CITY OF PRINCE GEORGE
Civic Operations
Parks and Solid Waste Division

PEST MANAGEMENT PLAN

Confirmation# 567-0010 21/26

NUISANCE MOSQUITO CONTROL MANAGEMENT PLAN

City of Prince George
1100 Patricia Blvd
Prince George, BC V2L 3V9

05 January 2021

Table of Contents

1. Introduction

The goal of the City of Prince George's nuisance mosquito control program is to reduce mosquito populations to a tolerable level. In areas adjacent to extensive larval development habitat, mosquito populations can become very high. When this happens, quality of life for residents in the area can decrease because of nuisance mosquitoes. Further, high numbers of mosquitoes can cause allergic reactions in some individuals and can also impact tourism.

The City of Prince George has conducted a nuisance mosquito control program since 1986. The program is based on the principals of Integrated Pest Management (IPM), in that the most environmentally sensitive methods of control are considered first. Prevention and reduction of mosquito larval development sites is the first objective of the City of Prince George program, as preventing a problem is always better than trying to control the problem once it occurs. However, there are few instances in which habitat-prevention is possible and therefore the vast majority of the City of Prince George mosquito control campaign is focused on controlling mosquitoes while they are in their larval stages, (as opposed to their adult stage) for two primary reasons. Firstly, larval control is much more efficient than adulticiding - it is possible to treat larval mosquitoes in very high concentrations in larval development ponds, while adult mosquitoes tend to disperse over a much wider area soon after emerging. Secondly, larvicides such as Aquabac, Vectobac and VectoLex are species specific, affecting only aquatic members of the Order Diptera, which includes mosquitoes, black flies and midges. These larvicides do not impact non-pest and beneficial insects such as pollinators and predators.

The City of Prince George has not included adulticiding in their plan for the management of nuisance mosquitoes. In the unlikely event of a West Nile Virus outbreak, and under the Order of a Medical Health Officer, the City of Prince George may be required, under the Health Act, to adulticide for mosquitoes, however this work would be completed under a separate permit or PMP held by the Ministry of Health Services.

The *British Columbia Integrated Pest Management Act* and the Integrated Pest Management Regulation require pesticides to be applied pursuant to the principles of IPM. This in turn required the development of a Pest Management Plan (PMP) and the use of pesticides in accordance with the terms and conditions of the Integrated Pest Management Regulation and the commitments made in this PMP.

1.1. Geographic Boundaries of this Pest Management Plan

The PMP includes all areas within the municipal boundaries as well as some additional areas outside but adjacent to the City of Prince George boundaries including sites within the Regional District of Fraser-Fort George. These are small, low-lying areas that are known breeding habitat and are near enough to populated areas within the City of Prince George that they must be treated to preserve the integrity of the program.

These areas may include:

- The Lheidli T'enneh band office and vicinity ranging south to the floodwater channel off Beaver Forest Road.
- West of the City boundary along the Nechako River along Takla Forest Road.
- East of the City boundary to the Denicola subdivision
- Southeast of the City boundary adjacent to Blackburn
- Northeast of the City boundary on Goose Country Road
- South of the City boundary along Haldi Lake Road including Haldi Lake
- South of the City boundary, ditches on East Beaverly Road

Within this area, all municipal, private, crown, and Regional District land is included with permission of the applicable owner, agency, or authority. A map of the geographic boundaries to which this PMP applies can be found in Appendix A. Detailed maps displaying the locations of larval development sites can be viewed by contacting Dean Ward, Supervisor, Parks, and Solid Waste at 250-561-7600.

1.1.1 Regions Within the City

A major change that took place within the structure of the program in 2005 was the division of the treatment area into six community associated regions, the Hart, College Heights, Blackburn, Cranbrook Hill, Fraser Vista, and City Centre.

Hart Region
The Hart region is located north of the Nechako River and extends north to the City of Prince George boundary. This is the largest region with respect to area and number of sites. The breeding sites range from ornamental ponds in residents' yards to large woodland pools on public land.

College Heights
College Heights is located in the southwestern region of the City of Prince George and has been combined with Vanway and Beaverly. This area is primarily comprised of woodland ponds, grassland pools and ponds, rain pools and snowmelt pools.

Blackburn
The Blackburn region is located in the eastern area of the City of Prince George limits and encompasses the area surrounding the Prince George Airport. Ditches, sewage lagoons and wet depressions in fields make up the majority of the sites in this area.

Cranbrook Hill
Cranbrook Hill is a small agricultural community located along the mid-western border of City limits. The sites in this area are mostly wet depressions in fields, ditches, woodland ponds and pooling off small streams.

There are untreatable areas in this region, such as a certified organic farm. A map of these areas was obtained to prevent any intrusions and is an appendix to

this plan. As the location of these fields can change from year to year, the organic farmer should be contacted prior to program commencement each season.

Fraser Vista
Fraser Vista is located in the Northeast corner of the City, which encompasses a small area near the PG Sawmill and Cantor property and includes the Shelley Reserve. This region is comprised of a collection of large sites along the Fraser River that are categorized as temporary floodwater sites located in forested areas and grassland depressions.

City Centre
The City Centre is the area commonly referred to as "The Bowl" in Prince George. The sites in this area primarily located in public spaces and are generally temporary rain pool and snowmelt pool sites. Sites such as Cottonwood Island Park and Hudson's Bay Slough are in this region.

1.2. Responsibility for the Integrated Mosquito Control Program

The person responsible for managing pests within the City of Prince George and therefore the primary contact for information relating to this Pest Management Plan is Dean Ward, Supervisor, Parks and Solid Waste, City of Prince George. Mr. Ward can be contacted at 250-561-7600.

1.3. Time Period of this PMP

This PMP shall be in force for a five-year period from the date that a Pesticide Use Notice (PUN) has been submitted to the BC Ministry of Environment and confirmation of the plan has been received. This project will run from March 2021 to March 2026.

1.4.0utline of this PMP

The content of PMP's prepared in the Province of British Columbia is legislated under the *Integrated Pest Management Regulation* (section 58) and the checklist provided in the *Regulation* is included in Appendix B. This PMP will describe the City of Prince George Nuisance Mosquito Control Integrated Pest Management Program including monitoring activities, treatment decisions, treatment options, and treatment evaluations.

It will also outline the operational procedures conducted by the City of Prince George to ensure safe methods of transporting, storing, handling, and applying the pesticides used in this program. This PMP will address the City of Prince George's policies for disposing of empty pesticide containers and unused pesticide, as well as for responding to pesticide spills.

