Regional District of North Okanagan
Mosquito Surveillance and Control Program

Integrated Pest Management Plan
2024 – 2029

PMP # 141-Mosq-24/29

Executive Summary

Common Blue Damsel fly (*Enallagma cyathigerum*) resting

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1.0 PEST MANAGEMENT PLAN SUMMARY

The Regional District of North Okanagan (RDNO) contains an abundance of natural features and resources which enhance the outdoor enjoyment of residents and visitors to the area. Lakes, rivers, forested and undeveloped areas make the Regional District a major stopping point for tourists travelling through to other parts of BC and is the base of operations for cattle ranches, farming, orchards, forestry, utilities, transportation and tourism related industries. Expanding residential and commercial businesses, hospitality, recreational and agricultural activities which are all impacted by adult mosquito annoyance. The goal of the mosquito surveillance and control program is to provide residents, workers and visitors to the RDNO with the prevention of widespread, extreme, or persistent adult mosquito nuisance and reduction of potential disease vectors.

This 12 page document is an informational summary of the more extensive, and detailed (~40 page), Pest Management Plan (PMP) prepared to guide the annual mosquito surveillance and control program. A copy of the complete PMP is available upon request.

The mosquito control program proposed for select communities and areas of the RDNO Electoral Areas D and F are intended to benefit residents, businesses and visitors by using a comprehensive and sustainable, Integrated Pest Management (IPM) approach to control. This approach focuses on the timely detection and treatment of larval mosquito populations using biological products and methodologies.

This 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) Adaptive management of operations during a season in response to observations; and,
5) Review of results, program evaluation and assessment to ensure sustainable, effective controls have been achieved.

The PMP outlines the procedures and methodologies which will reduce local mosquito populations and habitat for the purpose of preventing mosquito annoyance for area residents and visitors.

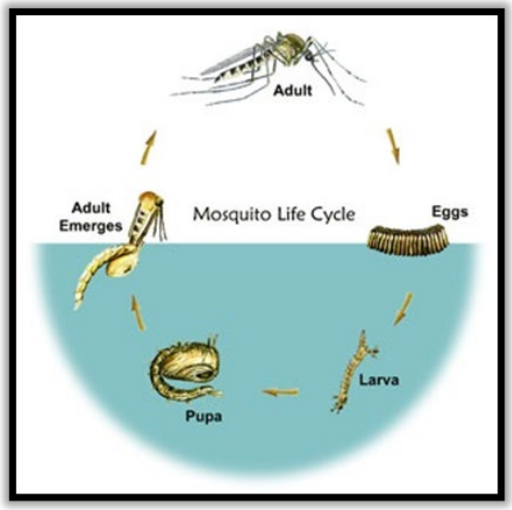
1.1 Mosquito Biology

Mosquitos are found world-wide in standing water of all possible descriptions. They belong to the order Diptera, along with other pests such as the common house fly and black fly. There are four predominant genera of mosquitos common to British Columbia. These are *Aedes*, *Culex*, *Culiseta* and *Anopheles*. They have differences in life cycles, habitat preferences and the time of the year when they predominate as larvae and adults. There are over sixty species common to Canada and over thirty are found in British Columbia.

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. Specific details on the response guidelines, surveillance, permitting, and other related information is available online through www.BCCDC.org

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*, are laid on the soil and can survive for upwards of 20 years and hatch upon being wetted.

Mosquito development occurs in a wide range of larval habitats ranging from snowmelt and precipitation-influenced flood and seepage water pools and channels along rivers and lakes 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 and any man-made container capable of holding water for a period of 7 to 21 days can provide suitable larval mosquito habitat.



Once hatched, mosquito larvae go through 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 blood meal to complete the development of her eggs.

The control of mosquitos for the purposes of preventing WNv infection or transmission in people is not the purpose of mosquito control operations described in the PMP. The goal of the annual mosquito control program is to provide residents and visitors to the RDNO 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 nuisance mosquito control program which focusses on the identification and prevention, or timely control of larval mosquito populations, also contributes to the protection of public health.

The Pest Management Plan is 'owned' by the Regional District of North Okanagan and would remain in place for the purposes of mosquito control for the five-year period, 01 April 2024 to 31 March 2029. A professional, experienced, environmental consulting firm is retained by the RDNO to coordinate, and supply these specialized services, and is responsible for program adherence to the Pest Management Plan. The consultants for the RDNO annual mosquito surveillance and 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 with the BC Ministry of Environment, Integrated Pest Management Program.

