Manitoba
Health, Seniors and Long-Term Care

Integrated Pest Management

Quick Guide for Provincial Cost-Share Participants

This document provides stakeholders with additional information and practical solutions for the integrated pest management of mosquitoes, particularly *Culex tarsalis*, as it relates to the Manitoba Health, Seniors and Long-Term Care (MHSLTC) provincial West Nile virus targeted cost-share larviciding program. Further, it may also be used to assist cost-share participants with the Integrated Pest Management (IPM) plan that must be submitted annually as part of the pesticide permit use condition as set out by Manitoba Environment and Climate Change. Note that questions involving pesticide use permits and IPM requirements should be directed to Manitoba Environment and Climate Change.

The purpose of this document is to 1) help improve mosquito control programs, 2) facilitate the development and use of IPM programs throughout Manitoba, and 3) improve the health outcomes for Manitobans. This document is intended to be a companion to: the Municipal Planning Documents provided by MHSLTC; the Canadian Pesticide Education Program: Applicator Core Manual; and Mosquitoes and Other Biting Flies Manual by the Federal, Provincial &Territorial Standing Committee on Pesticide Education, Training and Certification. All pesticide applicators in Manitoba receive IPM training as part of their pesticide licensing. Applicators may also choose to take an IPM certification course as part of their training. This is currently only required for Golf Course Pesticide Applicators but may be beneficial for all applicators, including mosquito control technicians.

Integrated Pest Management uses six elements: prevention, identification, monitoring, thresholds, treatments and evaluations to improve pest control outcomes. These elements are outlined herein, with specific examples, to show how cost-share participants can include the IPM concepts to improve the success of their mosquito control programs and to reduce the risk of West Nile virus infection within their respective communities.

Rationale

Manitoba Health, Seniors and Long-Term Care (MHSLTC) is committed to working with the communities, rural municipalities (RMs) and service providers to continually improve both the West Nile Virus (WNV) cost-share program and the health outcomes for all Manitobans.

The cost-share larviciding program represents a significant investment in financial, personnel and time resources for both the participants and MHSLTC. For this reason, periodic reviews of the program can be beneficial to help identify opportunities for improvements and support. One recommendation was to create a short and user-friendly resource on Integrated Pest Management and how it may apply to the cost-share participants. MHSLTC acknowledges that every cost-share participant has its own unique

challenges in terms of geography, personnel resources and in-house expertise. As such, not all suggestions and opportunities are available or practical for every stakeholder.

What is Integrated Pest Management?

Integrated pest management, or IPM, is a systematic decision-making process that aims to prevent pests from becoming a problem and to determine what actions to take if pest problems occur.

In an IPM program, all available information and treatment methods are considered to manage pest populations effectively, economically and in an environmentally sound manner.

What are the benefits?

By using an IPM program, cost-share participants will have opportunities to protect human and environmental health; provide long-term solutions to mosquito populations; reduce mosquito habitats; improve communications between stakeholders and the public, and possibly reduce pesticide use.

How does an IPM program work?

Communication is the thread that ties the elements in an IPM program together from the development phase through to implementation and evaluation. A large amount of data and observations must be made to craft a successful IPM program and then this information needs to be communicated amongst the stakeholders such as applicators, municipal staff, regional coordinators, and to the public for whom the program serves.

An IPM is a dynamic program in which information flows between the different elements (explained below) to create a stronger and more effective program.

Elements of an IPM

An IPM program has six key elements or phases: 1- prevention, 2- identification, 3- monitoring, 4- action/ response thresholds, 5- treatment, and 6- evaluation. This document outlines the details of each element with examples on how they relate to the cost-share program goals of reducing *Culex tarsalis* mosquito populations and thereby minimizing the risk of WNV transmission to residents of and visitors to Manitoba.

1 - Prevention

Prevention is important because avoiding pest problems is often more economical and provides better and longer-term results than relying on treatments (i.e. larviciding) alone. Prevention methods such as personal protection, source reduction and infrastructure planning can reduce WNV transmission.

A- Personal Protection

The public should be encouraged to take an ownership role in their own health by adopting behavioral and structural management practices aimed at minimizing mosquito exposure into their daily routines. Mosquito bites and therefore WNV illness are preventable. People should wear appropriate insect repellents, wear exclusion clothing (i.e. bug jackets and hats), cover up in long-sleeved shirts and pants, wear light-colored clothing and reduce the time they spend outdoors during peak mosquito biting times (typically between dusk and dawn). Structural management can be achieved by maintaining the integrity of window screens and doors, and using screened-in porches, gazeboes or similar when spending time outdoors.
Educational materials such as brochures, fact sheets and posters are available at https://www.gov.mb.ca/health/wnv/factsheets.html. Printed copies are also available at no cost by completing the order form available at http://www.gov.mb.ca/health/jmc/index.html.