There will be a discussion of the City of Prince George's strategies for the protection of community watersheds, domestic and agricultural water sources, fish, wildlife, riparian areas, and food intended for human consumption.

Finally, this PMP will outline the commitments of the City of Prince George with respect to maintaining pesticide records and submitting annual reports and notices.

2. Integrated Pest Management

A requirement of all PMPs in British Columbia is an explanation of how the applicant (the City of Prince George) will utilize the elements of Integrated Pest Management (IPM). The six elements of an IPM strategy that will be discussed in detail in the following sections are:

1) A strategy to *prevent* organisms from becoming pests (planning)
2) A method to *identify* pests
3) A *monitoring* (surveillance) program
4) A description of the *injury thresholds* used to make treatment decisions
5) *Treatment options* and selection criteria, and
6) A method for *evaluating effectiveness* of pesticide use.

2.1. Prevention (Planning)

Prevention is one of the most important options for successful mosquito control. The City of Prince George actively pursues the following preventative measures in its mosquito control program.

1) Reduction and/or modification of mosquito larval development sites and,
2) Public Education.

2.1.1. Source Reduction/Modification

The City of Prince George actively encourages the reduction of mosquito larval development sites and water management as effective methods of mosquito control. The fact that mosquitoes require water to develop is the key to their effective control. Without standing water there are no mosquitoes, as mosquitoes are unable to complete their life cycle without water.

Source reduction is simply the use of physical methods to eliminate standing water by draining or filling in mosquito larval development sites. Public education will include tips on reducing standing water around the home (i.e., clear eaves troughs of debris so they can drain properly, empty water holding containers, keep water from pooling on swimming pool covers, etc.). In addition, City of Prince George and Contracted staff will identify sites that are within the municipal land base, are outside of riparian habitats, and can be accessed with appropriate equipment for filling

them in or promoting draining (as in the case of ditches). When available, the City of Prince George will undertake participation in voluntary tire collection/recycling opportunities. Through education and awareness and providing collection sites, unused tires can be voluntarily brought in to be recycled. Tires can be significant breeding sites if left with water in them.

If draining or filling are not options, many mosquito larval development sites such as sewage treatment ponds, ditches, farm dugouts, and ornamental ponds can be made unsuitable for mosquito larval development through a combination of good design (i.e., steeply sloped, and graveled shorelines), water level manipulation, and control of emergent vegetation. Bodies of water with sloped, graveled, rocky or sandy shorelines will generally support fewer mosquitoes, as larvae will be exposed to wave action and will have difficulty obtaining food. In addition, scraping of sediment from the bottom of roadside ditches every few years can make the ditches unattractive for mosquito larval development by enhancing proper drainage. Ditches that are slow to drain may form a series of pocket pools and support lush grasses and weeds, thereby becoming prime larval development sites. Landowners and government agencies will be encouraged to use the above-described methods within their lands.

Through public education, homeowners will also be encouraged to participate in habitat management. Ornamental ponds can be outfitted with water agitators such as fountains or aerators. Screens can be placed over rain barrels to prevent female mosquitoes from reaching the water surface to lay eggs (as well as preventing the emergence of larvae already present in the barrels), and compost piles can be turned frequently to prevent the pooling of water on this nutrient rich environment. The public will be encouraged to manage larval development sites such as children's wading pools and bird baths by draining and replacing the water at least once per week, so that any larvae present will be killed by desiccation.

In some agricultural areas, over-irrigation or flood-irrigation can produce significant larval development habitat. Proper watering of fields at ranching and hay farming operations will be encouraged by the City of Prince George through education. Efforts will be made to contact farmers when over-irrigation, flood-irrigation and/or broken irrigation pipes are noticed. Farmers will be encouraged to alter their practice and/or repair broken irrigation pipes.

2.1.2. Public Education

The City of Prince George has prepared an information sheet describing measures that can be taken by individuals and landowners to reduce the number of larval development sites and to minimize the impact of mosquito populations on quality of life and the health of individuals and landowners where heavy infestations exist. This information is made available on a property-by-property basis and in the City of Prince George's Spring/Summer Leisure Guide which is

provided free to residents. In addition, the City of Prince George website has information concerning mosquitoes, mosquito control and mosquito borne illness.

2.2. Identification of the Pest

Mosquito surveillance allows controllers to identify when and where mosquito pests occur. The City of Prince George has engaged in both ongoing larval surveillance and adult surveillance. All six of BC's mosquito genera have been identified in the City. These are *Aedes, Anopheles, Coquillettidia, Culex, Culiseta,* and *Ochlerotatus.* At least Twenty-six different species of mosquitos have been captured in adult light traps and as larvae in the City of Prince George.

All the following species present in the City of Prince George except *Culex territans* (feeds on amphibians) can be considered nuisance species:

Anopheles earlei	*Aedes cinereus*	*Aedes vexans*
Coquillettidia perturbans	*Culex territans*	*Culex tarsalis*
Culiseta alaskaensis	*Culiseta incidens*	*Culiseta morsitans*
Ochlerotatus canadensis	*Ochlerotatus cataphylla*	*Ochlerotatus excrucians*
Ochlerotatus fitchii	*Ochlerotatus communis*	*Ochlerotatus diantaeus*
Ochlerotatus euedes	*Ochlerotatus excrucians*	*Ochlerotatus fitchii*
Ochlerotatus hexodontus	*Ochlerotatus implicatus*	*Ochlerotatus increpitus*
Ochlerotatus intrudens	*Ochlerotatus provocans*	*Ochlerotatus pullatus*
Ochlerotatus punctor	*Ochlerotatus sticticus*	*Culex pipiens* *Culex inornata*

In the field, mosquito larvae and adults are very difficult to identify to the species level. For positive identification, mosquitos need to be examined under a microscope. In the City of Prince George, the determination as to whether a larva is likely to be a pest species or not, will be based on the habitat where the larvae are found and the time of year. Mosquitos are selective with their habitats. Different species of mosquitos tend to choose different types of habitats. The time of year can also give clues to the identity of the mosquito species.

Generally, the mosquito larvae that appear in early spring (sometimes even before ice-off) are of the genera *Aedes* and/or *Ochlerotatus. Aedes* is the Greek word for disagreeable and is an accurate reflection of these species in terms of both numbers and ferocity. *Aedes* and *Ochlerotatus* species lay their eggs at the edges of water bodies or in moist soil. Snowmelt species rely on warm temperatures and/or low oxygen levels in water to induce their eggs to hatch. Larvae of the floodwater species appear as soon as their eggs are wetted (following snowmelt and then river flooding). Large areas of habitat often become active simultaneously with rising floodwaters along creeks and rivers and in permanent marshes as the snow melts and raises the water level in the marshes. Therefore, large numbers of *Aedes* and/or *Ochlerotatus* mosquito eggs hatch at the same time. This is due primarily to

the fact that eggs laid by most *Aedes* and *Ochlerotatus* species remain viable for a number of years, and therefore egg concentrations in the soil can become very dense. Whenever habitat along flooding creeks and rivers, ditches, woodland pools, or permanent marshes in the spring contains mosquito larvae, it is assumed that these are pest species and treatment of the larvae will be considered.

