canada and over thirty are found in British Columbia.

Mosquitos undergo four distinct development stages; egg, larvae, pupae and adult. Larvae and pupae are aquatic. Eggs are laid on the water surface or on soil and vegetation adjacent to water. The eggs of some species of mosquitos, such as *Aedes*, can survive for upwards of 20 years and will hatch after a period of winter freezing, and upon being wetted.

Mosquito larvae undergo four larval instars (or moults), each time emerging larger, but virtually unchanged from the previous instar. This is the feeding stage of the aquatic mosquito. The mosquito pupa, like a butterfly chrysalis, is a non-feeding stage and is where the once aquatic, larval mosquito undergoes metamorphosis to emerge as the winged, terrestrial adult mosquito. Adult mosquitos feed on plant juices and it is only the female which requires a necessary blood meal to complete the development of her eggs.



Mosquito development occurs in a wide range of larval habitats ranging from salt marshes, snowmelt and precipitation-influenced flood and seepage water pools and channels along rivers and lakes to freshwater, ponds, marshes, ditches and similar water-holding depressions. Bird baths, plugged rain gutters, livestock watering troughs, stored equipment, irrigation and surface water run-off collection ponds, ditches and any man-made container capable of holding water for a period of 7 to 21 days can provide suitable larval mosquito habitat.

Mosquitos are best known as vectors of 'tropical' diseases such as malaria and yellow fever. Although these exotic afflictions are extremely rare in British Columbia, mosquitos can still pose a serious health concern. Extreme allergic reactions or secondary infections from mosquito bites can occasionally require hospitalization. Diseases such as canine heartworm, Western Equine Encephalitis (WEE) and West Nile virus (WNV) are transmitted from some mosquito species to family pets, humans, and livestock.

The BC Centre for Disease Control (Vancouver) and local health authorities are responsible to coordinate the surveillance, identification and reporting of these diseases and their mosquito vectors. As part of this planning the BCCDC has developed the *Arbovirus Surveillance and Response Guidelines for British Columbia*, and the BCCDC has a provincial database containing

all mosquito, bird and human health surveillance data relating to WNV and vector mosquito species. Due to the low and stable incidence of WNV it was decided by the BCCDC in the fall of 2014 that it was no longer necessary to conduct active surveillance of mosquitos or other indicators. The provincial decision to eliminate this surveillance was reached at the BC Communicable Disease Policy Advisory Committee meeting in February 2015. Human clinical testing will continue. Human clinical testing continues as part of routine blood donor collection programs. Specific details on the response guidelines, surveillance, permitting, and other related information is available online through www.BCCDC.org

1.3 Need for Mosquito Control

The purpose of the annual mosquito control program is to provide residents, workers and visitors to the Central Saanich area with relief from extreme and/or persistent adult mosquito annoyance. The control program is not intended to, nor is it possible to eradicate local mosquito populations.

In addition to negative impacts on the lifestyle and general health of residents, a large population of adult mosquitos can have a negative economic impact on local businesses. Worker safety, comfort and efficiency can be compromised by adult mosquito annoyance. Milk, beef, and egg production in farming communities can be reduced when animals are unable to feed or rest because of extreme mosquito annoyance or through a reaction to mosquito saliva-borne toxins or disease. Farm, orchard and crop harvesting can be affected by nuisance impacts on pickers and field workers. Reduced use and enjoyment of hotel and restaurant outdoor patios, sports fields, golf courses, campgrounds and cycling or hiking trails by residents and area visitors directly affects business operations and revenues.

Although not a common occurrence in most areas of British Columbia, mosquitos are capable of transmitting (vectoring) diseases. A well organized and effective larval mosquito control program is important to limit the potential for both, widespread adult mosquito annoyance, and potential for disease transmission. Despite the best of efforts though, some adult mosquito annoyance may still occur during some months and residents are encouraged to avoid areas of mosquito harbourage (typically treed, forested or landscaped areas) during certain times of day, and to use repellents and approved adult mosquito control devices and products as per label directions.

The goal of the annual mosquito control program is to provide residents and visitors to the Central Saanich area with relief of adult mosquito annoyance through proactive larval mosquito control using an Integrated Pest Management (IPM) approach to surveillance and control. However, since mosquitos capable of vectoring diseases to man are often the source of localized annoyance (human biting), the control of mosquito populations known to cause nuisance also provides the benefit of controlling mosquito species having the potential to vector disease, including WNV. An effective, pro-active mosquito control program which focuses on the identification, prevention, or timely control of larval mosquito populations, also contributes to the protection of public health.

The Central Saanich, Tsawout and CRD Mosquito Population Management and Control Program Pest Management Plan, PMP # 825-0003-21/26, described in detail below, is presented in a format which adheres to the requirements of *Integrated Pest Management Act and Regulation*, including amendments, and the *Mosquito Management Sector Review Paper*. Copies of these documents may be accessed through the BC Ministry of Environment home page at www.env.gov.bc.ca/epd/epdpa/ipmp/pestact/index.html. The annual, Central Saanich Mosquito Population Management and Control Program is a collaboration between the District of Central Saanich, the Capital Regional District (CRD) and the Tsawout First Nation.

The Pest Management Plan is 'owned' by the District of Central Saanich and partners, the Tsawout First Nations and Capital Regional District. It would remain in place for the purposes of larval mosquito population management and control for the five year period, 2021-2026. The objective of the annual mosquito population management and control program is to reduce adult mosquito populations and the potential of widespread mosquito annoyance for residents, workers and visitors to the Central Saanich area. This is achieved using an Integrated Pest Management (IPM) approach to reducing, and suppressing, local mosquito populations through a focus on larval mosquito prevention and control initiatives. The program methodologies described within this PMP are a hybrid of approaches developed through collaboration with mosquito nuisance and vector control professionals worldwide. It has been carefully and specifically designed for the unique conditions of the program area and is a model of environmental compatibility.

A professional, experienced, environmental consulting firm is retained by program participants to coordinate and supply these specialized services through adherence to the Pest Management Plan. The consultants for the District of Central Saanich, the CRD and the Tsawout First Nations annual mosquito control program would have Registered Professional Biologists (R.P.Bios.,) as program managers and senior biologists. All program personnel would be appropriately certified as pesticide applicators by the BC Ministry of Environment, Integrated Pest Management Program.

Public relations and ongoing program education was accomplished through regular contacts with residents, businesses and local First Nations representatives. Information on mosquitos, their control, and prevention, is available to the general public in a variety of forms including notice boards, informational brochures, websites, newspaper articles and interviews. Resident requests for service were followed up with telephone contact and site inspection. Physical reduction, elimination or alteration of larval mosquito development habitats is an important aspect of the control program. Wherever possible, and practical, property owners were advised of measures they could undertake to reduce mosquito development.

1.4 Term of the Pest Management Plan (PMP)

A five year period, extending from 15 April 2021 to 14 April 2026.

The designated contact for this Plan is Mr. Norm Doerksen, Superintendent, Public Works, District of Central Saanich, 1903 Mt. Newton Cross Road, Saanichton, BC V8M 2A9. Telephone # 250-544-4224.

2.0 MOSQUITO CONTROL PROGRAM BACKGROUND

The geographical area covered under the PMP is defined as the boundaries of the District of Central Saanich and includes all lands owned by the Capital Regional District and the Tsawout First Nations (East Saanich Indian Reserve #2). Larval mosquito habitats within this area include freshwater marshes, ponds and ditches located in low-lying forested areas, farm fields, undeveloped areas and along roadsides and saltwater tidally-influenced habitats located on public, private and First Nations lands. Additional larval development habitats include roadside catch basins and temporary sites such as water-filled tire ruts, depressions, un-used or abandoned pools or boats, live-stock watering troughs, and containers.

The annual mosquito control program provided by the District of Central Saanich, the CRD and Tsawout First Nations focuses surveillance and control efforts on areas where larval populations occur and where past, often extreme, adult mosquito annoyance was documented. Mosquito control services are provided to residential and rural property owners, businesses, municipal and regional parks, sports fields, campgrounds, golf courses and other outdoor recreational and tourist facilities located within the area defined as Central Saanich.

In operation for over twenty five years the annual program has continued to evolve to increase its environmental compatibility, its effectiveness, and its affordability for area residents. The Central Saanich mosquito population management and control program has always been one of innovation and adaption. Detailed site mapping, larvicide product research and the establishment of predictive indices for larval mosquito development, particularly for species developing in the salt marsh and old field habitats of the Island View Beach and East Saanich Indian Reserve areas has improved program success, efficiency and sustainability.

The largest sources of mosquito development within Central Saanich is the near-continuous salt marsh and old field seepage and floodwater habitats which extend from Cordova Point and the East Saanich Indian Reserve #2 southwards through the CRD Island View Beach Regional Park and recreational area. Totalling some +57 hectares, these tidally-influenced permanent ponds, ditches and temporarily flooded depressions, ponds and channels are recurring sources of larval mosquito development. In addition, some 130 individual site locations comprised of natural and manmade ponds, marshes and ditches along public roadsides, at golf courses, on private properties and in farm and undeveloped lands exist throughout the program area. Ranging in size from less than

10m² to upwards of 1-2 hectares in area, these largely freshwater habitats provide another 30-40 hectares of potential larval mosquito development habitat.

The commencement of larval surveillance and control operations for salt marsh and old field habitats beginning in late January, and early February, is unique to the program area. Initially completed in 2010, and annually ever since, this “early” start is responsible for the significant reduction in adult mosquito nuisance in the eastern portion of the District, at the CRD Island View Beach Regional Park and the Tsawout First Nation residential and recreational camping areas. Freshwater habitats are routinely sampled, and treated where required, beginning in early April, and thereafter on regular basis through to late August and or early September. The Figure presents the locations of both fresh and saltwater influenced habitats.

A variety of monitoring and control methods, including physical site reduction or modification and the use of biological control products support the principles of an Integrated Pest Management (IPM) approach to mosquito control. They are the most effective means of reducing adult mosquito populations and the potential for annoyance or disease transmission. This IPM protocol consists of five components:

- 1) Public Education which explains mosquitos, the program, and how the public can contribute to successful operations;
- 2) Surveillance and identification of mosquito species and their distribution;
- 3) Timely implementation of mosquito controls and preventative measures;
- 4) Review of results achieved and adaptive management during a season; and,
- 5) Program evaluation and assessment to ensure sustainable, effective controls have been achieved.

The annual mosquito control program focuses mosquito population surveillance and control efforts in areas where larval populations are known to occur and where past, occasionally notable, adult mosquito annoyance was documented. Mosquito control services are provided to residential and rural property owners, businesses, municipal and regional parks, sports fields, campgrounds, golf courses and other outdoor recreational and tourist facilities.