Information highlighting the surveillance and control efforts of your mosquito control program can be included in local papers or other media. This can be used as an opportunity to encourage residents to adopt personal protection and source reduction (see below) measures. Residents may even respond to such information by providing applicators information on potential mosquito larval habitats and grant landowners permission to treat on their property. This can be very effective, especially in smaller communities.

B- Source Reduction

Mosquitoes require standing water for their eggs to hatch and to complete the immature phase of their life cycle. A mosquito can go from egg to flying adult in as little as 5 to 7 days, especially in shallow water sources where the water can warm quickly and where there are no predators.

While most mosquito control tends to focus on ditches, a significant number of water sources for mosquitoes are found in small, shallow containers on personal property. Some common examples of these “containers” include tires, children’s wading pools, clogged eaves troughs, empty paint cans, flower pots, buckets, tarps and liners, poorly maintained bird baths or water gardens, rain barrels, empty food or drink containers and many more (**Figure 1**). Any item that can hold water for several days can become a potential habitat for mosquitoes.

Figure 1: Tires fill with water and organic debris and become ideal mosquito breeding habitats. *Photo courtesy of P. Curry*.

Source reduction focuses on removing or regularly emptying containers, or other management techniques to reduce the number of potential larval mosquito development sites. Communities and RMs can encourage their residents to reduce the number of containers in their yards through educational campaigns (newspaper, radio, social media, newsletters), by having a "free garbage drop-off day", by supporting cleanup activities such as Earth Day or by organizing one with local Scout or 4H groups. One community shared that the "Communities-In-Bloom" program promoting beautification of the community has significantly contributed to residents removing unsightly items (such as old paint cans, tires) from their yards. This had the dual benefit of beautification and reducing of potential mosquito habitats.

Do not ignore commercial and industrial areas. Equipment that is stored outdoors, tires, tire ruts, large garbage receptacles can all accumulate water for larval development sites and contribute significantly to elevated mosquito populations (**Figure 2**). These mosquito sources are very close to workers and could increase exposure risk for employees. Encourage businesses to help them reduce potential mosquito habitats on their property. Encourage local health and safety committees to consider reducing mosquito habitats, thereby minimizing the risk of WNV transmission, as part of their regular safety inspections.

Figure 2: Industrial Mosquito Habitats. This urban parking lot next to a construction site was unable to drain for weeks resulting in the growth of cattails and mosquito larvae. *Photo courtesy of D. Race*.

Landscape management can play a role in reducing adult mosquito populations as well. Adult mosquitoes require a shady and humid place to rest in order to prevent drying out during the heat of the day. Residents and businesses can keep their lawns cut short and the foliage on their trees and shrubs pruned to allow more breeze. This is especially important for shrubs or trees near walkways and entrances in which mosquitoes can be disturbed by people walking by. Reducing the number of potential resting sites can reduce the numbers of biting mosquitoes around homes and businesses and thus lower the risk of WNV transmission.

C- Landscape Modifications and Infrastructure Planning

Considering mosquito management at the onset of new developments or public works projects, can prevent issues before they arise. Some considerations can include proper sloping so that water drains away rather than pooling in low spots or channeling run-off water into a rain garden, temporary floodwater retention area (i.e. soccer pitch, ball diamond) or storm water ditch.

Applicators can make note and flag areas that are consistently wet and can report these findings to the public works and park departments of the community or RM (**Figure 3**). These problem areas can then be targeted for remediation by in-filling, re-sloping or silt and debris removal.

These operations require coordination with municipal departments and applicators, but can often solve many problems at once. By in-filling or re-sloping problem areas drainage is improved, mosquito habitats are reduced, potentially dangerous water sources (such as near daycares or schools) are removed and the overall aesthetics are improved.

Figure 3: Source Reduction. This small rut can easily be filled in with soil and will cease to be a potential mosquito laying site site. *Photo courtesy of D. Enns*. **Please note that any major changes to drainage (i.e. digging deeper ditches, lowering of culverts, wetland drainage) need to be reviewed by Environment and Climate Change.**

2 - Identification

There are over 50 species of mosquitoes in Manitoba, each of them with their own unique combination of ecology, feeding habits and habitat preferences. The purpose of the cost-share program is to reduce the number of *Culex tarsalis* mosquitoes as this is the primary vector of WNV in the prairies. Understanding the habits of *Culex tarsalis* will help applicators target sites where this mosquito is likely to have laid its eggs.

Culex tarsalis is a true prairie mosquito species which thrives in the relatively hot and dry grasslands of the south central and southwestern portions of the province. It is rarely found in the boreal forest in the eastern portion of the province and is uncommon in the aspen parkland eco-region which circles the northern edge of the prairie. A map of the eco-regions is included in the Appendix F.