As the summer progresses, the occurrence of floodwater larvae tends to decrease (unless a large storm event causes flooding, or in the case of agriculture, a farmer over-irrigates, flood-irrigates, or fails to repair broken pipes). Water left standing after the spring floods will begin to colonize with species of mosquitoes from the *Anopheles, Culiseta* and *Culex* genera. *Anopheles* mosquitoes are easily recognized in the field as the larvae are much different in appearance from all other larvae in British Columbia. They lay flat on the surface of the water and lack a siphon. All *Anopheles* species in British Columbia can be considered pests and therefore whenever these species are seen, treatment will be considered. *Culiseta* and *Culex* mosquitoes lay their eggs on the surface of standing water and will produce multiple generations over the summer. Most species from each of these genera can be nuisance mosquitoes, so if they are present in high enough numbers, they will be treated.

2.3 Monitoring (Surveillance) Program

The City of Prince George conducts three kinds of surveillance as part of their nuisance mosquito control program: 1) monitoring environmental conditions; 2) monitoring larval development sites and larval populations, and 3) monitoring adult mosquito populations.

2.3.1. Environmental Monitoring

As the first stage of environmental monitoring, the City of Prince George monitors ambient temperatures, river levels, snowpack levels and precipitation. Monitoring of each of these variables allows mosquito control staff to estimate the size and number of larval development sites that will appear throughout the season.

Also, current weather conditions are monitored as these can affect whether treatments are carried out on any given day. Hand treatments of granular larvicides are occasionally deferred during high precipitation events although wind velocity is generally not a factor that affects hand application of larvicides. When helicopter applications are planned, wind and precipitation monitoring is especially important as helicopter treatments are halted when wind conditions (velocity and direction) make it difficult for the pilot to aim granular larvicides at the larval development site (i.e., the pilot is unable to compensate for drift of the granular product due to wind). Also, helicopter campaigns are not possible during precipitation events as the granular larvicides become wet, thus clogging

the application equipment. This can result in improper application rates and possible damage to the application equipment.

2.3.2. Surveillance of Larval Development Sites and Mosquito Larvae

An ongoing activity in the nuisance mosquito program is that of searching for and cataloguing mosquito larval development sites. Sites have been identified through ground searches, reports from citizens of the City of Prince George, and mapping exercises. The City of Prince George has developed a detailed map that outlines the known larval development sites. Information including owner of the land (private or public), history of monitoring and treatments, and comments concerning the type of larval development site (permanent marsh, snowmelt, transient floodwater site, etc.) is maintained and regularly updated. Information such as "no treatment" areas is also included. Examples of "no treatment" or "avoid" areas include those that: the landowner has refused permission; are in environmentally sensitive areas such as wildlife sanctuaries; or are in fish bearing habitats. Site information is updated throughout the season with treatment information and newly located larval development sites.

Once larval development sites have been located, they are included in a schedule for larval surveillance. Depending on the type of habitat, predictions are made as to when they are likely to become active with larvae. The sites are then visited and an assessment as to the number and lift stage (instar) of the larvae is made. A 300 ml mosquito dipper is used to collect water from the larval development site and the number and life stage of the larvae is determined. Depending on the size of the larval development site, several "dips" may be taken to determine the mosquito population throughout the site. Information as to the average larval density and life stage of the larvae is recorded prior to treatment so that a comparison can be made post-treatment when crews return on another day to the treated sites to assess the effectiveness of the larvicide application.

If the larvae are at an appropriate life stage and in sufficient numbers to meet a threshold level (Section 2.4.1), larvicide activity will be considered. At this point several things will be considered. First, the size and characteristics of the site will be examined to estimate the amount of larvicide needed (application rates vary depending on the depth of site and the amount of organic material present). Next, no treatment areas will be considered, and if they cannot be avoided, plans for treatment will stop.

Finally, if possible, the genus of the mosquito will be recorded, however as mentioned earlier, this is often difficult in the field.

2.3.3. Surveillance of Adult Mosquitoes

When possible, adult surveillance will be conducted in the City of Prince George to assess the efficacy of larviciding activities and to identify the species of mosquitoes in a given area. Mosquitoes are specific as to the habitats in which they will lay their eggs and therefore identification of the adults can assist mosquito control staff in their search for likely larval development areas.

For example, if a landowner is concerned about adult mosquito numbers, a light trap could be set up to trap mosquitoes. If *Aedes vexans* is the primary species collected in the trap, staff would know that these mosquitoes came from a floodwater habitat, and they would then look for low lying areas around streams or rivers that may have been recently flooded and produced the brood of mosquitoes. In subsequent years, this area could be visited following a flood and prior to emergence of the adults and larviciding be conducted.

2.4 Injury Thresholds

Injury thresholds are pre-set parameters that are used by staff to determine whether populations meet a high enough level for treatment (larval or adult control).

2.4.1. Thresholds for Larval Treatments

The treatment threshold for mosquito larvae is determined by the certified applicator and takes into account a number of variables. The applicator makes a decision as to whether the numbers of larvae present are likely to cause a nuisance if allowed to develop to adults.

As a general guideline, the treatment threshold for mosquito larvae is an average of **one to three larvae per 300ml dip.** This threshold was selected as it is the standard that has been used in British Columbia and other areas of Canada and the United States. However, the City of Prince George and/or their contractors will consider exceptions to this rule. In some cases, an applicator may decide that an average of three larvae per dip may not be sufficient numbers for treatment.

For example, if the larval development site is very small and a good distance from the public, the applicator may decide that allowing the larvae to develop will not pose a nuisance problem and therefore no treatment would be necessary. Or perhaps the technician will determine that the site is likely to dry-up prior to the larvae emerging. Conversely, a technician may encounter a site that is very large and deep with larvae distributed throughout the water column. In this case, it may be difficult to capture three larvae in a dip, however the cumulative number of larvae in the site can be astounding and treatment could be warranted. Certified applicators working for the City of Prince George mosquito contractor, may, in conjunction with the City of Prince George authorized employee, make the final decision as to whether to carry out larval treatment.