1.2 Need for Conducting Mosquito Control

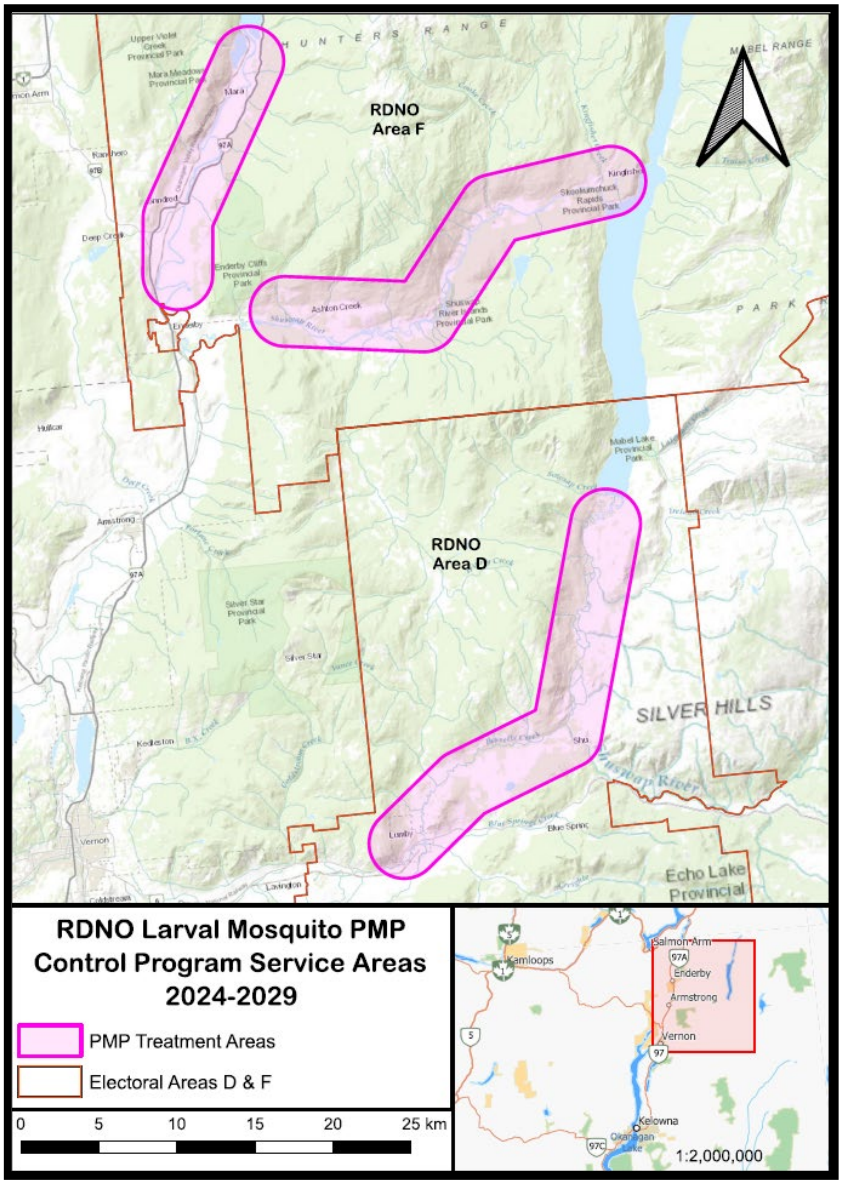
The purpose of an annual mosquito control program is provide residents, workers and visitors to the several RDNO communities, and immediate area, with relief from extreme and / or persistent adult mosquito annoyance. The control program is not intended to, nor is it possible, to eradicate local mosquito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

In addition to negative impacts on the lifestyle and general health of residents, a large population of mosquitos can have a negative economic impact on local businesses. Milk, beef, and egg production in farming or ranching 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. Worker safety, comfort and efficiency can be compromised by adult mosquito annoyance and distraction. 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 disease transmission, and widespread adult mosquito annoyance. Uncontrolled larval mosquito development in the flood and seepage water areas adjacent Mara Lake, Mabel Lake and the Shuswap River through the RDNO can produce sufficient numbers of adult mosquitos and nuisance for residents. Typically occurring during the summer months of June through August, depending on local weather and conditions, adult mosquito annoyance limits the enjoyment of outdoor activities. While the absence of adult mosquitos may go unnoticed, adult mosquito annoyance does not, and return visits to a particular area are governed accordingly. Extreme adult mosquito annoyance has resulted in the cancellation of golf and baseball tournaments, and high vacancy rates at local campgrounds and motels.