Culex tarsalis prefers to lay its eggs in sunny open locations that are organically rich – such as ditches or puddles. Early in the season, applicators should monitor roadside ditches, rights-of-ways along hydro corridors and railway tracks, culverts and open-air sun exposed locations where irrigation or drainage results in shallow, sun-light pools. As the season progresses and populations increase, *Culex tarsalis* will seek out small temporary pools and water filled containers, such as those previously discussed in the source reduction section, to lay their eggs. *Culex tarsalis* tend to be more common in rural or farm environments than in urban areas. *Culex tarsalis* is a generalist feeder, meaning that it will blood feed from a variety of animals including birds and mammals.

Culex tarsalis is not usually found in more permanent wetland such as bogs or cattail marshes. The water is usually too deep, too cool and filled with natural predators such as dragonfly larvae which keep mosquito populations low. However, in years of extreme drought *Culex tarsalis* may be limited in their selection of water bodies and may access these sites. They are also not commonly found in woodland pools as these water areas are usually too cool and shaded.

Applicators can be trained to identify *Culex* larvae on site using a simple hand-held field microscope (or magnifier) and a mosquito larval identification key in the field (Figure 4). This can help applicators become more familiar with *Culex* mosquito egg-laying habitats in their control area and become more proficient at finding additional sites. An excellent source for larval identification is "*The Insects and Arachnids of Canada Part 6: The Mosquitoes of Canada*" by Wood, Dang and Ellis and published by Agriculture Canada.

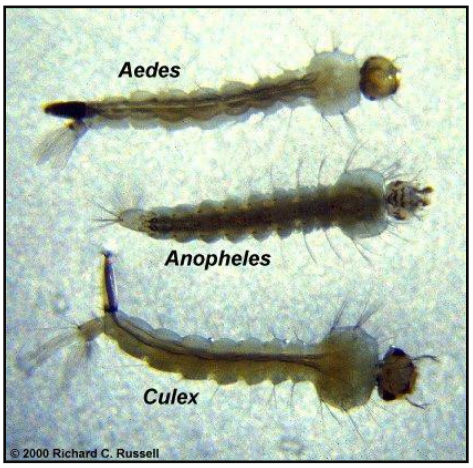

Figure 4: Various mosquito larvae. Note that *Culex* larvae have an elongated siphon and a large triangular shaped head. *Photo from* www.inyomonoagriculture.com

3 - Monitoring

Larval and adult mosquito surveillance allows applicators, cost-share participants and MHSLTC to make informed decisions regarding mosquito population trends and the level of WNV activity. Regular inspections, note taking and observations are all necessary to ensure that *Culex* mosquito population development is monitored and control activities are timely and well documented. It is equally useful to record when mosquito larvae are not found, just as it is when they are found. **The larval sampling logs are a legal document required by Environment and Climate Change as a condition of a pesticide use permit.** These logs also serve as a knowledge legacy document informing future decision makers and applicators about mosquito development sites, life history, standing water volumes and much more.

Documenting and mapping of potential *Culex tarsalis* larval habitats is an eligible expense for the cost-share program as is mapping and monitoring that are equally important for planning and response purposes. This is especially important as *Culex tarsalis* larvae are only found in about 20-25% of the available habitats.

Larval mosquito populations are monitored by using a dipper, or other receptacle, attached to a long stick. An applicator will "dip" in a body of water and count the mosquito larvae per dip. There is a lot of information that can be gained by dipping. An applicator can identify the mosquito species (or genus), count the average number of larvae per dip, determine which instar (growth stage), or if there are multiple instars (2nds and 4ths in the same dip for example), the presence or absence of pupae or pupal cases, presence of other beneficial insects, if the water is organically rich or not and a relative temperature of the water (warm, cool). All these pieces of information work together to inform the applicator what is going on with the mosquito larvae populations and if treatment should proceed.

Between mid-June and early September MHSLTC releases a weekly surveillance report using data from sentinel communities across southern Manitoba (accessible at www.gov.mb.ca/health/wnv). A Communicable Disease Control (CDC) trap with carbon dioxide as an attractant (**Figure 5**) is used to harvest mosquitoes and provide data for this report. This type of trap collects large numbers of mosquitoes (**Figure 6**), including *Culex tarsalis*, which are, in turn, tested for WNV. This report includes information on mosquito trap counts, average *Culex tarsalis* counts per trap per night, positive pools (through WNV testing), along with weather data, and by-week comparisons with previous years in addition to other surveillance indicators such as the number of WNV human cases that have been identified. Communities can find the sentinel community in closest proximity and use the surveillance data provided by MHSLTC to make decisions locally. In addition, communities may also wish to purchase these traps to assist in guiding any nuisance mosquito control program they may have.