No larviciding will be conducted on private property without the consent of the landowner.

2.5 Treatment Options

Once a technician determines that a threshold has been met, there are a number of treatment options available. In the case of larvicides, there are bacterial control products containing *Bacillus thuringiensis* var *israelensis (Bti)* and *Bacillus sphaericus (Bsph).* Of these, *Bti* provides control over several days and *Bsph*, can, for some species provide several weeks of control. There is also the option to perform a physical control, requiring no pesticides at all. Each of these choices will be discussed below.

2.5.1. Non-Pesticide Control (Physical Control)

A technician may find a larval development site and encourage the site to be drained (i.e. a pool of water in a farmer's field can be ditched or filled in) or a slowly moving ditch could be dug out and drained. Other options for non-pesticide control are outlined in Section 2.1.1 and these will be considered first, before any pesticide application.

2.5.2. Control Options for Larval Mosquitoes

Control of larva using larviciding will be the most common approach for controlling nuisance mosquitoes in the City of Prince George. The City of Prince George will consider the use of any of the registered mosquito larvicides listed below, and this PMP may be updated with any new larvicides that become registered in Canada during the course of this PMP. The list of larvicides proposed for use in the City of Prince George under this PMP is listed in Table 1.

According to the Integrated Pest Management Regulation section 78(2), a pesticide free zone is not required around standing water when applying the mosquito larvicides included in this PMP. However, in accordance with section 78(1) of the Integrated Pest Management Regulation, mosquito larvicides will not be applied in permanent, fish bearing bodies of water or waters that have permanent, direct, surface water connections with fish bearing bodies of water. Also, larvicides will never be applied to any human drinking water sources. All applications will be done by individuals that hold valid British Columbia Pesticide Applicator Certificates in the Mosquito and Biting Fly Category.

2.5.2.1. Bacillus thuringiensis var israelensis

The majority of the larval treatment within the City of Prince George will be with granular larvicides containing the active ingredient *Bacillus thuringiensis* var *israelensis (bti)* (trade names Vectobac, Aquabac). These products are formulated with byproducts of the metabolism of the bacterium *Bti* which is applied along with paraffin to crushed corncobs that serve as a carrier. *Bti*

produces an endotoxin that contains five different proteins that can be digested in the alkaline gut of mosquito larvae. Once digested, the proteins become toxic to the larvae and work to destroy the larvae's gut. The *Bti* products are effective against mosquitoes in the larval stage, and are applied by hand, backpack blower or by helicopter to standing water containing significant populations of mosquito larvae. Application rates vary from 2.5 to 20 Kilograms per hectare (with the higher rates applied to polluted or highly organic water), although most sites are treated at about 4 to 10 kilograms per hectare. Liquid formulations of these products may also be used, although not to the same extent as the granular products.

The benefits of the *Bti* larvicides are many. *Bti* larvicides are considered to be very specific to mosquito larvae and non-toxic to fish, amphibians, reptiles, mammals and most other insects. They are easy to apply and have no residual effect, along with being the most economical of the larval controls. *Bti* larvicides work best when applied to larvae in their 2nd and 3rd instars, however control can be achieved when applied to 1st and early 4th instar larvae as well. Death of the larvae usually occurs within 24 hours. This allows for technicians to be able to assess effectiveness soon after application. *Bti* products can be applied to practically any type of standing water including temporary and permanent pools, floodwater, snowmelt pools, irrigation pools, sewage lagoons, retention ponds, ditches, natural marshes and catch basins.

There are very few disadvantages associated with the use of *Bti,* when applied according to the labeled rates; it is virtually non-toxic to all organisms aside from mosquito larvae. However, studies have shown that at application rates 10 to 1,000 times greater than the labeled rates, some effects have been documented on non-target larvae such as chronomids, biting midges and dixid midges. As the *Bti* products have no residual effect, only the larvae present at the time of application are affected. In habitats where multiple generations of larvae appear, more than one application of larvicide may be necessary. Another possible disadvantage is the short window for treatment with optimum control of the larvae in the 2nd and 3rd instars.

2.5.2.2. Bacillus sphaericus

Bacillus sphaericus is sold under the trade name Vectolex. The mode of action of the bacteria is similar to *Bti* in that it produces toxins that attack the gut of mosquito larvae.

The benefits of *Bacillus sphaericus* are also similar to those of *Bti* in that it is virtually non-toxic to non-target organisms while being very effective and specific to mosquito larvae. This product works better than *Bti* when applied to highly organic larval habitats and it has the added benefit of maintaining its effectiveness for up to 28 days and thus can control multiple generations of larvae with a single application. Vectolex CG can be applied to any kind of

standing waters, as with *Bti* larvicides. The VectoLex Water Soluble Pouches (WSP) are only registered for use in catch basins at this time, and so it is unlikely that they will be used as part of the nuisance control program as nuisance mosquitoes rarely develop in catch basins. However, if registration changes to allow VectoLex WSP to be applied to sanding water other than catch basins, the City of Prince George will consider using these pouches accordingly.

The greatest disadvantage of *Bacillus sphaericus* is its cost. At present, it is the most costly of the larvicides and therefore will only be considered in larval development sites where multiple generations of larvae are known to occur. In these cases, the increased cost of the larvicide may be warranted as fewer applications would be required over the course of the summer.

Table 1
List of larvicides that are included in this PMP for use in the City of Prince George Nuisance Mosquito Control Program. Selection of the larvicide will be made by the applicator following assessment of the larva development habitat and available resources.

Trade Name	Formulation	Active Ingredient	PCP No	Application Rate	Application Method*
Vectobac 200G	Granules	*Bacillus thuringiensis* var *israelensis*	18158	3-10kg/ha	Ground or Aerial
Aquabac 200G	Granules	*Bacillus thuringiensis* var *israelensis*	26863	2.5-20kg/ha	Ground or Aerial
VectoLex WSP	10g water soluble pouch	*Bacillus sphaericus*	28009	Water bodies at 1 pouch/5m2 & 1 pouch per catch basin	Ground
VectoLex CG	Granules	*Bacillus sphaericus*	28008	5.6-16.8 kg/ha in water bodies & 0.56-1.68 g/m^2 of water surface area in tires	Ground or Aerial

*Ground applications may be done by hand and/or with blowers and/or with misters. Aerial applications may be with helicopter.