2.1 Primary Land Use

The primary land uses of the areas contained within the control program are agricultural and undeveloped farm or forest areas. Light industrial and commercial properties (lumber yards, landscaping, shopping malls, campgrounds), recreational (golf courses, passive parks, playing fields, etc.), residential and rural land uses comprise the rest. In addition to agricultural, service and retail services, organized outdoor sports activities (Baseball, soccer, etc.) and recreational activities include walking, hiking, photography, golfing, camping, fishing, boating, sight seeing and bike riding.

2.2.1 Mosquito Species Identified within the area

Mosquito development occurs in a wide range of larval habitats ranging from tidally-influenced flood and seepage water pools and channels to permanent freshwater, ponds, marshes, ditches and similar water-holding depressions. Bird baths, plugged rain gutters, livestock watering troughs, stored equipment, irrigation and surface water run-off collection ponds, ditches, marshes and any man-made container capable of holding water for a period of seven to twenty days can provide suitable larval mosquito habitat.

Mosquito pest species collected from the Central Saanich area include:

Aedes dorsalis
Aedes excrucians
Aedes implicatus
Aedes increpitus
Aedes mercurator
Aedes sticticus
Aedes vexans

Anopheles punctipennis
Coquillettidae perturbans
Culex pipiens
Culex tarsalis

Culiseta impatiens
Culiseta incidens
Culiseta inornata



The majority of mosquito species collected from salt marsh and old field habitats are predominantly a complex of *Aedes dorsalis*, *Aedes vexans* and to a lesser extent *Ae. increpitus* and *Ae. sticticus*. These mosquitos are aggressive biting pests which prefer habitats such as fluctuating salt marshes (*A. dorsalis*), and seepage, floodwater and precipitation runoff accumulations in low-lying fields and deciduous forest areas (*Aedes sticticus* and *Aedes vexans*).

Developing in response to tidal influences fluctuating water levels in various ponds, depressions and overgrown ditches in the old salt marsh area *Aedes dorsalis* mosquitos are the most common species throughout the season, but from February through June they are the most numerous. Decreasing tidal height fluctuations and increasing ambient temperatures, evaporation and

decreased precipitation typical to July and August causes many of these habitats dry, drain and disappear.

Culex and *Culiseta* mosquitos typically develop later in the season, from June through August, and require a different set of cues to initiate the onset of larval development including day length and temperatures. They prefer permanent and slow-draining, or frequently-refilled sites including

natural and man-made irrigation and display ponds, ditches and containers such as stored tires, boats and buckets or livestock watering troughs. *Anopheles* mosquitos prefer permanent sites or slow draining and flowing ditches or stream margins. Species such as *Culex tarsalis* are able to withstand brackish waters and a high degree of pollution. They can inhabit areas with high organic content, including septic field seepage, sewage lagoons and livestock hoof prints around barns, feed lots and along creeks. *Culex pipiens*, the “house mosquito”, can use a large variety of freshwater habitats including manmade containers and in some areas they are the predominant (+99%) mosquito developing in roadside and sports field catch basins.

Culex, *Culiseta* and *Anopheles* are at their most numerous during late summer when drier conditions and warmer conditions typically exist. Although their populations and individual development sites are not usually as large as the synchronous hatching *Aedes* mosquitos, *Culex* and *Culiseta* mosquitos are capable of producing several generations in a typical season. They are very common in the old field habitats of Island View Beach Regional Park and in freshwater sites scattered throughout the Central Saanich area. They can be a source of reportable annoyance since their preferred habitats are common to residential, commercial, recreational and agricultural properties.

All of the species collected above are able to develop as multiple hatches during the season. With the exception of *Cu. territans*, all are capable of causing reportable and often extreme annoyance, particularly *Aedes*, and locally collected *Ae. dorsalis*, *Ae. vexans* and *Ae. sticticus* are all potential West Nile virus (WNV) vectors. *Culex* and *Culiseta* mosquitos are not only a source of annoyance but they too are also recognized as vectors of several diseases, including WNV. *Culex tarsalis*, *Culex pipiens* and *Culiseta incidens* are identified by the BC Centres for Disease Control (BCCDC) and the Centers for Disease Control (Atlanta, USA) as three of the primary vector vectors of WNV in North America. Control of locally occurring *Aedes*, *Culex* and *Culiseta* mosquitos not only prevents widespread nuisance for the benefit of residents, businesses and visitors, but also contributes to the protection of public health.

An uncommon mosquito, collected for the first time in Central Saanich during summer 2020, was *Coquillettidia perturbans*, the “cattail mosquito”. It’s larval siphon and pupal trumpets are serrated allowing them to puncture young cattail stems where they access air from in these hollow plants as a source of oxygen. Because of this attachment, they are not “free swimming” and generally not collected in routine larval sampling. They can be an aggressive biting pest of man and animals.

2.2.2 Mosquito Control Program Operations

In response to resident, workers and visitor reports of recurring adult mosquito annoyance, the District of Central Saanich, the CRD and the Tsawout First Nations have worked together to since 1989 to provide an effective nuisance mosquito control program for residents, workers and

visitors to the area since this time. During this time the program has evolved to become an example of environmentally-sound, and sustainable mosquito control using an IPM approach. This methodology incorporates public education, development site identification, surveillance, extensive mapping, correlation with tidal heights, and recommendations for the alteration or modification of suitable habitats. Where required, larval mosquito control is completed using the safest, most effective biological control agents available.

Ongoing mosquito development site surveys, monitoring and identification of larval and adult mosquito specimens updates the local mosquito species complex. Identified mosquito habitats are monitored throughout the season, typically from early February through to mid-September, depending on conditions, to assess the abundance and species of mosquitos developing in them. New Jersey or CDC (Atlanta) light traps and standardized mosquito biting and landing counts are used to sample and monitor adult mosquito populations. Routine suite surveillance and input from residents, business owners, facility operators and First Nations assists field technicians in locating and identifying new, altered or eliminated habitats.

Within Central Saanich there are currently over 130 properties or site locations where larval mosquito development habitats have been identified for routine surveillance and control as required. Ranging in size from less than 10m² to over 2 hectares in treatment area, these sites vary in description from a single, permanent ditch or irrigation pond to salt marsh and old field habitats which may contain a hundred or more individual temporarily-filled depressions, ponds or ditches. Stagnant and non-flowing ponds and ditches, most of them manmade or influenced, provide ideal freshwater larval mosquito development habitat and often have the greatest diversity of species. Flooding and seepage water accumulations from spring and summer tides provide extensive habitat for repeated *Aedes dorsalis* and *Culex tarsalis* larval development in area salt marshes and old field habitats.

Other habitats such as bird baths, buckets, stored boats, livestock watering troughs, tires are not treated as part of routine control program operations. When discovered, physical control of these habitats can be easily accomplished by removal of the container or for bird baths or watering troughs, regular drainage and refilling. This prevents larval mosquito development and subsequent adult mosquito annoyance. Public education activities encourage property owners to survey their properties and identify these types of habitat.

Adult and larval mosquito population monitoring is conducted as part of ongoing operational mosquito management and control programs. This allows for an assessment of larval control effectiveness in reducing nuisance mosquito populations, updates the local species record and larval mosquito development site database.

2.2.3 Control Products (Larvicides) Proposed for Use

The Central Saanich Nuisance Mosquito Control Program has been developed with a focus on larval control initiatives and on the basis of using only biological control products. The bacterial mosquito larvicides VectoBac 200G (PCP # 18158) and VectoLex CG (PCP # 28008) are the control products of choice under this PMP. Both VectoBac 200G and VectoLex CG contain spores and crystals produced by *Bacillus*, a naturally-occurring soil bacteria and as such they are classed as a bio-rational control. See Appendix 1 for manufacturer's information package including labels and Material Safety Data Sheets, or from www.valentbiosciences.com.

Larval mosquito populations would be controlled from the ground and by hand or back pack spreader-broadcast using VectoBac 200G and VectoLex CG or WSP. Section 3.4.3 Larval Control in the Appendix of this PMP, discusses the products VectoBac and VectoLex further. Other, equivalent products may be used. These would be identified to the BCMOE with the annual Notification of Intention (NIT) to treat.

3.0 CONTROL PROGRAM METHODOLOGIES

The objective of the annual nuisance mosquito control program is to reduce the potential for widespread adult mosquito annoyance for residents, workers and visitors to the Central Saanich area. A program of this scope is not intended, nor could it, eliminate the local mosquito population. All public education initiatives and outreach activities remind residents and visitors that mosquitos are a part of the natural environment and that some mosquito annoyance may be reasonably expected at certain times of the seasons, in some locations and during some years. The total eradication of a widespread, fecund insect pest such as mosquitos is not practical, or feasible.

The potential impacts of control products, and activities, combined with a need to coexist with a delicate aquatic habitat, necessitates that an integrated approach to mosquito control be undertaken. This approach requires an assessment of the problem, an in-depth understanding of factors influencing the situation, followed by the use of appropriate control.

Control of or prevention of larval mosquito development is preferred over control of the often widely dispersed and mobile adult mosquito. Mosquito larvae are concentrated in one place, must remain there for 7-21 days, and are very susceptible to the bio-rational control (larvicide) products, VectoBac and VectoLex. Drainage, filling of depressions, restoration of flow in ditches or other physical alterations to appropriate larval mosquito development sites is the preferred and permanent control method. Physical control can be integrated into local public works and construction activities such as roadside grading, ditch maintenance and cleaning. For home and

business owners it can include the removal of water-holding containers such as buckets and unused pools, or the regular draining and refilling of livestock watering troughs and bird baths.

Only the most environmentally compatible, least toxic and persistent control products would be deployed for use within this annual program. Specifically, the bio-rational larvicides, VectoBac 200G and VectoLex both made with the *Bacillus* sp. bacterium are the larval control products of choice. Section 3.4.3 discusses these products in detail and sample labels are provided in Appendix 1 or available on-line through www.valentbiosciences.com.

Routine adult mosquito control applications (adulticiding) for the purposes of nuisance mosquito control **are not** a component of the Central Saanich Mosquito Population Management and Control Program or this Pest Management Plan.

The operational components of the PMP and the successful, annual, Central Saanich Mosquito Population Management and Control Program may include the following activities, as detailed in Sections 3.1 through to Section 4.5.

3.1 Public Information and Education

The general public must be advised of control program efforts in their area and provided with the opportunity to have input to their mosquito control program. Public input is invaluable to any community function and it is a key component of all successful, pro-active mosquito control programs. This is essential since, in the final analysis, it is the general public which must be satisfied with control efforts.