Figure 5 & 6: CDC Trap with Carbon dioxide bait being set up for WNV surveillance (left), and collected adult mosquitoes (right). *Photos courtesy of K. Powell*.

4 – Action/ Response Thresholds

When it comes to mosquitoes, like most other pests, it is both impossible and impractical to eliminate them from the environment. Therefore, there will always be at least some mosquitoes through the spring, summer and fall seasons. The goal of an IPM program is to manage mosquitoes to a level where populations remain low enough that risk of WNV transmission to the public is minimized.

While the "HOW" to control mosquitoes is well-studied, the "WHEN" to control mosquitoes is a lot more subjective. People who live in rural areas are generally much more tolerant of mosquito activity than people who live in urban areas. Ironically, *Culex tarsalis* thrives in hot and dry summers, when other nuisance mosquitoes are not so numerous. Therefore, **the biting pressure of nuisance mosquitoes is not correlated to the risk of West Nile virus transmission**. Whether a community or RM also engages in nuisance mosquito control, in addition to the cost-share program, thresholds regarding when to treat need to be established in advance of the season. Clearly defined thresholds, based on larval and adult mosquito surveillance data, will allow communities and RMs to make evidence-based decisions which are a requirement of pesticide use permits.

A- Larval Treatment Thresholds

Due to the large size of many communities and RMs, applicators will often treat mosquito larvae when they are found regardless of instar simply because they may not return by which time the larvae will be adults and not be treatable by larviciding.

Applicators can estimate the larval density by taking 10 evenly-spaced dips per water body. If the average number of larvae is low (1 - 4 in 10 dips), it may not be worth treating, especially if the water body is large. Again, the goal of an IPM is not to eradicate the entire pest species, but to use treatments only when they have actual benefits. Densities greater than 5 larvae per 10 dips are generally worth treating especially if the water body is small (a larval sampling guideline is included in **Appendix A).** In the figure (**Figure 7**) below, more than 100 larvae were collected in a single dip, showing how a small site can produce a significant number of mosquitoes.

Figure 7: High Density of Mosquito Larvae. *Photo courtesy of K. Kokolsky*.

B- Adult Treatment Thresholds – Nuisance

MHSLTC's cost-share program does not cover adult mosquito control for nuisance mosquitoes. Communities may choose however, to fund their own nuisance mosquito control operations. If this is the case, MHSLTC and Manitoba Environment and Climate Change recommend that permit holders use adult mosquito traps to monitor mosquito populations, and establish thresholds/ triggers to limit adulticiding (fogging) to situations where nuisance mosquito populations negatively impact the quality of life. The frequency of trap deployment should depend on the individual municipality's needs, priorities and community tolerance (e.g. complaints). For municipalities who routinely conduct nuisance mosquito fogging, traps should be deployed throughout the season. Alternatively, for municipalities conducting fogging infrequently, traps may only need to be deployed ahead of time, such as in advance of any special community event. In addition, communities with infrequent trap use, may consider deploying these in response to citizen complaints to assess whether action thresholds/ triggers are met to conduct nuisance mosquito fogging.

Protocols as described in **Appendix A** of the Pesticide Use Permit (also included in the appendices of this document).

C- Adult Treatment Thresholds – West Nile Virus

The Province may conduct adult mosquito control in the presence of an imminent public health threat related to WNV. This decision is based on adult *Culex tarsalis* populations, the amount of WNV circulating in the mosquito population, past and predicted weather patterns, human population density, time of year and the current stage in the life cycle of *Culex tarsalis* populations. Should the threshold to trigger adult mosquito control related to WNV be met, MHSLTC and Manitoba Environment and Climate Change will inform and work collaboratively with the affected community or RM.

Adult mosquito control related to WNV will be conducted by municipal staff from Brandon, Winkler or Winnipeg as they are equipped and trained to carry out such operations. The pesticide product used is DeltaGard 20 EW®. Buffer zones will be respected for waterways, and attempts will be made to respect freshly harvested crops still sitting in the field, honeybee and alfalfa leaf-cutter bee operations and organic farms. As adult mosquito control related to WNV is aimed at reducing *Culex tarsalis* numbers and thus lowering the risk of WNV transmission, buffer zones requested by community residents are not respected as they are with nuisance mosquito control programs.

5- Treatments

Treatments can fall into multiple categories. Cultural treatments, for example are covered in the prevention section. It can never be stressed enough that people have control over their own behaviors to reduce mosquito bites and minimize the risk of exposure to WNV.

For the cost-share program, the treatments conducted by the applicators are larval treatments. Treating mosquito larvae while they are confined to a relatively small body of water is an efficient approach. This approach is also the safest for applicators, residents and the environment and provides the best overall treatment for reducing *Culex tarsalis* populations.