2.5.3. Selection of a Treatment Method

Once a decision has been made to conduct a treatment, the applicator must first decide which product they will use. Next, the decision on how to apply the product will be based on a combination of the following considerations:

FORLARVALTREATMENTS

1) The advantages and disadvantages of each pesticide as discussed in Section 2.5.2.
2) The life stage (instar) and species of the larvae (single generation mosquito or multi-generational mosquito).
3) The characteristics of the larval habitat (high organics, intermittently dry, size, and location of site, predator presence/absence).
4) The availability of the larvicide.
5) The cost of the larvicide.
6) The proximity to fish bearing water and the likelihood of intermittent connection to fish bearing water.

In smaller sites, a hand may be used to spread granular larvicide. In larger sites, a backpack blower may be preferred as this equipment can blow granules great distances and cuts down on the amount of walking an applicator may have to do. Blowers can also be used to blow larvicide into water that is too deep for an applicator to wade in.

Finally, aerial control may be selected. Aerial campaigns are costly, but are often the only means of finding, accessing, and treating large areas of larval development habitat in a short time frame (while larvae are in appropriate instars). When the snow melts in the spring in Prince George, large areas of land become active with larvae of snowmelt mosquitoes. Also, when river levels peak during spring freshet, huge areas of habitat often become active simultaneously and mosquito control staff are unable to treat all larvae before they pupate. Aerial control is an excellent choice in these circumstances as many of hectares of larval development habitat can be treated in just a couple of days.

2.6 Treatment Evaluations

The final component of an Integrated Pest Management approach is that of treatment evaluation. Post-treatment evaluation can help to improve a program over time as applicators learn which pesticides, application rates, methods and timing worked best at each application site. Constant evaluation of a program and its results will allow City of Prince George staff to improve and refine their nuisance mosquito control program.

The *Integrated Pest Management Regulation* section 78(4b) specifies that the efficacy of a mosquito larvicide be assessed by conducting pre-treatment and post-treatment larval samples of the water being treated. Certified pesticide applicators will conduct

and record all pre-treatment monitoring as described in Section 2.3.2. Within 1-7 days following treatment, certified applicators will return to a representative sample of larval development sites to conduct post-treatment monitoring using the same methods of accessing larvae as described in Section 2.3.2 for pre-treatment monitoring. This information will be used to determine if the rate and type of pesticide application chosen for the location was suitable, and if the application failed, it will allow the applicator to plan for alternate methods of control.

3. Operational Information

The following sections describe the City of Prince George's plans for safe handling, preparing, mixing, applying and otherwise using pesticides. Much of the information included in the following sections is drawn directly from the Integrated Pest Management Regulation and the *Canadian Pesticide Education Program, Applicator Core Manual, British Columbia Edition (Ministry of Environment 2011)*

3.1 Procedures for Safely Transporting Pesticides

The following procedures for safely transporting pesticides will be practiced by all City of Prince George staff or contractors working under this PMP. The Integrated Pest Management Regulation (section 65(1)) legislates that pesticides must be kept, handled, stored, and transported in the container in which they were originally packaged and with the labels originally packaged and with the labels originally affixed by the manufacturer, or in containers designed for containing the pesticide and labeled accordingly. Also, section 33(2) of the Regulation states that a "person who transports or causes or allows the transport of a pesticide must ensure that the pesticide is secured and transported ... in a manner that prevents the escape, discharge or unauthorized removal of the pesticide from the transport vehicle, and prevents the contamination of food or drink intended for animal or human consumption, household furnishings, toiletries, clothing, bedding, or similar items that are transported with the pesticide".

Further, the *Canadian Pesticide Education Program, Applicator Core Manual, British Columbia Edition (Ministry of Environment 2011)* outlines a number of general precautions to be taken during transport of pesticides, and the City of Prince George will adhere to the following·practices which are applicable to the use of larvicides:

1) All pesticide containers will be inspected for defects prior to transporting.
2) Pesticides will never be transported along with food, feed or consumer goods.
3) All pesticide containers will be secured to prevent spillage.
4) The driver of any vehicle transporting pesticides will be trained in spiil clean-up and will carry, along with the pesticides, necessary equipment to contain and/or neutralize a spill.

5) Limited amounts of pesticides shall be carried in any one vehicle. The quantity shall be no more than what is necessary for each project, except where transportation occurs between storage facilities or aerial application staging areas.
6) Pesticides shall be carried in a secure lockable compartment/container such as a vehicle trunk, a locked storage box or a truck canopy.
7) Pesticides shall be transported separately from food and drinking water, safety gear and people.
8) Pesticides will be transported only with approved, intact labels.

3.2 Procedures for Safely Storing Pesticides

The City of Prince George and/or their contractors will adhere to the following standards of the Integrated Pest Management Regulation with respect to the safe storing of pesticides:

1) A person who stores a pesticide will store it in a manner that minimizes hazards to human health and the environment (Section 33(1)).
2) All pesticides will be stored in the container in which they were originally packaged and with the labels originally affixed by the manufacturer, or in a container designed for containing the pesticide and labeled with the trade name, chemical name, concentration of active ingredient and Pest Control Product number (Section 65(1)).
3) All pesticides will be stored separately from food intended for human or animal consumption (Section 66(1a)).
4) According to Section 66(1b) all pesticides will be stored in a facility that is:

   (i) ventilated so that pesticide vapors are vented to the outside (not applicable to granular larvicides),
   (ii) not used for the storage of food intended for human or animal consumption,
   (iii) locked when unattended, and
   (iv) accessible only to persons authorized by the person storing the pesticide.

5) According to Section 66 (2), each door providing access to a storage facility, will clearly bear the words "WARNING; CHEMICAL STORAGE -AUTHORIZED PERSONS ONLY" written in block letters.
6) According to Section 31, the City of Prince George will inform the local fire department of the pesticide storage location within 60 days after starting to store pesticides.

3.3 Procedures for Safely Mixing, Loading & Applying Pesticides

None of the pesticides listed in this PMP require mixing prior to use. During larviciding campaigns there are few safety precautions necessary due to the non-toxic nature of the pesticides. However, applicators will follow all precautions as described on the larvicide labels.

3.4 Procedures for the Safe Disposal of Empty Pesticide Containers & Unused Pesticides

City of Prince George staff or their contractors will dispose of empty pesticide containers as described on the manufacturer's product label. Also, the recommendations described in the *Canadian Pesticide Education Program, Applicator Core Manual, British Columbia Edition (Ministry of Environment 2011)* will be followed and as a minimum, pesticide containers will be emptied and to prevent someone from attempting to reuse the containers, they are typically cut open and then taken to an approved landfill. Granule *Bti* and *Bsph* come in plastic or paper bags which are approved for disposal with garbage in municipal or regional landfills.

In the unlikely event that the City of Prince George has pesticide that will not be used, the Ministry of the Environment and Climate Change will be contacted and consulted as to protocols for disposing of the pesticide.