The *Integrated Pest Management Act and Regulation* requires public notification of Pest Management Plan preparation through newspaper notices which must be published twice in a two week period starting at least 45 days before submission of a notice confirming that a pest Management Plan has been prepared according to the legislation. The general public, first nations and other stakeholders are invited through these advertisements to provide to consult with the PMP holder or his or her designate, on PMP contents and the proposed mosquito population management and control program. In addition, those individuals or groups which had requested information or who had supplied input when the local mosquito control program was last advertised and approved are contacted directly each time the PMP is renewed.

The Central Saanich Nuisance Mosquito Control Program has employed various, proven effective approaches during the past + 25 years of annual operation to ensure that the general public are informed of ongoing, annual control program operations. Interactive public education initiatives include literature, poster boards and brochure distribution, presentations for business associations, committees, display booths and 'open houses' at schools and fairs. Broadcast media

coverage via newspaper, radio and television interviews and articles or advertisements are very efficient in reaching a large audience and can be an effective component of public education activities.

Considerable value can be obtained through exposure of the control program and interactions with the public. For example, public contact can result in the locating of new mosquito development sites thus augmenting efficacy. Residents are encouraged to contact control program consultants through District of Central Saanich and/or Tsawout First Nation offices to report potential sources of larval mosquitos (a waterbody) or adult mosquito annoyance. Suggestions for physical removal or source reduction on private property allow the owner to participate on a smaller scale. Once accomplished, physical source reduction, especially the removal of artificial containers, grading of depressions or filling of tire ruts eliminates the need for further attention.

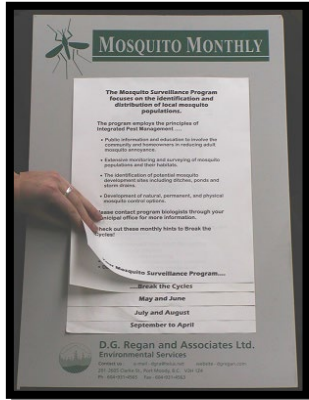
The annual nuisance mosquito control program is well known and supported by area residents and businesses. It's highly visible nature using field biologists working along roadsides, in parks, golf courses, along dykes and salt marshes has ensured that property owners, facility managers and residents remain familiar with their annual program. In annual operation for over thirty seasons, it has been providing mosquito surveillance, monitoring and larval control services for the benefits of residents, businesses and visitors to the area. Throughout this time, newspaper articles and advertisements, brochures, posters and interactions with field personnel have provided the public with regular and frequent information on mosquitos and program access.

Movement of adult mosquitos, either by active flight or passively by wind, from outside of treated areas into built up and developed areas is always a possibility given the nature of local geography. Public education further encourages residents and businesses to undertake actions for excluding adult mosquitos and modification of personal behaviours which will reduce the potential for annoyance. Through eliminating development sites on their property and learning to reduce adult mosquito annoyance through preventative actions residents can actively participate in their program. In addition to providing residents with information on how they can reduce larval development and annoyance around their properties, education initiatives help residents understand that the control program can only suppress mosquito populations, not eradicate them, and that some adult mosquito annoyance may be anticipated at certain locations, times of day and during some years.

Examples of some various public education and information initiatives which have been successfully employed in our other programs and which are available and have been deployed within Central Saanich throughout the years include:

- Newspaper Display Advertisements – placement in local newspapers from April – September. Provides information relevant to each month and program access details.

- *Newsmedia interviews* – provides opportunities to update the public on program operations and status, mosquito biology and additional public outreach
- *Presentations at Council meetings - (Power Point™).*
- *Open houses, farmers markets*
- *Radio, television and newspaper interviews and /or articles*
- *Informational Brochures* – these review mosquito biology and control, mosquito “myths”, program operations and contact information for program biologists.
- *Cardboard Door Knob Hangers* - these “Sorry we missed you” door knob messages are left when residents aren’t home during property inspections. They summarize field biologist site observations and have return contact information for resident use.



- Web-based program information and service contact details.
- Facebook account – another method of public access/information
- *Laminated posters* – durable. Can provide basic information on protection from annoyance. Installation along walking trails, picnic and camping areas is possible.
- *Mosquito Monthly poster board* - a ‘flip chart’ type of display board for placement in public access and reception areas of City Hall, at libraries, Recreation Centres, including pools and ice rinks etc.

At program start-up each season, residents and facility operators with previously identified larval development habitat on their property are contacted and control program operations, site status, access and notification procedures reviewed. As part of these initial contacts field personnel answer inquiries, supply relevant literature and complete on-site property inspections. Ongoing interactions and conversations with property owners, residents and general public provides opportunities to discuss program operations, goals and allow for the distribution of public education and outreach materials and information. Office and field personnel response to service requests, by telephone, email, and in person provide additional opportunities for public education and information sharing of program operations.

The cooperation and support of local businesses, the Capital Regional District, Tsawout First Nations, farmers, business, facility operators and other property owners is indicative of true community spirit and support for a successful program which benefits workers, residents and visitors to the Central Saanich area. Prevention of adult mosquito annoyance through pro-active, larval mosquito control provides significant benefit to outdoor worker and recreational uses.

3.2 Mosquito Control Program Data Collection and Reporting

The environmental consultant (contractor) managing the annual mosquito control program for the Central Saanich program is responsible to follow the data collection and reporting requirements of the PMP and the *Integrated Pest Management Act and Regulations*.

The District of Central Saanich, Capital Regional District and the Tsawout First Nations would be regularly informed of control program activities of this contractor/consultant through personal contact, telephone, facsimile or e-mail with program managers and field personnel. In addition, written progress reports summarizing weather conditions, surveying and monitoring results, treatment areas and interactions with the public are typically prepared by program consultants and submitted on a regular basis during the operational phases of the control program.

At the conclusion of each annual Nuisance Mosquito Control Program season a summary report detailing all activities and pesticide treatments completed under the PMP and it's BC Ministry of Environment (BCMOE) issued confirmations is produced. All pesticide use reporting required under the *Integrated Pest Management Act*, the approved PMP and as requested during the season by government regulatory agencies including the BCMOE, is completed as necessary.

At a minimum, the consultant would maintain the following information for their use in managing the program and to complete the reporting and information requirements of the annual control program, the PMP, the Pesticide Use Confirmation, the *Integrated Pest Management Act and Regulations*, and the BC Ministry of Environment:

- a mosquito development site database with information including property ownership, address, contact telephone number, public access information (paths, trails, roadways), development site maps and or photographs, records of past and current monitoring and treatment activities, pesticide use daily operation records and other relevant information related to the control program.
- a record of properties identified as 'AVOID' areas, where the owner or residents have indicated through telephone, written, verbal (in person conversation) or electronic (e-mail, facsimile) communication with the District, CRD, Tsawout or the program consultants, their wish to be excluded from the mosquito control program.
- a list and/or maps identifying 'AVOID' areas of environmental sensitivity, including provincial or regional parks, habitat conservation areas and other identified or designated speciality management areas. When the status of a waterbody or other area of potential environmental concern (eg. bird nesting sites) is unknown, a local representative of Fisheries and Oceans Canada or the Environmental Stewardship Division of the BCMOE would be consulted.

The development site database and avoid area lists are updated during each field season when control program personnel meet with residents, owners and operators of the farms, businesses and recreational facilities. Property ownership, access, development site status, avoid areas and control program operations are reviewed at this time. Regular contact is maintained with these individuals throughout the season to provide updates on control program operations and opportunities for input and comment on the control program. Ongoing activities related to surveying, monitoring and mosquito control operations are recorded in the historical data section of the database as they occur.

3.3 Surveying and Monitoring of Mosquito Populations

As part of the annual program start-up, and throughout the season, program field biologists conduct regular, comprehensive surveys of Central Saanich and surrounding areas by ground and air, as appropriate. The goal of these surveys is to confirm the extent and locations of existing, known mosquito development sites and to identify any new, or previously undetected, larval habitats. Surveying and monitoring of larval development sites (always waterbodies) determines the presence of larval mosquitos, the need for control and allows for regular update of the database. Where observed, larvae are collected and enumerated using a standard 350 ml white larval mosquito dipper. Larval specimens are identified to the species level whenever possible.

Mosquito development varies from year to year and throughout the season depending on environmental conditions and habitat availability. Environmental cues interact to affect both the timing and magnitude of mosquito development, and adult mosquito survival. Provincial and regional snowpack accumulations, river levels, tidal heights, precipitation and temperatures are reviewed as necessary to ensure timely surveying to detect mosquito development.

Monitoring and correlation of fluctuating tidal heights, local temperatures and precipitation totals over several seasons allows for the determination of 'thresholds' which aid in the prediction of larval development and distribution within the salt marsh. Similarly, temperatures, humidity and precipitation all influence the extent of flooding and seepage water accumulations in adjacent low-lying fields, forested areas, ditches and ponds. Failure to timely survey and monitor larval habitats could allow unchecked development of larvae which will result in adult mosquito annoyance. When investigating resident reports of adult mosquito annoyance or potential larval development sites, a thorough survey of each area is performed to locate the source of annoyance, and any previously unidentified larval habitat.

- ***Larval mosquito monitoring***

Surveying and monitoring of larval development sites (always waterbodies) determines the presence of larval mosquitos and the need for control. Larval habitats would be monitored throughout the season using a standard 350ml white larval mosquito dipper to assess the relative



~200 larvae/350ml dip sample

abundance and species of larval mosquitos found in these habitats. Routine sampling of development habitats is completed on a 6-10 day basis, depending on conditions and observations, throughout the operational season, typically mid-April to mid-September.

Larval mosquito populations as small as one larvae per 350ml dip sample in an area as small as a backyard swimming pool (5m x 10m) can produce thousands of adult mosquitos over the course of a season. Located adjacent to established outdoor recreational facilities including golf courses, sports parks, water slides, picnic areas, campgrounds and nearby residential and commercial areas, salt marsh and old field permanent sites (ponds, ditches) are a major source of potential mosquito annoyance and a primary focus of the annual mosquito population management and control program.

Pre-treatment surveys determine the extent of larval development which ensures that control measures are directed only to those areas containing larvae. In addition to providing pre-application information essential to timely control applications, surveying and monitoring following treatment, 'post-treatment monitoring' allows for an evaluation of the degree of control achieved from a particular application. Environmental compatibility and cost effectiveness of a control program is dependent on proper pesticide use through the application of control measures directed only to those areas requiring them. Post-treatment monitoring to confirm to larval mortalities is typically completed within 2-96 hours of larvicide (VectoBac 200G and VectoLex CG and WSP) application.

- ***Adult mosquito monitoring***

To objectively measure the success and effectiveness of larviciding efforts in reducing adult mosquito populations, two internationally accepted sampling methods are employed. The first, a standard biting/landing count, measures the number of mosquitos which land, to bite, on the exposed forearm (from wrist to elbow) in a one minute period. Adult biting counts of three or more per minute, measured between the wrist and exposed forearm, is intolerable for most people. Beyond three bites per minute, outdoor enjoyment and worker performance and safety are affected, and negative economic impacts on recreation and tourism can be expected.