The products that are approved for use in the cost-share program use *Bacillus thuringiensis israelensis* (BTi) as the active ingredient in the commercial products AquaBac® and VectoBac®. *Bacillus sphaericus*, sold under the brand name VectoLex®, is another safe and effective biological treatment, but has a specific mode of action that may not be effective for conventional treatments. Cost-share participants wishing to use VectoLex ® should consult with the WNV Program Coordinator to ensure the use is appropriate and therefore covered as an eligible expense.

Treatments for mosquito larvae typically occur at the same time as surveillance. When an applicator finds mosquito larvae, the applicator should make a judgment as to whether control treatments are necessary and if so, conduct treatments based on label rates, temperatures, larval stages and organic matter content of the water. If time and staffing allows, it is preferable to wait for several days after a heavy rain to survey and treat in order to let excess water drain away and reduce the potential size of the area to be treated.

Larviciding with the above-mentioned products are the only chemical or biological treatments eligible as part of the cost-share program. Other larval treatment options do exist, but they may not be as safe or effective, or may not be suitable for the treatment of *Culex tarsalis.*

Treatments for adult nuisance mosquitoes will not be discussed in this document as nuisance mosquito control is not covered by the cost-share program.

6 - Evaluation

The goals of a program evaluation are to ensure that the IPM results are achieved. This applies both in the short term, such as level of control after a specific treatment, and in the long-term following the season. A program review is often useful to identify how the program can be improved and help plan for the following season.

Post-treatment evaluations are important to ensure that treatments are effective. These evaluations can help evaluate the accuracy and precision of the applicator, the functionality of equipment and the effectiveness of pesticide products.

A post-treatment evaluation should occur approximately 24 to 48 hours after larvicide treatments. This is done by surveying the water bodies where mosquito larvae were treated. The applicator should find either no larvae (they decompose quickly) or dead larvae. If mosquito larvae are still alive and active, this means that the water body may have been missed, the amount of product applied was insufficient or that the product is losing its efficacy (BTi has a shelf life of approximately two years if stored properly as indicated on the label).

Programs with adult mosquito traps can further verify the effectiveness of their control programs by monitoring the change in numbers of adult mosquitoes during the season. Keep in mind that mosquito traps catch a variety of mosquito species, some of which have specific times when the adults can be very numerous. It may be better to learn to identify *Culex tarsalis* adults to avoid confusion with changes in populations of other species (**Figure 8**). It can take up to two weeks before larval treatments will start to show reductions in adult mosquito populations.

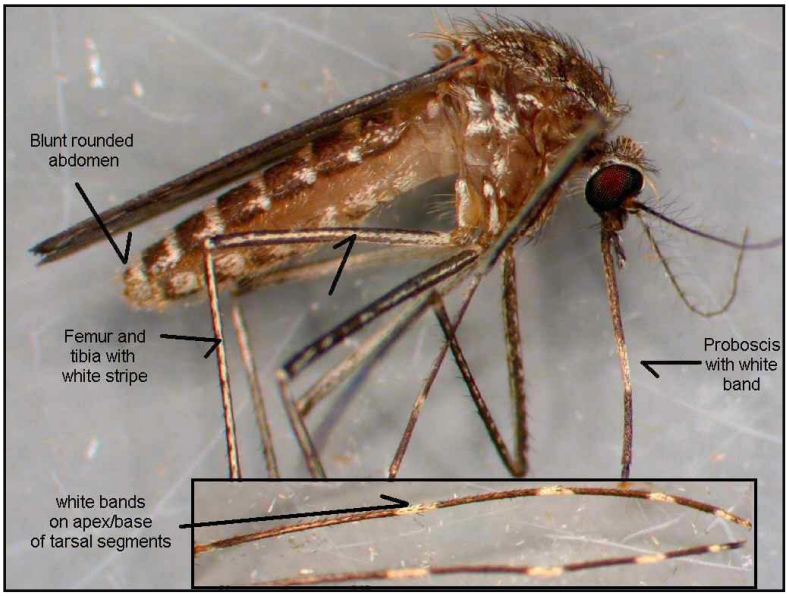

Figure 8: Adult Female *Culex tarsalis*. Note the distinct white band on the proboscis. No other prairie mosquito species has this feature. *Photo from* www.mosquitocontrolsouthdakota.wordpress.com/2012/07/05/west-nile-virus/

Reviewing treatment records, such as the larviciding logs, in retrospect can help identify local "hot spots" where mosquito larvae are frequently found in high numbers. These locations can become priority locations to monitor the following year. If multiple applicators are participating in the program, the larviciding logs can also help determine whether all applicators are treating consistently, according to label rates and whether their efforts are effective.