2.0 MOSQUITO CONTROL PROGRAM BOUNDARIES

The geographical area covered under the PMP is centred on five communities and adjacent agricultural and undeveloped lands from, Grindrod to Mara Lake, Kingfisher (Mabel Lake) to Ashton Creek and Lumby to south Mabel Lake. This includes both public and private properties and low-lying, flood and seepage water-influenced habitats and impoundments in farm fields, ranch lands, First Nations lands, undeveloped forest, and at commercial and industrial properties, with permission, of the applicable owner, agency or authority.



2.1 Mosquito Species Identified within the area

The majority of mosquito control programs operated within BC are conducted for communities located along river floodplains and in northern BC and Yukon for areas surrounded by extensive muskeg swamps or perma-frost. Locally, mosquito development occurs in a wide range of larval habitats ranging from snowmelt and precipitation-influenced sites, river flood plains and seepage sites to permanent ponds, marshes, man-made ditches and ponds. Bird baths, rain gutters, livestock watering troughs. tire ruts and any other container or depression capable of holding water for a period of 7–21 days can provide suitable larval mosquito habitat. Left undetected, larval mosquitos will complete their development to the adult stage within this time span.

Over thirty species of mosquitos, representing all of BC's six genera of mosquitos have been collected from within the Okanagan. All of the following species, except *Culex territans* (which feeds on amphibians) can be a nuisance and many species, particularly those which bite birds and mammals other than man, are also capable of vectoring diseases, such as dog heartworm, Western Equine Encephalitis and West Nile virus.

Mosquito pest species collected locally in the Okanagan include:

Aedes canadensis	*Aedes increpitus*	*Anopheles freeborni*
Aedes cataphylla	*Aedes intrudens*	*Coquillettidia perturbans*
Aedes cinereus	*Aedes mercurator*	*Culex pipiens*
Aedes communis	*Aedes provocans*	*Culex tarsalis*
Aedes dorsalis	*Aedes punctipennis*	*Culex territans*
Aedes euedes	*Aedes punctor*	*Culiseta alaskaensis*
Aedes excrucians	*Aedes stirriensis*	*Culiseta incidens*
Aedes fitchii	*Aedes sticticus*	*Culiseta inornata*
Aedes flavescens	*Aedes vexans*	*Culiseta impatiens*
Aedes hendersoni	*Anopheles earlei*	*Culiseta minnesotae*

The majority of mosquito species occurring along river floodplains and vegetated lake shorelines are predominantly (+90%) *Aedes* mosquitos, and overall they account for between 70-80% of all mosquitos occurring in the Okanagan. These mosquitos are aggressive biting pests of mammals (including man, livestock and pets) and prefer flooded, temporary or recurring habitats such as over-irrigated fields, low-lying stream and riverbanks, ditches, snowmelt pools in woodlands, meadows and fields, and flooding from rising lake, river and marsh water levels. *Aedes* females will bite once and then lay their eggs in moist soil along the edges of recently flooded areas where the eggs can lay dormant for upwards of twenty years. Snowmelt species rely on increasing water temperatures to hatch.

Following a period of wetting, and drying, eggs become "primed" to hatch. Larvae, once inundated, particularly with flood and snowmelt species, can hatch out in large numbers, with populations typically ranging from 50-100 larvae/350ml dip sample, although +200 larvae/dip sample isn't uncommon. Developing in response to fluctuating water levels and river freshet flooding occurring with snowmelt and precipitation run-off, *Aedes* mosquitos are typically the most numerous during the first half of the season, from mid-April through July. Receding water levels, increasing temperatures, evaporation and decreased precipitation causes many of these habitats to dry, drain and disappear.

Culex and *Culiseta* comprise the balance (20-30%) of mosquito pest species for the area. Larval populations normally range from 1-20 larvae/dip sample and multiple,

or recurring hatches each season are possible with additional egg laying by adult females. They 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 increasing day length and temperatures. *Culex* and *Culiseta* prefer permanent and slow-draining, or frequently-refilled sites including natural and man-made ponds, ditches and containers such as stored tires, boats and buckets or livestock watering troughs. They overwinter as adults and females and can bite multiple times, a variety of hosts (mammals, birds) and lay eggs several times in a season. *Culex* and *Culiseta* mosquitos are capable of producing several generations in a typical season.

Anopheles are large mosquitos which prefer permanent sites or slow draining and flowing ditches or stream margins. They are not very common and are often the least numerous of the mosquito species occurring in the area. Although their populations and individual development sites are not usually as large as the synchronous hatching *Aedes* mosquitos, they can be a source of reportable annoyance since their preferred habitats are common to residential, commercial, recreational and agricultural properties.