Although it is the accepted world-wide standard, it must be noted that bite counts are not without bias. Clothing and body physiology make some people more or less attractive than others. Also, daily timing for collection is crucial as mosquitos are most active at dusk and dawn, when temperatures are lower and humidity generally higher. For these reasons, collection timing,

locations and clothing worn by the observer are standardized as much as possible. When reviewed in conjunction with anecdotal reports from residents, this data is a useful measure of mosquito annoyance levels and facilitates the collection of mosquito species that actively seek a human blood meal.

The second method used for adult mosquito population assessments uses either Standard New Jersey or Center of Disease Control (CDC, Atlanta) Adult Mosquito Light Traps. Both types of traps use a normal incandescent light source as an infra-red attractant and are programmed to start collections at sunset and terminate at sunrise. Samples are typically retrieved the following morning and forwarded to the laboratory for enumeration and identification. These traps can be augmented (baited) with CO₂, in canisters, or as dry ice, to increase capture rates as it is another key attractant for female mosquitos. Information gathered from light trap captures can be used to give an indication of the mosquito population size, species complex and the type of development habitat.



CDC Light Trap

New Jersey or CDC Light traps would be deployed to monitor adult mosquito populations in areas with a history of adult mosquito annoyance problems. Benefits associated with these traps include the collection of a much greater number of specimens than with un-baited traps, or from biting counts, and they provide an objective, reproducible sampling method. These collections complement bite count sampling for annoyance by allowing field personnel to more effectively collect and identify mosquito species present in a particular area. Correlation of this data over several years with larval monitoring and adult mosquito biting count data allows for continued, increased forecasting of mosquito populations.

Larval and adult mosquitos would be identified in our laboratory according to the taxonomic keys of Darsie and Ward (1981) and Wood, Dang and Ellis (1979), and others as appropriate.

3.3.1 Mosquito Development in Central Saanich

The largest and most prolific sources of mosquito development in Central Saanich are tidally-influenced flood and seepage water accumulations in salt marshes and old field habitats located on Tsawout and CRD lands in northeastern Central Saanich. Several days of sustained tides exceeding 3.3 metres (as measured at Fulford Harbour), fill sections of the old the ditch system, low-lying areas of the salt marsh and adjacent undeveloped farm fields. Resultant lateral and

vertical seepage produces water accumulations in ponds and isolated channels scattered throughout the marsh. Egg eclosion (hatching) occurs within hours of inundation and over the next several days larval development occurs throughout the East Saanich (Island View Beach) salt marsh and old field habitats, and is at its greatest during peak tides in excess of 4.0 m. *Aedes dorsalis*, a very pestiferous mosquito species develops in response to these fluctuating water levels.

Located adjacent to established outdoor recreational facilities including golf courses, sports parks, picnic areas, campgrounds and nearby residential and commercial areas, salt marsh and old field sites are a major source of mosquito annoyance and a primary focus of the annual nuisance mosquito control program. Regular monitoring of salt marsh habitats during the season ensures that larval mosquito development does not proceed unchecked. With larval populations averaging between 50-100 larvae/350ml dip sample, multiple hatches in a seasons, and a total treatment area often amounting to over 50% of annual efforts for the Central Saanich area, the control of larval development in salt marshes and old field habitats is essential to prevent widespread adult mosquito annoyance. In addition to developing throughout the summer, salt marsh and old field habitats have been found to support larval mosquito development throughout fall and winter. Larvae have been found in the months of October, November, December and January. Starting in 2010, larval surveillance and treatment has been completed for salt marsh and old field development sites beginning in late January or early February and continuing through to late August or September, depending on weather conditions.

Impounded irrigation, display and water run-off/collection ponds also provide ideal habitat for larval development. Largely permanent, these sites fluctuate in size throughout the season in response to seepage and surface water runoff accumulations from precipitation and human activities including field irrigation, equipment and vehicle washing, dust control and site clean-up. These permanent and temporary development sites can support larval mosquito populations for as long as they contain water. Typically located near residential and commercial or recreational areas, control of larval development in these sites are of great importance to preventing localized annoyance and under certain conditions, they have the potential to impact residents located several hundred metres to a few kilometres away.

The remaining larval mosquito development habitats of Central Saanich are roadside ditches and depressions. As a result of ongoing and long-term ditch maintenance programs (grading, vegetation removing, culvert cleaning) larval development in these types of sites is highly variable from season to season and site to site. Sampling and treatment of freshwater development sites (ponds, marshes, ditches) typically begins in early to mid-April and extends through to late August or September depending on conditions.

Although their populations and individual development site sizes are not usually as large as the synchronous hatching *Aedes* sp. mosquitos in salt marsh flood and seepage water habitats,

Culex and *Culiseta* mosquitos make use of a large variety of habitats, including containers such as stored tires and equipment, livestock watering troughs, buckets and bird baths. Such habitats are common throughout urban and rural areas and since they are typically located close to residences, businesses and outdoor recreational areas *Culex* and *Culiseta* mosquitos can be a source of reportable, localized mosquito annoyance. When discovered by field personnel during site inspections the presence of water-holding containers would be brought to the attention of property owners for removal, drainage or regular water changes which would eliminate their potential as sources of mosquito development and annoyance.

3.4 Mosquito Control Options

Mosquito development varies from year to year and throughout the season depending on environmental conditions and habitat availability. Environmental cues interact to affect both the timing and magnitude of mosquito development, and adult mosquito survival. These factors include mountain snowpack accumulations, tidal fluctuations, temperatures, humidity, and precipitation.

Each mosquito development site will have its own unique requirements and treatment options. The PMP for this mosquito control program uses a combination of techniques, and an IPM approach, to achieve the management and control of mosquito populations. The best choice for control reduces both mosquito populations, and the potential for adverse effects on people, domestic animals, livestock and natural ecosystems. Sometimes, particularly with man-made habitats such as ditches, irrigation or display ponds and containers, larval mosquito populations can be reduced, or effectively limited using physical or natural controls. These control options would be considered as a potential solution prior to any larvicide applications.

Many of the possible physical control options suggested below may be implemented by local public works personnel and landowners. Private property owners with mosquito development habitat are best motivated to become involved in their control program through public education initiatives (see Section 3.1 above) and through consultations with program personnel. Once educated about mosquitos and their habitats, property owners can undertake steps to reduce or eliminate larval mosquito habitat and adult mosquito annoyance on their property. A reduction in larval populations contributes to the overall decrease in adult mosquito annoyance.

The preservation or enhancement of balanced wetland habitats has the best opportunity for a meaningful long-term contribution to overall mosquito control program success through reduction of mosquito populations and enhancement of natural controls including insect, fish and birds. Elimination of stagnant water and enhancements in natural or created ecosystems will be of benefit to overall control program efficacy through increasing habitat for natural mosquito predators. The use of a biological control products such as *Bacillus thuringiensis* var.

israelensis (VectoBac 200G) and *Bacillus sphaericus* (VectoLex) maximizes the effectiveness and environmental compatibility of the program.

IPM-focused mosquito control programs do not have deleterious effects on humans, domestic pets and livestock, wildlife, fish and their food and are routinely conducted throughout British Columbia. There are three larval mosquito control options available to the program. These are physical, biological and bio-rational product oriented.

3.4.1 Physical Control

A major emphasis for the control program is decreasing or eliminating larval mosquito development habitats. Although initially very expensive, physical mosquito control through source reduction (filling, ditching, draining, dyking) is a preferred method of control. Once done, it is permanent and usually requires no further attention.



Removal or alteration of mosquito producing habitat does not necessarily mean drainage resulting in habitat destruction for other organisms and natural predators such as birds and fish. As part of a comprehensive approach to mosquito control, property owners are encouraged to manage stagnant and non-flowing waters to minimize their use as sources for mosquito development. For example, the removal of emergent shoreline vegetation, combined with either water level management at greater than one metre in depth or a shoreline groomed to a gradient of 3:1 or steeper, effectively eliminates

mosquito production in irrigation and settling ponds or other water impoundments. The installation of fountains in display ponds found on golf courses and in parks can reduce their suitability and use as larval mosquito development habitat.

Ditching of flooded depressions located in fields may be a suitable solution to larval development by permitting drainage or allowing fish access to temporarily flooded areas. Grading or filling of depressions may reduce an area's potential to retain water. The costs for such physical control measures may, however, be prohibitive or not desirable for reasons other than mosquito control.

Clearing established ditches of obstructions or vegetation, failed culverts or grading to effect flow may increase flow, drainage or access by fish or aquatic insect predators. Where possible, and appropriate, public works crews, residents and business operators are encouraged to remove, or alter standing waters which provide suitable habitat for larval mosquito development. For most property owners this involves eliminating water-holding containers, such as buckets and boats or

canoes and the draining or regular changes of water in bird baths, livestock watering troughs, wading pools and display ponds. When done by the homeowners, this permits residents an opportunity to actively participate in their control program. This can be especially important for residents, as two of the most common West Nile virus vector mosquitos, *Culex tarsalis* and *Culex pipiens*, make ready use of manmade habitats.

Installation and maintenance of window screens, mosquito magnets™ (adult mosquito traps) and the use of mosquito repellents by individuals provides additional protection from potential adult mosquito annoyance and potential disease transmission.



3.4.2 Biological Control

Biological control involves the use of predators, pathogens, and parasites to reduce mosquito populations. Insects predators, both aquatic (ie. dragon flies, beetles) and terrestrial (ie. spiders, wasps), contribute to the natural mortalities of both larval and adult mosquitos. Conserving, or enhancing natural habitats wherever possible, allows these predators to contribute to control program effectiveness.



Of all the various predator control methods tested, only larvivorous fish are used operationally in widespread programs. Regan *et al.* (1982) evaluated the effects of three-spined stickleback fish (*Gasterosteus aculeatus*) on mosquito larvae located in the Fraser Valley. They were found to be effective in reducing larval populations. Their natural fecundity combined with their ubiquitous nature makes these fish an ideal natural (biological) control agent. They are a common occurrence in many of ditch systems.



Introduction of fish (Koi, gold fish) to manmade, self-contained outdoor display or irrigation ponds may also reduce, or eliminate larval mosquito development in such habitats. Most practical in the warm, lower mainland Fraser Valley and Vancouver Island, in areas with very cold winters, this type of control requires considerable work and cost which many include the over-wintering of fish indoors or annual replacement. The relocation, or introduction of fish to any natural water course requires approval and permitting through various governmental agencies including Department of Fisheries and Oceans and the BC Ministry of Environment.