3.5 Procedures for Responding to Pesticide Spills

All of the larvicides in this PMP are solids as either granules or pellets. Therefore, most of the guidelines for Pesticide Spills as outlined in the *Canadian Pesticide Education · Program, Applicator Core Manual, British Columbia Edition (Ministry of Environment 2011)* do not apply. However, spill equipment (i.e. a broom or shovel) will be ready and available at the storage site (including mobile storage). All persons authorized and trained to work with the larvicides will be familiar with the protocol for sweeping up spills. The spill equipment will include:

1) A long handled broom.
2) A shovel.
3) A water proof waste receiving container such as a used larvicide bag which could be taped up.

In most cases, when granular larvicide is spilled it can be scooped up with the applicator's hands and put back in the larvicide bag to be applied to larval habitat.

If a large spill occurs, such as in a vehicle or helicopter accident, the City of Prince George and/or their contractors will follow the recommendations as described in the

1) The source of the spill will be contained.
2) People and animals will be kept away from the spill site and people will be prevented from walking though, or driving through the spill.
3) The product label or knowledgeable agencies will be consulted to determine the best course of action for clean-up of the spill.
4) If the spill is small enough to be handled without assistance, clean-up will begin immediately.
5) Appropriate personal protective gear will be worn during the clean-up.

4. Environmental Protection Strategies & Procedures

The following sections describe the City of Prince George's policies for protecting the environment. Much of the information included in the following sections is drawn directly from the Integrated Pest Management Regulation and the *Canadian Pesticide Education Program, Applicator Core Manual, British Columbia Edition (Ministry of Environment 2011).*

4.1 Strategies to Protect Community Watersheds and Domestic & Agricultural Water Sources

The City of Prince George and their contractors will follow the following guidelines to protect watersheds:

1) The location of community watersheds will be determined by accessing the Ministry of Environment Community Watershed website: http://www.env.gov.bc.ca/wsd/datasearches/comm watersheds/index.html (not applicable to larviciding practice).
2) A 1Om pesticide free zone will be maintained around all streams, lakes and other water bodes (not applicable to larviciding practice).
3) A 1OOm no treatment zone shall be maintained upslope of a community water supply water intake (not applicable to larviciding practice).
4) An adequate buffer zone will be maintained around no treatment areas.
5) No mixing of pesticides will occur within a community watershed (not applicable to larviciding practice).
6) No pesticides will be stored within a community watershed.

In order to protect domestic drinking water and water for agricultural use, the City of Prince George and/or their contractors will strictly adhere to all standards for pesticide-free zones (PFZs) and (NTZs) as specified in the *Integrated Pest Management Act* and Regulations. Table 2 lists the PFZs and the NTZs for larval mosquito control applications.

Table 2

Standards as described in the *Integrated Pest Management Regulation* (IPMR) for Pesticide Free Zones (PFZ) and No Treatment Zones (NTZ) to protect water during mosquito control activities.

Insecticide	Water Source	Regulation	Applicable Section from IMPR
Bacterial Larvicides	Water supply intake or well used for domestic or agricultural purposes, including water for livestock or for irrigation or crops	Exempted from PFZ	71(12)
	Bodies of water* and streams	Exempted from PFZ however no treatment allowed in permanent, fish bearing bodies of water or waters that have permanent, direct, surface water connections with fish bearing bodies of water.	78(2); 78(1)
Non-Bacterial Larvicides (Methoprene)	Water supply intake or well used for domestic or agricultural purposes, including water for livestock or for irrigation or crops	30m NTZ unless applicator is reasonably satisfied that the smaller zone will ensure that pesticide from the use will not enter the water supply intake or well.	71(3); 71(4)
	Bodies of water* and streams	Exempted from PFZ however no treatment allowed in permanent, fish bearing bodies of water or waters that have permanent, direct, surface water connections with fish bearing bodies of water.	78(2); 78(1)

*"Body of water" does not include a human-made, self-contained body or structure for water.

4.2 +Strategies to Protect Fish & Wildlife, Riparian Areas & Wildlife Habitat

Riparian areas are defined as the areas around bodies of water. These areas usually contain lush vegetation and high biodiversity (birds, insects, reptiles, amphibians, plants and mammals). Riparian areas are important for stream, lake and marsh health as they support vegetation that maintains bank stability and provide cover for water bodies to help maintain cooler water temperatures. With respect to pesticide applications, herbicides are generally considered the most dangerous pesticides in these ecosystems; however chemical insecticide applications are also of great concern.

Due to the low toxicity of the bacterial larvicides, applications will be conducted within riparian areas, however care will be taken to keep impacts on vegetation and soil at a minimum (i.e. attempt will be made to stay on paths and avoid trampling vegetation). Also, as per the Integrated Pest Management Regulation, fish habitat will be protected as no larviciding will take place in fish bearing waters with continuous direct surface water connections with fish bearing waters.

4.3 Strategies to Prevent Contamination of Food Intended for Human Consumption

The larvicides proposed for use in this PMP will not cause contamination of food intended for human consumption. This is due to their physical properties and their use only in aquatic areas. However, general guidelines for safety will be followed by applicators (i.e. applicator will wash hands before eating and food will be stored separately from pesticides and equipment used for larviciding).

4.4 Pre-Treatment Inspection Procedures for Identifying Treatment Area Boundaries

When planning to larvicide, the applicator will ensure that he or she has permission to treat the site, and the applicator will ensure that he or she is not treating in a permanent, fish bearing body of water or waters that have permanent, direct, surface water connections with fish bearing bodies of water.

4.5 Procedures for Maintaining & Calibrating Pesticide Application Equipment

Constant calibration of larviciding back-pack blowers and aerial application equipment will be done daily during all treatments. As these products broadcast spread the larvicide granules, applicators must be aware of the spread pattern and its correlation to application rate. Spread pattern "posters" are displayed at the larvicide storage shed, and applicators are encouraged to look at these often. Applicators will be trained on the appropriate use of backpack blowers so they are able to adjust their calibration as they walk through and around standing water (walking slower and faster).

4.6 Procedures for Monitoring Weather Conditions & Strategies for Modifying Pesticide Application Methods for Different Weather Conditions

During larvicide activities (hand application, backpack blower application or helicopter application), the following weather conditions will be· considered:

1) Precipitation (weather forecasts may be consulted and conditions at the site will be observed). In significant rain events, the aerial larviciding equipment can be clogged and so in the event of significant rain, aerial application may be postponed.
2) Wind speed will be observed and recorded once per day. When wind speeds reach a level that causes granular product to drift outside of the treatment area (i.e. the applicator is no longer able to control the placement of granules accurately), application will be postponed.
3) Temperature is not a factor in larviciding treatments although at present this variable will be recorded once per day to comply with current pesticide legislation.