Cattail marshes, which are located throughout the Okanagan, provide ready habitat for *Culex* and *Culiseta* mosquitos but can also provide habitat for a unique, and difficult to sample mosquito. *Coquillettidae perturbans*, an uncommon mosquito, often called the cattail mosquito, has a serrated larval siphon and pupal "trumpets" allowing it to attach to young cattails (*Typha* sp.) and similar aquatic plants so that it can access the air inside these hollow plants and "breath" underwater. Because they are not free swimming like most larvae, they are not generally collected in routine larval sampling. They can be aggressive biters of man during the night and in shaded areas adjacent their development habitats.

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 natural and man-made freshwater habitats including containers and they are the predominant (+99%) mosquito developing in catch basins.

All of the species collected locally are able to develop as multiple hatches during a typical season. They are all capable of causing reportable and often extreme annoyance, particularly *Aedes,* and *Ae. vexans* and *Ae. sticticus* are 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 Centre for Disease Control (BCCDC) and the Center 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 residents, workers and visitors, but also contributes to the protection of public health.

Mosquito development habitats are monitored throughout the season, typically from mid-April through August, to assess the abundance and species of mosquitos developing in them. Larval

populations are sampled, measured and recorded as the # larvae/350 ml dip sample and by their age class, 1st, 2nd, 3rd, 4rth instars or pupae. New Jersey or CDC (Atlanta) light traps and standardized mosquito biting and landing counts are used to sample and monitor adult mosquito populations and distribution.

3.0 MOSQUITO CONTROL OPTIONS

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 options would be considered as a potential solution prior to any larvicide applications.

Many of the possible physical and biological control options available may be supported and possibly 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 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 long-term contribution to control program success through reduction of mosquito populations and enhancement of natural controls including insect, fish and birds. Elimination of stagnant water and flows in natural or created ecosystems will benefit 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.

3.1 Physical Control

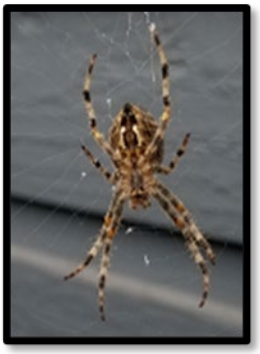
A continued focus for the control program technicians and public education initiatives would be the identification, and reduction or elimination, of larval mosquito development habitats wherever possible. Clearing ditches of obstructions or vegetation, replacing failed culverts or grading to effect flow may increase flow, drainage or access by fish or aquatic insect predators.

Ditching of roadside depressions may be a suitable solution to larval development by permitting the drainage of temporarily flooded areas. Grading or filling of depressions and tire ruts may reduce an area's potential to retain water. When completed as part of routine maintenance activities by public works crews they can be effective means of reducing local mosquito populations. Any such activities along public roadways, in parks or other publicly-owned properties would be coordinated through the appropriate public works and engineering departments. The BCMOE, DFO and other government regulatory agencies, as appropriate, may also need to be consulted prior to any such planned work in area ditches.

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 man-made golf course and park ponds can reduce their suitability and use as larval mosquito development habitat.

3.2 Biological Control

Biological control involves the use of predators, pathogens, and parasites to reduce mosquito populations. Insects predators, both aquatic (ie. dragon flies, beetles, backswimmers, amphibians, fish) and terrestrial (ie. dragon flies, spiders, wasps, birds, bats), 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.



Where applicable, and where permitted by local bylaws and provincial or federal environmental regulations, the ditching of habitats or clearing of obstructions in ponds or man-made ditches may increase access or use by fish or aquatic insect predators. Such activities might, however, also have a detrimental impact on established plant and animal communities or land uses and may cause an unexpected increase in larval mosquito development habitat. Professional engineers, hydrologists and biologist input is required and will require long-

term commitment for monitoring in order to assess the impacts on mosquito and other species populations. The BC Ministry of Environment, the Department of Fisheries and Oceans and other government regulatory agencies, as appropriate, may need to be consulted prior to any such planned works.

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 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.

3.3 Bio-rational Control

The RDNO mosquito surveillance and control program has been developed on the basis of using bio-rational, *Bacillus* sp.-containing larvicides, including VectoBac 200G (or equivalent) and VectoLex CG. Extensive product information can be found at the manufacturer's website www.valentbiosciences.com or through the Health Canada, Pest Management Regulatory Agency (PRMA) website www.pmra-arlc.gc/ca. and the Pesticide Label Search www.hc-sc.gc.ca.