Although flying insects can form a large component of the diet for flying insectivores (eg. bats, swallows, Purple Martins), there is no evidence which suggests they provide a detectable level of mosquito control. Both birds and bats are also opportunistic feeders and adult mosquitos have been identified as a small component (<2%) of their diet, (Fang 2010 and Gonsalves *et.al.*, 2013).



They are not however, scientifically recognized as able to provide any real impact on mosquito populations when used solely as a mosquito population control option. Interested residents would however still encouraged to install bird nesting boxes or bat houses if they wish, since it allows individuals to contribute to a comprehensive, integrated mosquito control program, and in some cases may provide residents with a sense of reduced adult mosquito annoyance.



Pathological agents such as viruses and certain parasites have received much research attention, but none of these are commercially available or approved for use in Canada. The naturally occurring soil bacteria, *Bacillus thuringiensis* var. *israelensis* (Bti) and *Bacillus sphaericus* (Bsph) have highly specific insecticidal properties and are discussed below.

The greatest natural control of mosquitos is an absence of water. Evaporation or drainage eliminates, or reduces, the magnitude of water accumulations or pond size, and therefore larval habitat. Warm temperatures and low humidity similarly causes the desiccation (drying out) and death of adult mosquitos.

3.4.3 Bio-rational Control

The Central Saanich nuisance mosquito control program, through it's PMP, would only use VectoBac 200G and VectoLex CG or WSP for larval mosquito control. VectoBac and VectoLex are the closest form of a natural or biological control agent currently available for routine use in operational mosquito control programs. The use of these products maximizes the environmental compatibility of the annual mosquito control program when used in circumstances where other control options such as physical or natural (biological) control are not practical, they support the principles of an IPM approach to control. The Appendix contains VectoBac and VectoLex product labels and information. Brochures and Material Safety Data Sheets (MSDS) are available at www.valentbiosciences.com.

Property owners would be consulted with prior to any larvicide applications and for any recommended physical or biological/natural methods. Product brochures, labels, MSDS sheets and website addresses are provided and reviewed as required to ensure residents, business, and facility operators understand, are comfortable with, and approve, proposed treatments. In the event that a property owner wishes exclusion from the control program this request would be honoured and noted in the development site database.

VectoBac acts on the larval mosquito stomach and must be eaten to be effective. VectoBac 200G is very specific, producing rapid lethal effects (within hours) in larval mosquitos. It has no residual activity, does not bio-accumulate and has no impact on beneficial organisms found in mosquito development habitats. Negative or toxic effects on mammals, birds or other wildlife have not been observed. Formulated as a corn cob granule it requires no mixing and is ready to apply by hand, backpack blower or by helicopter. The granule allows the larvicide to penetrate vegetative covers and reach the water surface where the *Bti* is “released” for consumption by mosquito larvae.



VectoBac 200G is recommended by the manufacturer for use in standing water habitats including temporary and permanent pools in pastures and forested areas, irrigation or roadside ditches, natural marshes or estuarine areas, waters contiguous to fish-bearing waters, catch basins and sewage lagoons.

Similar to VectoBac 200G, VectoLex CG also contains a naturally occurring, spore-forming soil bacterium. VectoLex CG contains spores and crystals produced by *Bacillus sphaericus*. It also is classed as a bio-rational, rather than conventional, pesticide. Like VectoBac, VectoLex acts on the larval mosquito stomach and must be eaten to be effective. VectoLex is very specific and produces lethal effects in a narrow range of mosquito species, including *Aedes vexans* and most *Culex* and *Culiseta* mosquito species. It has also been found to be an effective control for *Coquilleltidae perturbans*, an aggressive adult pest of humans. Known as the “cattail mosquito”



because of the unique adaption of the larval siphon and pupal “trumpets”, which are serrated, for attachment to young cattails, they can access the air in these hollow plants as a source of oxygen. Because there are not “free swimming” like most other larvae they are not generally collected in larval sampling. Several sites, most notably irrigation ponds, have a significant amount of cattail (*Typha* sp.) along their margins.

The use of VectoLex CG and VectoLex WSP in these types of sites has greatly reduced anecdotal reports of adult mosquito annoyance. Like VectoBac, VectoLex larvicides do not have any effects on man or animals, fish and other insects which may use these aquatic habitats.

Operationally, the important differences between VectoLex and VectoBac are speed of action and persistence in the larval habitat. Larval mortality can take several days for VectoLex versus several hours with VectoBac 200G. This occurs because *B. sphaericus* is more stable, has a

slower settling rate in the water column and the unique ability for its spores to germinate, grow and reproduce in dead mosquito larvae. This is known as recycling and is the mechanism which allows VectoLex to provide long-term, extended control (in excess of 28 days in the Fraser Valley, Lower Mainland) of recurring larval mosquito development. VectoLex CG is recommended by the manufacturer for use in standing water habitats including temporary and permanent pools in pastures and woodlots, irrigation or roadside ditches, natural marshes or estuarine areas, waters contiguous to fish-bearing waters, catch basins and sewage lagoons.

In permanent ponds and stagnant ditches with difficult access because of thick, overgrown, or dense vegetation (i.e. blackberries and *Typha* sp. cattails), the long-acting VectoLex WSP may be used for treatments. These 10gm satchels (2cm X 2cm) can be readily thrown into these sites where the bio-degradable, glucose-based bag quickly dissolves, and the granules disperse across the water surface.



The use of *Bti* and *Bsph* maximizes the environmental compatibility of the annual mosquito control program since both products are species (target) selective and non-toxic to other aquatic organisms which co-exist in these habitats including insects, fish and amphibians. When used in circumstances where other control options such as physical or cultural control are not practical, they support the principles of an IPM approach to mosquito control.

See the Appendix for copies of the manufacturer's product labels for VectoBac 200G and VectoLex CG and WSP, or contact www.valentbiosciences.com for more information.

The Central Saanich nuisance mosquito control program would use the least toxic, most environmentally sound control products available. As new products become available and registered in Canada, their suitability for use in annual control program will be reviewed.

3.4.4 Chemical Control

Chemical control products and equipment are predominantly used for the purposes of reducing adult mosquito populations. As with most adult insect control programs, adult mosquitos are typically controlled using a broad-spectrum (adulticide) insecticide. Although there are 'natural' adult mosquito control products made from chrysanthemum flower extracts (pyrethrins) and their synthetic equivalents, all adulticides only provide temporary control.

Because of the variable dispersion patterns of mosquitos, geography, types of vegetation encountered and ambient weather conditions at the time of treatment, it is difficult to provide anymore than temporary control of localized adult mosquito annoyance. Unless regular and

routine treatment of 'problem areas' is completed, uncontrolled adult mosquitos developing in other areas will often expand into these treated areas to again cause annoyance.

Typically applied from the ground using cold aerosol sprayers or misters, and much less commonly, from the air using helicopters or fixed-wing aircraft their mode of action is on the nervous system following contact with the organism and absorption across through the exoskeleton. Because they are applied to the air, and



the fact they are non-specific, such applications will not only control adult mosquitos which come in contact with the spray mist, but other non-target organisms such as moths, flies, flying beetles and other insects. Restrictions on applications include habitat type, timing of applications, mosquito population thresholds, weather conditions and areas of identified avoidance.



Adulticide applications **ARE NOT** a component of the annual mosquito control program at Central Saanich. The mosquito control program described within this PMP does not utilize any chemical control methods for the abatement (control) of larval or adult mosquitos.

3.5 Mosquito Control Operations

A total of over 80 hectares of potential larval mosquito habitat located at +130 separate development site locations identified within the District of Central Saanich, including CRD parks and the Tsawout First Nation lands. The actual total area that will become infested and require larvicide treatment in each season is dependent on hydrological and meteorological events. Fluctuating water levels in tidal salt marsh habitats and precipitation or seepage-water influenced development sites cause recurrent larval development. Ponds, channels and flooded depressions throughout area salt marshes, old field habitats and similar freshwater sites in low-lying farm fields and wooded sites typically require multiple treatments to effect control. Permanent irrigation or display ponds and ditches become routinely infested with larval development as their depths fluctuate and temperatures increase with water use later in the season.

The well-organized, pro-active, IPM approach to mosquito control for the Central Saanich reduces the potential for adult mosquito annoyance by ensuring the timely identification and control of larval populations occurring in sites which are unable to be drained, filled or effectively modified to reduce their use for larval development. Larvicide applications would be completed at identified larval mosquito development habitats where pest populations exceed identified thresholds for control, and where other options such as site drainage or alteration are impractical,

inappropriate or fiscally prohibitive. New or previously undetected, larval mosquito development sites, once identified, are monitored, treated as required with permission, and added to the site database for future surveillance and control as necessary.

As required by the *BC Integrated Pest Management Act and Regulations*, all larvicide applications would be completed, and/or supervised by, personnel certified by BC Ministry of Environment as pesticide applicators in the category of *Mosquito and Biting Fly Abatement*, or equivalent.

All larvicide treatments would be completed using application rates, equipment and methods recommended by the pesticide manufacturer.

3.5.1 Public, Worker and Environmental Safety During Mosquito Control

To ensure public and worker safety, all conditions and restrictions governing biorational larvicide (VectoBac and VectoLex) applications would be followed. Pesticide applicators will follow the conditions of the approved PMP, with regulations contained in the *Pest Control Products Act*, the *Pesticide Control Act*, the *Transportation of Dangerous Goods Act* and other relevant government regulations. Larvicide handling, storage and application procedures would conform with those detailed on product labels and endorsed in the '*Pesticide Applicators and Dispensers Handbook*' and associated reference materials supplied through the BC Ministry of Environment.

The Central Saanich Mosquito Population and Management and Control Program is not intended to eliminate the mosquito population and as such landowners and residents who want to be excluded from the control are recorded and their wishes respected. Landowner permission to survey, monitor and treat infested larval mosquito habitats located on private property is confirmed each season. Treatment of developing larval mosquito populations in waterbodies on public lands are permitted under this approved PMP.

Program personnel will take all practical precautions to protect application personnel, the environment and the general public during all larvicide applications. Prior to larvicide application field personnel would:

- verify property ownership, treatment site boundaries, public points of access (paths, trails, roadways), pest presence and population size, both pre and post-treatment.
- review, and as required update, the development site database information for the mosquito control program. The database contains information on property ownership, address, contact telephone number, development site maps, photographs and records of past monitoring and treatment results. The database is continually being updated and contains information on all known mosquito development habitats, including those located on public and private lands.

- confirm the boundaries and/or locations of 'AVOID' areas, including surface (drinking) water intakes or wells, and identify these with flagging tape, ribbons or suitable equivalent, if required.
- identify fish-bearing waters or areas of environmental sensitivity (ie. bird nesting sites) and the need for avoidance of these areas, particularly for ground nesting birds,
- when necessary, community watersheds status will be determined by accessing the BC Ministry of Environment Community Watershed listings and informational website:

www.gov.bc.ca/wsd/data_searches/comm_watersheds/index.html.