5. Records & Reporting

Under the Integrated Pest Management Regulation, the City of Prince George and their contractors are required to maintain records of all pesticide applications and submit an *Annual Record of Pesticide Use* and an *Annual Notice of Intent to Treat.*

5.1 Treatment Records

The City of Prince George will maintain, for three years from the date of treatment, records of all pesticide applications including:

1) Treatment location
2) Pre-treatment monitoring results (larval dips)
3) Treatment and date
4) Type of pest targeted (mosquito larvae)
5) Trade name of pesticide used and its PCP number
6) Method of application
7) Rate of application
8) Total quantity of pesticide used
9) Relevant meteorological conditions (i.e. wind, precipitation, temperature) unless this requirement is changed by the Ministry of Environment since it is not applicable to granular application of larvicide.
10) Result of post-treatment monitoring and evaluation

5.2 Records of Larval Development Sites

The City of Prince George will work towards creating records of all larval development

sites, including:

1) GPS location or description of the location of the site
2) Name, address and phone number of owner or manager of the treatment site
3) Information concerning no-treatment areas or areas where permission has not been granted by the landowner.

5.3 Annual Report of Pesticide Use

By January 31st of every year, the City of Prince George will submit an *Annual Report of Pesticide Use* to the Administrator of the Integrated Pest Management Regulation which will include a summary of the previous calendar year's use including:

1) The name and address of the City of Prince George and their confirmation number
2) The trade name, PCP registration number, active ingredient name (s) and amount of pesticide product used in kilograms
3) The total area treated with each product.

5.4 Annual Notice of Intent to Treat

The City of Prince George will provide a *Notice of Intention to Treat* to the Administrator of the Integrated Pest Management Regulation 21 days prior to the commencement of the project in each calendar year of the PMP confirmation. The *Notice of Intention to Treat* will contain the following information:

1) The name and business location of the confirmation holder
2) A description of the proposed treatment locations for the calendar year and a map or diagram that clearly identifies those locations
3) A description of the proposed treatment for each area, including the pesticide to be used and its method of application.
4) The total area of the treatment areas in the proposed treatment locations for the calendar year.

6. Consultation

The Integrated Pest Management Regulation specifies that persons preparing a PMP must conduct public consultations. The Integrated Pest Management Regulation specifies that the consultation must include newspaper notices and "reasonable" efforts to contact and consult within individuals who have the potential to be impacted by a proposed pesticide use under the PMP. First Nations consultation will also be conducted. The City of Prince George completed all necessary consultations as described in the following sections.

6.1 Consultation Process

First Nations Consultations Summary for City of Prince George PMP

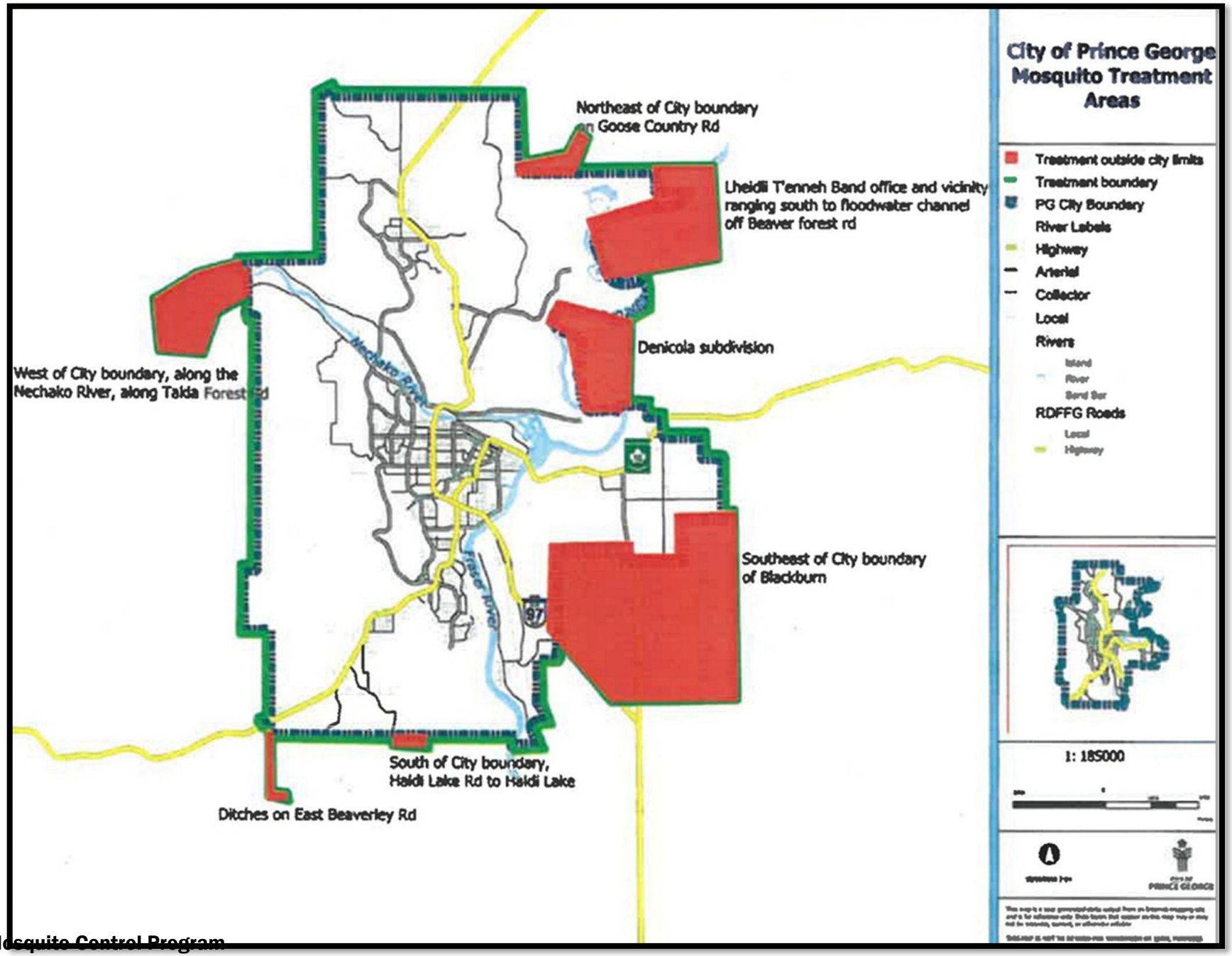
First Nation	1st contact	Letter received	Response to letter	2nd contact	.Additional notes
Carrier Chilcotin Tribal Council					As per SEA consultation map, no consultation is required for this PMP
Lheidli T'enneh First Nation	Registered letter sent Oct 16/20				
Nak'azdli Band	Registered letter sent Oct 16/20				
Nazko First Nation	Registered letter sent Oct 16/20				

6.2 Public & Stakeholder Response to the Amended PMP

N/A

Appendix A

Map of the Geographic Boundaries Described within this PMP
This map shows the boundaries of the City of Prince George of Prince George Nuisance Mosquito Control Program. Mosquito control treatments may be conducted anywhere within these boundaries.