These larvicide products are the closest form of a natural or biological control agent currently available for routine use in operational mosquito control programs. The use of VectoBac and VectoLex 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.

Property owners/residents would be consulted with prior to any larvicide applications and for any recommended physical of 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.

VectoBac 200G (PCP # 18158) contains spores and crystals produced by the bacterium (*Bacillus thuringiensis* var. *israelensis*, *Bti*) and, as such it is classed as a bio-rational, rather than conventional, pesticide. A naturally-occurring soil bacteria, it has no residual activity, is species-specific, does not bio-accumulate and has no impact on other organisms found in aquatic habitats. It is recommended for use in standing water habitats such as 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. VectoBac's mode of action is on the larval mosquito stomach, and it must be eaten to be effective. It is very specific, producing rapid lethal effects (within hours) in larval mosquitos.

Similar to VectoBac 200G, VectoLex CG (PCP # 28008) also contains a naturally occurring, spore-forming soil bacterium. VectoLex contains spores and crystals produced by *Bacillus sphaericus.* It also is classed as a bio-rational, rather than conventional, pesticide. Like VectoBac, VectoLex larvicides 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 most *Culex* and *Culiseta* mosquito species. 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 protein is "released" for consumption by mosquito larvae.

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. Vectobac often requires re-application to control additional larval development occurring several days after treatment. VectoLex, however, can provide larval control in some habitats for upwards of 45 days. VectoLex achieves this extended control because the *B. sphaericus* toxin 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 the dead mosquito larvae. This is known as recycling and is the mechanism which allows VectoLex to provide long-term, extended control of recurring larval mosquito development.

VectoBac and VectoLex are only applied when larval mosquitos are present. Larval mosquito dip samples averaging from 1-3 larvae/500ml dip sample in permanent and temporary sites containing predominantly 2nd and 3rd instar larvae would be the minimum treatment threshold for mosquito larvae found in open water sites. A treatment threshold of five, 1st instar larvae/500ml dip sample is utilized when monitoring synchronous, extensive *Aedes sp*. larval development common to early-season snowmelt, flood and seepage water habitats. 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).

VectoBac 200G and VectoLex CG are the larvicides of choice for aerial and ground-based larvicide applications. These products maximize the environmental compatibility of the Regional Districts mosquito control program since they are currently the most effective, selective, and least persistent larval control agents available. VectoBac 200G and VectoLex CG are only applied when larval mosquitos are present.

- ***Larvicide Applications***

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

Rapid, synchronous larval development over an expansive area, largely inaccessible from the ground, makes aerial larvicide applications essential to control program success. Fluctuating water levels in snowmelt, surface water run-off, river flood and seepage-influenced development sites cause recurrent larval development with many sites requiring multiple treatments to effect control.

Aerial larvicide (VectoBac) applications are completed by rotary winged aircraft (helicopters) fitted with under-slung granular application equipment. There are two primary makers of this equipment, Simplex ™ and Chadwick™. Both manufacturers make use of a fiberglass 'hopper' to hold the granules and an externally mounted Honda™ or Briggs and Stratton™ 5 HP motor which operates the 'disc gate' or 'piston/ram' and the rotary, granule dispersal impeller. Both buckets are suspended below the aircraft, and from its secure cargo hook. The certified pilot or applicator, through a direct wire connection, controls the off and on operation of the bucket and the opening and closing of the application gate or ram. All aerial larvicide application equipment is supplied and maintained by the aerial contractor and is calibrated as directed by the equipment and product manufacturers.

Prior to all aerial larvicide applications, pilots are accompanied on reconnaissance flights by control program management personnel and provided maps detailing treatment sites and areas of avoidance. Treatment site locations are confirmed by GPS (Geographical Positioning System) coordinates provided by on-board navigation equipment, and reviewed with the aerial applicator prior to treatment. Continuous radio contact is maintained between pilots and management personnel during all aerial larvicide applications. Applications are tracked, in real-time using GPS-enabled software and "tablets/note books".

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

3.4 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 make from chrysanthemum flower extracts (pyrethrins) and their synthetic equivalents, all adulticides only provide temporary control.

Typically applied from the ground using cold aerosol sprayers or misters, and much less commonly, from the air using helicopters of 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.

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 any more 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.

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

The most effective means of reducing adult mosquito populations and the potential for annoyance or disease transmission is through an Integrated Pest Management (IPM) approach focused on limiting larval mosquito populations and development. A well organized, pro-active, integrated pest management approach which concentrates on larval mosquito control ensures a safe, effective and environmentally compatible program.