- Similarly, a listing of registered groundwater Wells and Aquifers and an interactive map is available at:

www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers

- review larvicide product label and recommended precautions for handling and application, safety gear, weather restrictions (wind, temperatures, etc) and other listed precautions.
- inform the general public of ongoing applications through public notices, news media articles, advertisements and ongoing, routine personal contact.

3.5.2 Larval Mosquito Control, Treatment Thresholds and Application Rates

VectoBac and VectoLex are only applied when larval mosquitos are present.

Larval mosquito surveillance and control protocols would focus efforts on the timely identification and treatment of larval mosquito populations with surveillance and control efforts targeting 1st through 3rd instar larvae. Given that the most extensive larval development locally involves synchronous hatching *Aedes* mosquitos in recurring salt marsh habitats, this strategy ensures maximum control.

In addition to treating the most actively growing and feeding instars, it also, allows for retreatment (touch-up) of sites, or portions of sites, that may have not have been treated ascompletely, as desired, because of conditions on the day, changing water levels or because of subsequent hatching. Also, application rates can be lower, and therefore material costs, and overall mosquito larvicide use rates in the environment are reduced. Even though the products products, Vectobac 200G (*Bti*) and VectoLex (*Bsph*), proposed for use in the program have the safest environmental profiles of any bio-rational larvicides in common use, decreasing any volume of control product is beneficial and maximizes environmental compatibility.

Treatments targeting all mosquito populations with later 3rd or 4th instars under the guise of allowing natural predators to impact some level of control is not encouraged. It is not recommended on *Bti* or *Bsph* product labels, or by the *Municipal Mosquito Control Guidelines* (Ellis, 2005). Controlling mosquito larvae at their source, with a focus on 1st through 3rd instar larvae still contributes to the “food web”. Predators will feed on live larvae, and dead larvae become food for many other organisms, including insect detritivores, fungi and bacteria which in turn become food for other aquatic insect and vertebrate predators and grazers. While there may be predation of some mosquito species occurring in permanent ponds, such as *Culex* or *Culiseta*, the two most common genera in these types of sites, this strategy is wholly impractical for *Aedes* mosquitos.

Aedes hatch in large numbers, typically +100/dip, and inhabit temporary pools created by snowmelt, precipitation, river flood and seepage waters or salt marsh which may only last several days or weeks. These types of temporary habitats seldom have established natural predators and where they may occur they are typically inadequate to deal with larval populations of such extreme magnitude. A pond the size of a back yard swimming pool (50m²), with a larval population of just 1 larvae/350ml dip sample, can produce over 24,000 larvae. A one hectare site, about the size of 2 football fields, with a larval population density of 1 larvae/dip sample can produce 4,285,714 mosquitos.

Delaying treatments to target populations with later 3rd or 4th instars is also not ideal. The potential for reduced feeding rates of later instar larvae may provide incomplete control, reduced efficacy and may result in a number of other undesirable outcomes;

- 1) that larvae develop into the untreatable pupal stage, and then onto nuisance causing adults;
- 2) that field staff may not return at an appropriate time to treat them before this occurs. Changing weather conditions and temperatures over a few days can dramatically accelerate larval development rates; and lastly
- 3) product manufacturers recommend that later instar larvae are treated with higher application rates, upwards of 10kg/ha (1 gm/M), thereby requiring more larvicide, increased field personnel surveillance and treatment time and reduced environmental compatibility.

VectoBac 200G larvicide is only applied when larval mosquitos are present. Typically upwards of 5 - 10 dip samples per development site, depending on site size, are completed. Larval mosquito dip samples averaging from 1-3 larvae/350ml dip sample in sites containing predominantly 2nd and 3rd instar larvae would be the minimum treatment threshold for mosquito larvae found in many temporary, and most permanent sites which typically contain a high proportion of *Culex* and *Culiseta* mosquito larvae. A treatment threshold of five, 1st instar larvae/350ml dip sample is utilized when monitoring synchronous, extensive *Aedes sp.* larval development common to early-

season snowmelt, seepage water and similar temporary habitats. The threshold for 2nd and 3rd instar *Aedes* larvae would be 1-3 or more larvae/dip sample.

VectoLex larvicides which are largely ineffective against *Aedes* mosquitos would only be utilized to control developing larvae in those permanent and temporary sites having *Culex*, *Culiseta* and *Coquilleltidae perturbans* larvae. Larval populations averaging 1-3 larvae/350ml dip sample will be the threshold for treatment using VectoLex larvicides.

These thresholds are based on the “industry standard” used by operational mosquito control programs in the Northwest Mosquito and Vector Control Association (NWMVCA) and American Mosquito Control Association (AMCA).

Larval dip sampling, light trap collections and where appropriate, adult mosquito emergence traps, would be employed to evaluate post-application larval control results. Larval mortalities of at least 95% would be considered successful. If required, and where indicated by post application sampling, additional, or expanded treatments of nearby areas would be completed to achieve desired efficacy.

All ground-based larvicide applications to small and accessible sites are completed, where required, by hand broadcast or backpack spreader during the mosquito control season. Fluctuating water levels in many of these sites cause repeated larval development requiring repeated treatment.

All Vectobac 200G and Vectolex CG application rates would be within those recommended by the manufacturer. These rates range from 2.5 to 10.0 kilograms per hectare with applications completed under this PMP to be conducted at rates ranging from 4.0 to 8.5 kilograms per hectare. VectoBac and VectoLex application rates typically average 7.5 kg/ha which has been demonstrated over some 30 years on annual operation as effective under the conditions encountered at Central Saanich. All applications are followed with post-application monitoring to confirm the effectiveness of treatments.

Applications of VectoBac 200G and VectoLex CG to within 10 metres of fish-bearing waters, or waters contiguous to fish-bearing waters, and potable waters or wells is anticipated and waters contiguous with fish bearing water may be treated, as permitted on the Health Canada, Pesticide Regulatory Management Agency (PRMA) approved product labels.

3.5.3 Post Application Monitoring

Within 02-96 hours after (post) treatment with VectoBac 200G, larval mortalities would be confirmed through monitoring using a standard 350 ml mosquito dipper. The goal is for larval population reductions of 95%, or to levels averaging less than 1 larvae/350ml dip sample with

sampling results mostly measured at zero larvae/350ml dip sample, and averaging much less than 1 larvae/350ml dip sample. Post-application monitoring confirms treatment success and allows for the 'touch-up' treatment of any areas which may have, for reasons of geography, vegetative cover or access, received inadequate application. Because larval mortality from VectoLex can take several days to occur, and can continue to occur for several weeks, treated larval habitats would be monitored on a regular basis with re-treatment completed as required.

Adult mosquito populations would be monitored in areas adjacent to larval development sites to confirm the effectiveness of larval controls in reducing adult mosquito annoyance. In addition, adult mosquito populations would be monitored at select locations to compare adult mosquito populations between various location and community centres. Given the difference in individual tolerances to mosquito annoyance the success of larval control in limiting adult mosquito populations would be determined through resident reports, interviews and requests for service.

The goal of the annual Central Saanich Mosquito Population Management and Control Program is to decrease larval mosquito populations sufficiently to reduce, and/or prevent, adult mosquito annoyance for residents, workers and visitors. Property owners, residents and businesses are also expected to implement personal protective measures to limit their exposure to adult mosquito annoyance. These include repellent use, clothing choices (long sleeves, light coloured), avoidance of perfumed personal hygiene products (shampoos), window screens and temporal (minimize activity at dusk and dawn) or location avoidance which can lessen adult mosquito annoyance.

4.0 QUALIFICATIONS OF PROGRAM PERSONNEL

The contractor/consultant supplying mosquito control services to the District of Central Saanich, Capital Regional District (Parks) and the Tsawout First Nation will have all necessary Pesticide Vendor and/or Pest Control Service Licences. As required, all personnel working in the annual mosquito control program will be certified as pesticide vendors in the category of "*Commercial Pesticides*" and/or as pesticide applicators in the category of '*Mosquito and Biting Fly Abatement*' or equivalent, as accepted by the BC Ministry of Environment.

Consultant mosquito control program management personnel would be Registered Professional Biologists. Field personnel would include University and College graduates or senior Co-Operative Education students studying within the disciplines of biology and environmental science or equivalent practical experience with mosquito population management practices and training.

5.0 LARVICIDE HANDLING AND APPLICATION

As required by the BC Integrated Pest Management Act, all personnel handling and applying larvicides for the mosquito control program must be certified by BC Ministry of Environment as pesticide applicators in the category of *Mosquito and Biting Fly Abatement*, or equivalent.

Pesticide applicators will comply with regulations contained within the *Pest Control Products Act*, the *Integrated Pest Management Act*, the *Transportation of Dangerous Goods Act* and other relevant government regulations. Larvicide handling, storage and application procedures would conform with those detailed on product labels and endorsed in the '*Canadian Pesticide Education Program Applicator Core Manual*', the '*Pesticide Applicators and Dispensers Handbook*' and associated reference materials supplied through the BC Ministry of Environment. This PMP does not attempt to duplicate all the information contained within this handbook and other references. The 'Acts', the Handbook, product labels, manufacturers' websites and any other resource materials detailed above, and this PMP would be reviewed before handling, transporting, storing or applying pesticides.

5.1 Larvicide Transportation

During transportation, all pesticides would be secured to prevent an accidental spillage or theft. Granular VectoBac 200G and VectoLex CG larvicide products would be secured and handled to prevent tearing of bags, spillage and exposure to adverse weather conditions such as precipitation.

Mosquito Control program personnel will carry within their vehicles a suitable spill clean-up kit, basic first aid kit and appropriate personal safety gear and supplies.

Applicators would only transport the minimum amounts of pesticide required to complete the proposed treatments. It is common for field personnel to require less than forty kilograms of Vectobac 200G or VectoLex CG for a typical workday.

5.2 Larvicide Storage

The District of Central Saanich would provide secure, dry, well ventilated pesticide storage space for mosquito control larvicide (VectoBac 200G, VectoLex CG) within their secure public works facility. No large volumes of larvicide are stored on-site over the winter. In an average year, less than 200 kg of larvicide is stored on-site to be available for program start-up in early February.

Emergency telephone numbers for police, fire, ambulance, Canutec, Dangerous Goods Emergency Spills, Poison Control, and the BC Ministry of Environment are posted on-site at the storage facility and available at Public Works offices

5.3 Larvicide Mixing, Loading and Application

Applicators will follow the directions and precautions warranted by pesticide use as described above and in relevant references. All avoidance areas, pesticide free zones and pesticide buffer zones would be established and appropriately identified prior to pesticide application. All larvicide applications would be completed from the ground by hand broadcast or backpack applicator.