City of Prince George
Mosquito Treatment
Areas
Treatment outside city limits
Treatment boundary
PG City Boundary
River Labels
Highway
Arterial
Collector
Local
Rivers
RDFFG Roads
Local
Highway
1: 185000
Northeast of City boundary
on Goose Country Rd
Lheidli T'enneh Band office and vicinity
ranging south to floodwater channel
off Beaver forest rd
Denicola subdivision
West of City boundary, along the
Nechako River, along Takla Forest Rd
Southeast of City boundary
of Blackburn
South of City boundary,
Haldi Lake Rd to Haldi Lake
Ditches on East Beaverley Rd

Appendix B

Checklist of Required Information for the Development of Pest Management Plan
From Section 58 of the Integrated Pest Management Regulation

	Section of IPMR	Task	Associated Section within this PMP
	58 1(a)	Description of geographic boundaries with maps, etc	Section 1.1, Appendix A
	58 1(b)	Person responsible for managing pests in relation to land described above.	Section 1.2
	58 1(c)	Principal contact for information	Section 1.2
	58 2(a)	Description of the program to prevent organisms from becoming pests	Section 2.1
	58 2(b)	Description of pest identification or techniques for pest identification	Section 2.2
	58 2(c)i	Description of monitoring methods of environment and target population before and during pesticide use	Section 2.3
	58 2(c)ii	Description of monitoring frequency of above before and during pesticide use	Section 2.3
	58 2(c)iii	Collected data of 2(c)i before and during pesticide use	Section 2.3
	58 2(d)i	Treatment threshold and description of how it was chosen	Section 2.4
	58 2(d)ii	How treatment threshold will be applied	Section 2.4
	58 2(e)i	Description of all possible treatment methods	Sections 2.5.1, **2.5.2**
	58 2(e)ii	Rational for treatment selection	Sections 2.5.1, **2.5.2**
	58 2(e)iii	Benefits and limitations for each possible method under Sec 2(e)i	Sections 2.5.1, **2.5.2**
	58 2(e)iv	Description of how treatment method was chosen	Section 2.5.3
	58 2(f)i	Description of monitoring methods of pesticide efficacy and environmental effects	Section 2.6
	58 2(f)ii	Description of frequency of monitoring of above	Section 2.6
	58 2{f)iii	Description of data collected for 2(f)i	Section 2.6
	58 3(a)i	Procedures for safely transporting pesticides	Section 3.1
	58 3(a)ii	Procedures for safely storing pesticides	Section 3.2
	58 3(a)iii	Procedures for safely mixing, loading and applying pesticides	Section 3.3
	58 3(a)iv	Procedures for the safe disposal of empty pesticide containers and unused pesticides	Section 3.4
	58 3(a)v	Procedures for responding to pesticide spills	Section 3.5
	58 3(b)i	Strategies to protect water sources and community watersheds.	Section 4.1
	58 3(b)ii	Strategies to protect fish, wildlife, riparian areas & wildlife Habitat	Section 4.2
	58 3(b)iii	Strategies to prevent human food contamination	Section 4.3
	58 3(b)iv	Pre-treatment procedures for identifying treatment area boundaries	Section 4.4
	58 3(b)v	Procedures for calibrating application equipment	Section 4.5
	58 3{b)vi	Procedures for monitoring weather conditions	Section 4.6

Appendix C

Copy of the Advertisement published in the Prince George Citizen on 14 and 21 January 2021

CITY OF
PRINCE GEORGE

CITY OF PRINCE GEORGE DEVELOPMENT OF A PEST MANAGEMENT PLAN NUISANCE MOSQUITO CONTROL

Pest Management Plan (PMP) Number : 567-0010-21/26

Applicant: City of Prince George, 1100 Patricia Blvd., Prince George, BC V2L 3V9. Tel: (250) 561-7600. Email: larrry.ward@princegeorge.ca Supervsior of Parks & Solid Waste

Application Method: Backpack Blower, hand application, helicopter

Pesticides: The active ingredients and trade names proposed for use under this plan include;

Bacillus thuringiensis var. israelensis (VectoBac 200G, PCP# 18158 and Aquabac 200G, PCP# 26863). Bacillus sphaericus (VectoLex CG PCP# 28008, and VectoLex WSP PCP# 28009). These products provide species-specific control of mosquito larvae and are non-toxic to other organisms including fish, birds, amphibians, wildlife, man and domestic animals.

Potential treatment Locations: Within the municipal boundaries of the City of Prince George and the surrounding adjacent areas, including; The Lheidli T'enneh band office and vicinity ranging south to the floodwater channel off Beaver Forest Road. West of the City boundary along the Nechako River along Takla Forest Road. East of the City boundary to the Denicola Subdivision. Southeast of the City boundary in Balckburn. Northeast of the City boundary on Goose Country Road. South of the City boundary along Haldi Lake Road, including Haldi Lake. South of the City boundary, ditches along Beverley Road. This PMP includes crown, private and Regional District lands within this boundary by permission of the applicable landowners or agency.

The proposed duration of this PMP is from 15 April 2021 to 14 April 2026. This Pest Management Plan is being renewed for the City of Prince George by Duka Environmental Services Ltd. an environmental services firm with extensive experience in pest management plan development. Information on proposed treatment areas, annual mosquito control program operations and this PMP are available to the public by request through Duka Environmental Services Ltd., 19732 - 68 Avenue, Langley, BC V2Y 1H6 (604) 881-4565, Facsimile (866) 759-5902, or email; duka@telus.net.

A person wishing to contribute information regarding a proposed treatment site, relevant to the development of this Pest Management Plan, may send copies of the information to Duka Environmental Services Ltd.. (agents for the City of Prince George) at the contact addresses above within 30 days of the publication of this notice. The identity of any respondents and the contents of anything submitted in response to this notice and application will become part of the public record.