A comprehensive program review can include all aspects of the program. This is an opportunity to address concerns, suggest changes, and implement prevention or management strategies earlier in the program and come up with a solid plan for the following season. A program review can include feedback from the stakeholders including the public. MHSLTC program staff are willing to participate and assist with off-season program reviews at the request of participants.

Summary

To accomplish long term, successful and environmentally sound control of *Culex tarsalis* and reduce the risk of WNV exposure, the management of mosquitoes must use not one but all available mosquito control methods and tools. One such tool is an Integrated Pest Management plan. Not only is the development and implementation of an IPM plan now a requirement for the pesticide use permit, evidence has shown that IPMs are a valuable and effective tool for assuring responsible pest control.

MHSLTC along with Manitoba Environment and Climate Change are committed to helping communities achieve greater success in their cost-share programs to prevent WNV infections in an ecologically responsible manner. If there are additional questions or concerns, please feel free to contact MHSLTC and Manitoba Environment and Climate Change staff listed in **Appendix D** of this document.

Appendix A – Larval Mosquito Control Guidelines

Manitoba Environment and Climate Change

This document provides guidelines intended to supplement mosquito applicator training for applicators outside of the City of Winnipeg and focuses on the timing and triggers to initiate larval control (dip counts). It should be noted that adult mosquito control for reducing the risk of West Nile virus uses different criteria, targets certain species of mosquitoes and is carried out under a separate Ministerial Order.

Nuisance mosquitoes are usually the first to appear in the spring and can be abundant throughout the summer season depending on the amount of rainfall and standing water. Most species have a single generation per year, but the most common summer species (*Aedes vexans*) can have several generations if their eggs get re-flooded by heavy rains. These mosquitoes rarely cause human disease, but are small voracious biters that may occur in dense swarms. While most of the principles and techniques described in this document apply to appropriate use in all mosquito control programs, including those for West Nile prevention, this document is designed to address nuisance control specifically.

Effective nuisance mosquito control is maximized through an Integrated Pest Management (IPM) Plan. IPM planning can include:

- Identification of mosquito larval development sites.
- Creating a map or maps of the area where mosquitoes are to be controlled.
- Elimination, maintenance and reduction, where possible, of sources of mosquito habitat and development sites. These steps range from eliminating sources of standing water such as old tires, pails or other vessels that collect water to addressing blocked drainage or backfilling standing water sites.
- Biological control of mosquito larvae.
- Barrier control or residual treatments to control adult mosquitoes.
- Adult mosquito control (spraying or fogging) to control adult mosquitoes.

A pesticide applicator should conduct pre-pesticide application counts to determine if mosquito numbers are sufficiently high to warrant control measures, and post-application counts to determine the efficacy of the control program. Additionally, an applicator should have good up-to-date maps of the area being controlled and ideally should be able to identify the mosquito species being controlled at the larval and adult stages. At a minimum, applicators should be able to differentiate mosquito larvae from other aquatic insects and know the four larval instar (or development) stages and the pupal stage. For adults, applicators should be able to know the dominant mosquito species present and which ones are actively biting.

GENERAL CONSIDERATIONS

Surveillance is critical for effective mosquito control. Surveillance reveals the mosquito species that are active, including presence of disease vectors, larval sites and adult resting habitats, size of the population and when to apply pesticides for control.

A key component in surveillance is a good map of the area being surveyed. The map should include roads, ditches and other physical features that could include mosquito larval sites. Maps should be verified as to their accuracy and updated regularly. Maps should also include standard monitoring stations where dip counts will be routinely taken so that measurements are comparable and treatment efficacy determined in pre- and post-treatment counts.

When assessing the scope of the mosquito surveillance program, you may wish to consider:

- Extent of the problem or the population density of the larvae or adults;
- Closeness of the habitat to residential areas;
- Genus and species present and whether they can potentially cause nuisance or health concerns;
- Areas of environmental concern that need to be protected and extent of buffer zones that should be set to protect these sites;
- Notification requirements prior to application;
- Type of equipment best suited to control mosquitoes present;
- Amount of equipment required to effectively cover the treatment area; and
- Appropriate mosquito techniques.

To maximize the usefulness of surveillance data, be sure to also note key weather events such as temperature, windspeed and precipitation. Remember that all these factors can be variable across a surveillance area.

Monitoring of larval and adult populations should be completed before pesticide applications (triggers) and after to measure efficacy. Be sure to keep complete records of all your activities.

LARVAL MOSQUITO DIP COUNTS

The primary technique for larval population counts is the dip count. Ideally, dipping will be done at permanent marked dip stations for large areas or at random locations for small drainage basins or isolated woodland sites. Up to 20 dips per site (minimum 10) should be taken unless the threshold for treatment is exceeded with a small number of dips.