No mixing is required. VectoBac and VectoLex granular larvicides are 'ready to apply'. They are supplied in thick, plastic plastic bags. All used and empty bags would be disposed of in municipal or regional landfills as directed by the manufacturer on the Pesticide Management Regulatory Agency-approved pesticide label and MSDS sheets. All handling of pesticides for application would be conducted in level, well ventilated, outside areas. Field personnel would wear suitable safety gear, including the appropriate respirator, ear protection, rubber gloves, boots and other protective equipment as indicated by pesticide labels, MSDS sheets and the manufacturer.

Property owners would be consulted with prior to any larvicide applications and for any recommended physical or biological/natural methods. Product brochures, labels, MSDS sheets and website addresses would be supplied and reviewed to ensure residents, business, and facility operators understand, are comfortable with, and approve, proposed treatments. In the event that a property owner wishes exclusion from the control program this request would be honoured and noted in the development site database.

Weather forecasts would be consulted, and current weather conditions (wind speed, temperature, precipitation) would be noted, and recorded, during all larvicide applications. Treatments would be suspended in the event that wind speeds during larvicide applications are sufficient to cause the displacement, or drift, of granular larvicides outside of the treatment area. Similarly, should precipitation be sufficient to cause larvicide (corn cob) granules to clump and clog backpack blowers, or similarly affect hand broadcast applications, treatments would be suspended until suitable conditions return.

In the event of accidental spillage, personnel would follow accepted spill containment and clean-up procedures. With VectoBac and VectoLex granules this typically involves recovery with brooms and dustpans or shovels. This 'recovered' larvicide would be used for the treatment of intended habitats.

5.4 Equipment Maintenance and Calibration

Ground-based applications of VectoBac 200G and VectoLex CG are completed by hand broadcast or motorized back-pack type (leaf blower) applicator.

Applicators would adjust their walking speed, and throttle speed if using backpack blowers, to ensure they are achieving the correct application rate/density of granules per square foot of water surface. For an application rate of 7.5 kg/ha and granules which are 5/8 mesh in size, this is 4-5 granules per square foot.

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FIGURES

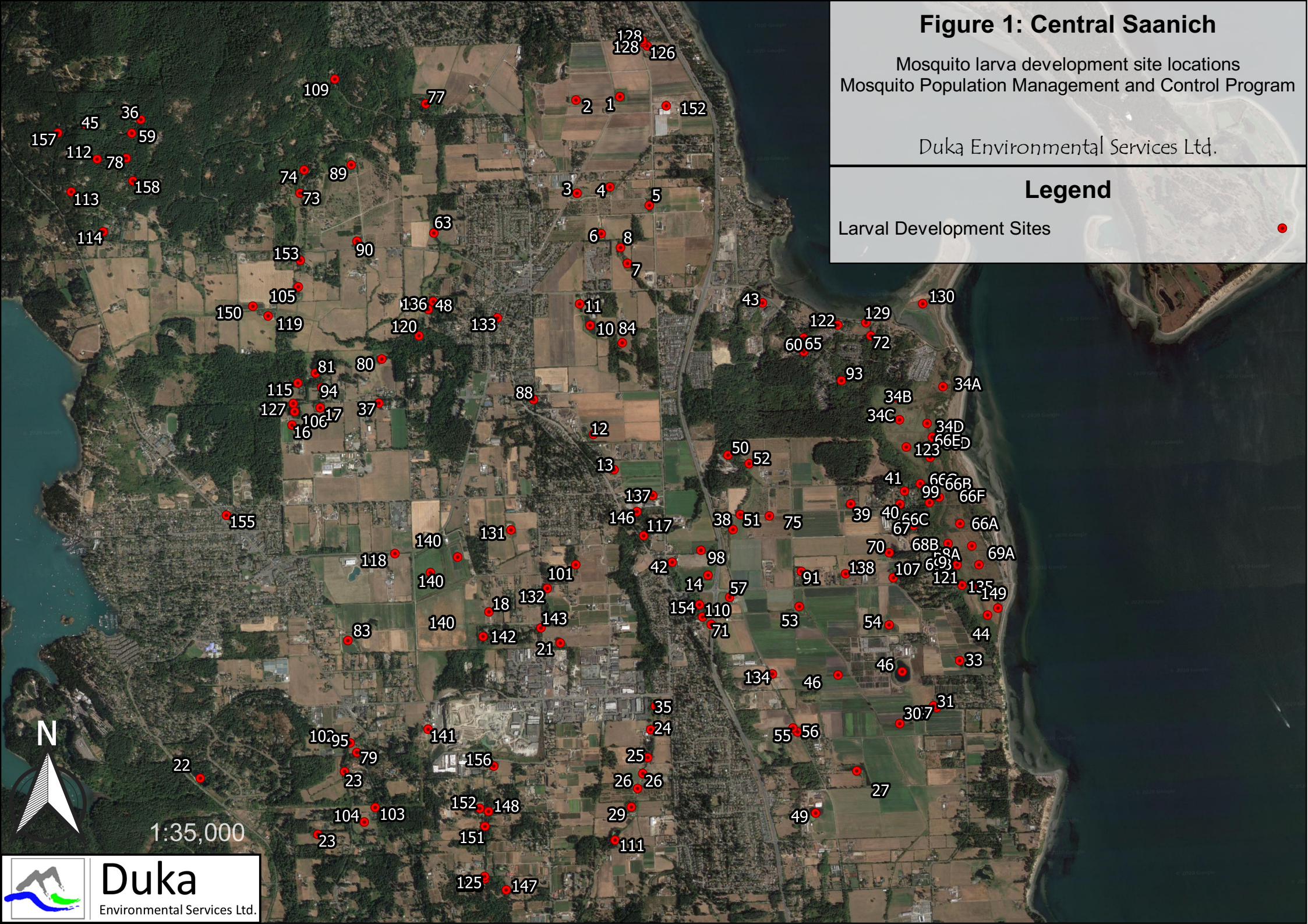
Figure 1: Central Saanich

Mosquito larva development site locations
Mosquito Population Management and Control Program

Duka Environmental Services Ltd.

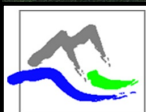
Legend

Larval Development Sites



N

1:35,000



Duka

Environmental Services Ltd.

APPENDIX

VectoBac and VectoLex (Larvicide) Product Information Package.

VectoBac[®] 200G

BIOLOGICAL LARVICIDE

GRANULE

GROUP

11

INSECTICIDE

RESTRICTED

GUARANTEE:

Bacillus thuringiensis subsp. *israelensis*,
Serotype H-14, strain AM 65-52, 200 International
Toxic Units (ITU) per milligram (0.2 billion ITU/KG)

REGISTRATION NO. 18158

PEST CONTROL PRODUCTS ACT

List No. 60214-13

INDEX:

- 1.0 Precautions
- 2.0 First Aid
- 3.0 Toxicological Information
- 4.0 Storage
- 5.0 Disposal
- 6.0 Notice to User
- 7.0 Directions for Use

READ THE LABEL BEFORE USING
KEEP OUT OF REACH OF
UNAUTHORIZED PERSONNEL
POTENTIAL SENSITIZER
CAUTION EYE IRRITANT

1.0 PRECAUTIONS

KEEP OUT OF REACH OF UNAUTHORIZED PERSONNEL
MAY CAUSE SENSITIZATION
CAUTION EYE IRRITANT

DO NOT apply directly to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

Avoid contact with skin, eyes, and clothing. Avoid breathing dust/spray mist. Wear a long sleeved shirt, long pants, waterproof gloves, shoes and socks, eye goggles and NIOSH-approved respirator with any N-95, R-95, or P-95 filter for biological products when handling, mixing/loading or applying the product and during all clean-up/repair activities. Applicators may remove gloves, eye goggles and respirators if the design and delivery of the application apparatus reduces exposure to a negligible level (e.g. backpack sprayer with application wands that apply product directly over water surface). Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

2.0

FIRST AID

If on skin or clothing	Rinse skin immediately with plenty of water. Remove contaminated clothing and wash separately before reuse. If irritation occurs and persists or is severe, seek medical attention.
If in eyes	Hold eye open and rinse slowly and gently with water. Remove contact lenses, if present, then continue rinsing eye. If irritation occurs and persists or is severe, seek medical attention.
If inhaled	Move person to fresh air, apply respiration if needed and seek medical attention.
If swallowed	Rinse mouth and throat with copious amounts of water. DO NOT induce vomiting. Promptly contact a physician or poison control centre. DO NOT give anything by mouth to an unconscious person.
General	Seek medical attention if irritation or signs of toxicity occur and persist or is severe. Take container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

3.0 TOXICOLOGICAL INFORMATION

Treat symptomatically.

4.0 STORAGE

In order to ensure microbial purity and potency, VectoBac 200G should be stored in the original container at 0 - 25°C and used within 24 months of the date of manufacture.

5.0 DISPOSAL

Triple- or pressure-rinse the empty container. Add the rinsings to the spray mixture in the tank. Follow provincial instruction for any required additional cleaning of the container prior to its disposal. Make the empty container unsuitable for further use. Dispose of the container in accordance with provincial requirements. For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.

6.0 NOTICE TO USER

This pest control product is to be used only in accordance with the directions on the label. It is an offence under the *Pest Control Products Act* to use this product in a way that is inconsistent with the directions on the label. The user assumes the risk to persons or property that arises from any such use of this product.

NATURE OF RESTRICTION: This product is to be used only in the manner authorized; consult local pesticide regulatory authorities about use permits which may be required.

DIRECTIONS FOR USE**MOSQUITOES****Suggested Range Rate****Habitat: Standing water**3 – 10kg/ha*
(0.3 – 1.0 g/m²)

Temporary and permanent pools in pastures and woodlots, irrigation or roadside ditches, natural marshes or estuarine areas, water contiguous to fish-bearing water, catch basins and sewage lagoons.

*Use higher rates in deep and/or polluted water, and when late 3rd and 4th instar larvae predominate.

Apply recommended rate by conventional aerial or ground equipment. Uniform coverage is necessary for best results. For aerial application, apply in uniform non-overlapping swaths when conditions do not favour drift or when wind speeds are less than 10 km/h.

A 3 to 14 day interval between applications should be employed. Monitoring will indicate the appropriate retreatment interval. VectoBac 200G Biological Larvicide does not affect non-target, aquatic, invertebrate predators and parasites which are non-filter feeders. Therefore, longer periods of suppression may result since these beneficials would be conserved to aid in mosquito population management.

AERIAL APPLICATION INSTRUCTIONS

Apply only by fixed-wing or rotary aircraft equipment that has been functionally and operationally calibrated for the atmospheric conditions of the area and the application rates and conditions of this label.

Label rates, conditions and precautions are product-specific. Apply only at the rate recommended for aerial application on this label. Where no rate for aerial application appears for the specific use, this product cannot be applied by any type of aerial equipment.

Ensure uniform application by using appropriate marking devices and/or electronic guidance equipment.

Use Precautions

Apply only when meteorological conditions at the treatment site allow for complete and even coverage.

Apply only when meteorological conditions are in compliance with local and/or provincial authorities.

Operator Precautions

DO NOT allow the pilot to mix product to be loaded onto the aircraft. However, loading of premixed product with a closed system is permitted. It is desirable that the pilot has communication capabilities at each treatment site at the time of application. The field crew and the mixer/loaders must wear the personal protective equipment described in the PRECAUTIONS section of this label. When handlers/loaders use closed systems to load product onto the aircraft, the handler requirement for eye goggles and a NIOSH-approved respirator/mask with any N-95, R-95, or P-95 filter for biological products may be waived. When reduced personal protective equipment is worn, the respirator/mask and eye goggles must be immediately available for use in an emergency such as a spill or equipment breakdown. All personnel on the job site must wash hands and face thoroughly before eating and drinking. Protective clothing must be washed before reuse. Decontaminate aircraft cockpit and vehicle cabs if contamination occurs.

Product Precautions

Read and understand the entire label before opening this product. If you have questions, call the manufacturer at 1-800-323-9597 or obtain technical advice from the distributor or from your provincial agricultural or forestry representative. Application of this specific product must meet and/or conform to the aerial uses and rates on this label.

RESISTANCE MANAGEMENT RECOMMENDATIONS

For resistance management, please note that VectoBac 200G Biological Larvicide contains a Group 11 insecticide. Any insect population may contain individuals naturally resistant to VectoBac 200G Biological Larvicide and other Group 11 insecticides. The resistant individuals may dominate the insect population if this group of insecticides are used repeatedly in the same site. Other resistance mechanisms that are not linked to site of action but are specific for individual chemicals, such as enhanced metabolism, may also exist. The following appropriate resistance management strategies should be followed to delay insecticide resistance:

- Where possible, rotate the use of VectoBac 200G Biological Larvicide or other Group 11 insecticides with different groups that control the same pests in a site.
- Insecticide use should be based on an Integrated Pest Management program that includes scouting, record keeping, and considers cultural, biological and other chemical control practices.
- Monitor treated pest populations for resistance development.
- Contact your local extension specialist or certified crop advisors for any additional pesticide resistance management and/or integrated pest management recommendations for the specific site and pest problems in your area.
- For further information or to report suspected resistance, contact Valent BioSciences Corporation at 1-800-323-9597.

VectoBac is a registered trademark of Valent BioSciences Corporation, U.S.A.

Registrant:



870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 U.S.A.
1-800-323-9597

Canadian Agent:
Valent Canada, Inc.
6-130 Research Lane
Guelph, Ontario N1G 5G3 CANADA

Biological Larvicide

VectoLex[®] CG

RESTRICTED

GUARANTEE:

Bacillus sphaericus Strain 2362, 50 BslTU/mg

REGISTRATION NO. 28008

PEST CONTROL PRODUCTS ACT

List No. 05722.13

INDEX:

- 1.0 Notice to User
- 2.0 Nature of Restriction
- 3.0 Limitations
- 4.0 Restricted Uses: Directions for Use
- 5.0 Mosquito Larval Control
- 6.0 Resistance Management Recommendations
- 7.0 Precautions
- 8.0 First Aid
- 9.0 Storage
- 10.0 Disposal
- 11.0 Notice to Buyer

READ THE LABEL BEFORE USING
KEEP OUT OF REACH OF
UNAUTHORIZED PERSONNEL
POTENTIAL SENSITIZER
CAUTION EYE IRRITANT

1.0 NOTICE TO USER

This control product is to be used only in accordance with the directions on this label. It is an offence under the *Pest Control Products Act* to use a control product under unsafe conditions.

2.0 NATURE OF RESTRICTION

This product is to be used only in the manner authorized; consult provincial pesticide regulatory authorities regarding appropriate use permits that may be required.

3.0 LIMITATIONS

DO NOT apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

4.0 RESTRICTED USES: DIRECTIONS FOR USE

VectoLex CG is a mosquito larvicide to be applied, without mixing or dilution, by conventional ground or aerial application equipment. Apply to mosquito breeding sites when sampling indicates that mosquito larvae are present. For best results, apply when young larval stages are present. Reapply at a minimum interval of one week as needed, if monitoring indicates that further applications are required. Do not reapply within one week of application.

5.0

MOSQUITO LARVAL CONTROL

VectoLex CG is a mosquito larvicide. It is not effective against mosquito adults and pupae. Apply to mosquito larval breeding sites when sampling indicates that mosquito larvae are present. For best results, apply when young larval stages are present.

For use in:	Mosquito species controlled	Application rate and interval	Application methods
Water bodies: freshwater marshes, salt marshes, flood plains, flooded fields and pastures, wetlands, ponds, storm water detention/retention and seepage ponds, wastewater sewage effluent, sewage lagoons, oxidation ponds, log ponds,	<i>Culex</i> spp. <i>Culiseta</i> spp. <i>Aedes vexans</i> (Other <i>Aedes</i> spp. and <i>Ochlerotatus</i> spp. have variable degrees of susceptibility to VectoLex CG)	5.6-16.8 kg product/ha (0.56-1.68 g product/m ²) of water surface area. Use the higher rate in water polluted with sewage, water with high organic content and water with a high level of suspended solids. Do not reapply within one week of application. Reapply at a minimum interval of one week as needed, if monitoring indicates that further applications are required.	Apply by ground or aerial application equipment capable of uniform delivery of VectoLex CG over the water surface.

Aerial Application Instructions:

Apply only by fixed-wing or rotary aircraft equipment which has been functionally and operationally calibrated for the atmospheric conditions of the area and the application rates and conditions of this label. Label rates, conditions and precautions are product specific. Apply only at the rate recommended for aerial application on this label. Where no rate for aerial application appears for the specific use, this product cannot be applied by any type of aerial equipment. Ensure uniform application by employing appropriate marking devices and/or electronic tracking equipment.

Use Precautions:

Apply only when meteorological conditions at the treatment site allow for complete and even coverage. DO NOT apply when wind speed is greater than 16 km/h at flying height at the site of application. Apply only under conditions of good practice specific to aerial application as outlined in the *Basic Knowledge Requirements for Pesticide Education in Canada: Applicator Core and Aerial Module*, available from the Federal/Provincial/Territorial Committee on Pest Management.

Operator Precautions:

Do not allow the pilot to mix product to be loaded onto the aircraft. Loading of premixed product with a closed system is permitted. It is desirable that the pilot has communication capabilities at each treatment site at the time of application.

The field crew and the mixer/loaders must wear the personal protective equipment described in the PRECAUTIONS section of this label. All personnel on the job site must wash hands and face thoroughly before eating and drinking. Protective clothing, aircraft cockpit and vehicle cabs must be decontaminated regularly.

Product Specific Precautions:

Read and understand the entire label before opening this product. If you have questions, call the manufacturer at 1-800-323-9597 or obtain technical advice from the distributor or from your provincial agricultural or forestry representative. Application of this specific product must meet and/or conform to the aerial uses and rates on this label.

Rinse and flush spray equipment thoroughly following each use.

For use in:	Mosquito species controlled	Application rate and interval	Application methods
impounded waste water, septic ditches, drainage ditches including open storm sewers and irrigation ditches			
Waste tires	<i>Culex</i> spp. <i>Culiseta</i> spp. <i>Aedes triseriatus</i>	0.56-1.68 g product/m ² of water surface area. Use the higher rate in water with high organic content and water with a high level of suspended solids. Do not reapply within one week of application. Reapply at a minimum interval of one week as needed, if monitoring indicates that further applications are required.	Apply by hand or ground application equipment to individual tires which contain standing water. Use with other mosquito management techniques such as shredding waste tires, removing standing water and covering the stacked tires.

6.0 RESISTANCE MANAGEMENT RECOMMENDATIONS

Mosquito populations may contain individuals naturally resistant to VectoLex CG. The resistant individuals may dominate the mosquito population if VectoLex CG is used repeatedly as the sole means of control in the same geographic location/use area.

To delay/avoid the resistance of mosquito populations to VectoLex CG it is recommended that users:

- Rotate the use of VectoLex CG with other mosquito larvicides currently registered in Canada, which do not contain *Bacillus sphaericus* as the active ingredient, providing they are registered for use in control of the same pests in the same sites.
- Treat a portion of the target area with a *Bti* formulation or an alternative insecticide ensuring the continual existence of populations of mosquitoes not exposed to VectoLex CG within a given geographic location.
- Insecticide use in mosquito control should be based on an IPM program that includes scouting, record keeping, and considers cultural/habitat, biological and chemical control practices suitable for the area to be treated.
- Monitor treated pest populations for resistance development.
- For further information or to report suspected resistance contact Valent BioSciences Corporation at 1-800-323-9597 or at www.valentbiosciences.com.

7.0 PRECAUTIONS

KEEP OUT OF REACH OF UNAUTHORIZED PERSONNEL.

May cause sensitization. May irritate eyes. Avoid contact with skin, eyes or clothing. Mixer/loaders and applicators

not in enclosed cabs or aircraft must wear a long-sleeved shirt, long pants, shoes plus socks, eye goggles, waterproof gloves and a dust/mist filtering respirator (MSH/NIOSH approval number prefix TC-21C) or a NIOSH approved respirator with any N-95, R-95, P-95 or HE filter for biological products when handling, mixing/loading or applying the product and during all cleanup/repair activities. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

8.0 FIRST AID

IF SWALLOWED: Rinse mouth and throat with plenty of water.

IF ON SKIN/CLOTHING: Take off contaminated clothing. Wash exposed skin with plenty of soap and water.

IF INHALED: Move to fresh air.

IF IN EYES: Hold eye open and rinse slowly and gently with water. Remove contact lenses, if present, then continue rinsing eye.

GENERAL: IMMEDIATELY seek medical attention if irritation or signs of toxicity occur and persist or are severe.

Take container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

9.0 STORAGE

Store at temperatures between 0°C and 25°C. Store container upright and keep tightly closed when not in use. Material must be used within 12 months of the Date of Manufacture.

10.0 DISPOSAL

1. Completely empty the bag into the application equipment.
2. Follow provincial instruction for any required additional cleaning of the container prior to its disposal.
3. Make the empty bag unsuitable for further use.
4. Dispose of the bag in accordance with provincial requirements.

For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

11.0 NOTICE TO BUYER

Seller's guarantee shall be limited to the terms set out on the label and, subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

VectoLex is a registered trademark of Valent BioSciences Corporation.

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