Using a standard system for sampling mosquito larval development sites will save time and simplify record-keeping. A sequential sampling technique can be used to estimate larval abundance and to determine if larviciding is necessary. The following table gives an estimate of larval density and can be used as a guide for treating or not treating a water body[1]. The counts are based on taking 10 dips taken around and close to the vegetation edge of the water body. At each “dip” the mosquito larvae are counted.

[1] Based on guidelines from the City of Winnipeg, Insect Control Branch

Density	Low	Medium	High
No. larvae in 10 dips	1-4	5-60	>60
Treatment required	No *	Yes	Yes

*Treating a site with low numbers depends on size. If it is small, then you can treat it. If the water body is large, then treatment is not cost-effective.

A larval survey form can be used when carrying out the survey of larval development sites. It is based on the sequential sampling table described above:

- If the number of larvae collected in at least 10 dips is 60 or more, the site is rated as "high".
- If only 1 to 4 larvae are collected in 10 dips, the site is rated as "low".
- If no larvae are collected, the site is rated as "nil".
- 10 dips must be taken to distinguish between "moderate' and "high".

Note that, if the surface area of the larval site is greater than 50 m by 50 m (2500 m²), then the number of dips taken should be doubled.

As a result of the collecting and maintenance of good surveillance information and map records, a mosquito abatement operation will become much easier with time. The importance of larval surveys will diminish as the years pass and the survey approaches completion. However, it must be remembered that each new land development may change the number and location of larval sites. In addition, there will always be an ever-changing number and distribution of container sites that require monitoring, not so much for the number but rather the kinds of mosquitoes present.

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APPENDIX B

Pesticide Use Permit Annual Report

Environmental Approvals Branch
Box 35, 14 Fultz Blvd
Winnipeg MB R3Y 0L6
pesticideusepermit@gov.mb.ca

Manitoba Environment and Climate Change

Please complete and return this form by March 31 following the year for pesticide program

REPORTING YEAR: _____ PESTICIDE USE PERMIT NO. _____

APPLICANT

NAME	ORGANIZATION REPRESENTED (DEPT., MUNICIPALITY, WEED DISTRICT, ETC.)	
BUSINESS PHONE NUMBER	FAX NUMBER	EMAIL ADDRESS
MAILING ADDRESS	CITY	POSTAL CODE

APPLICATOR

NAME	COMMERCIAL APPLICATORS LICENCE NO.

LOCATION OF SPRAY PROGRAM (Include map showing areas actually treated. Indicate legal land description of land and show right of way application.)

PESTICIDES USED IN PROGRAM

PESTICIDE	PEST CONTROL PRODUCTS ACT NO. (OF PRODUCT LABEL)	QUANTITY USED (L)	AREA TREATED (ha)

* You must provide the PCP number with your annual report.

DATE	SIGNATURE OF APPLICANT

PESTICIDES USED IN PROGRAM CONT'D

PESTICIDE	PEST CONTROL PRODUCTS ACT NO. (OF PRODUCT LABEL)	QUANTITY USED (L)	AREA TREATED (ha)

Appendix C
Information Bulletin - Integrated Pest Management Summary for Pesticide Use Permit Holders

Manitoba Environment and Climate Change

Effective January 1, 2014, Pesticide Use Permit Holders in Manitoba are required to comply with permit conditions that requires Integrated Pest Management (IPM) practices and techniques be exercised and documented.

An IPM plan and summary must be maintained and made available for review upon inspection by an Environment Officer. They should include ***descriptions*** of the IPM practices implemented at the site(s). Some examples of key areas that may be included in the report are provided below:

Planning and Preventing Pest Problems

- Document initiatives

Monitoring Regularly for Pests and Damage

- Recordkeeping and Evaluation (pre, post and at time of treatments)
- Site History
- Maps

Identifying Pests and Causes of Damage

- Education/Conferences/Seminars
- Coaching/Mentoring of Applicators
- Resources

Implementing Appropriate Management Methods

- Biological Control
- Chemical Control (Pesticides)
- Cultural Control
- Mechanical or Physical Control
- Application Technology

Environmental and Human Health Protection

- Mapping of No Treatment zones such as setbacks surrounding surface water features (as per label/permit instructions)
- Mapping of No Spray Zones surrounding registered objectors.

Failure to prepare an IPM summary is a contravention of the regulation and may impact the Pesticide Use Permit and/or result in regulatory action.

If you should have any questions please contact us at:

Manitoba Environment and Climate Change
Environmental Approvals Branch

Phone: 204-945-7065
pesticideusepermit@gov.mb.ca

APPENDIX D – Contact Information

Manitoba Health, Seniors and Long-Term Care

West Nile Virus Program Coordinator

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Communicable Disease Control – Population and Public Health Branch
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Manitoba Environment and Climate Change

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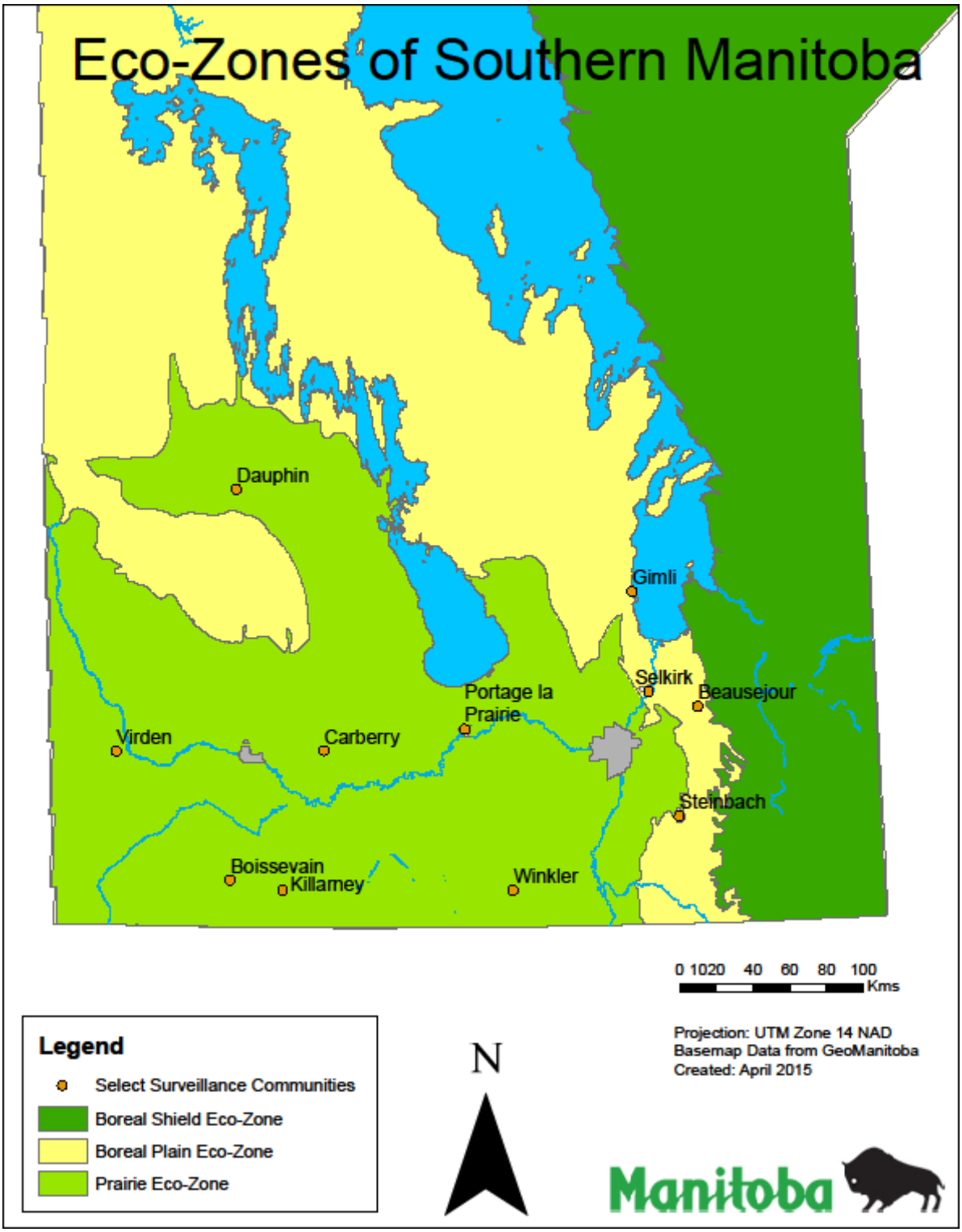
https://www.gov.mb.ca/sd/environment_and_biodiversity/pesticides

APPENDIX E – Eco Zones of Manitoba



APPENDIX F: Larval Sampling and Treatment Log

Larval Sampling & Treatment Log

City/Town/Village of:_____

Rural Municipality of:
_____

Larvicide Applicator:_____

Contact Number:
_____

Site ID	Water Present (yes/no)	Approximate Area Size (m^2)	# of larvae per dip	Date Dipped DD/MM/YY	Larvicided (yes/no)	Date Treated DD/MM/YY	Product	Rate*

CUMULATIVE AMOUNT OF PRODUCT APPLIED (kg) =_____

TOTAL TREATED AREA (m^2) =_____

* Rate is the calibrated setting for your application device. Please use Normal (N) or High (H).