MorrowBioScience

Metro Vancouver Regional District
Mosquito Control Program

2024 Year-End Report

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Executive Summary

Morrow BioScience Ltd. (MBL) has now completed its first of a three-year contract renewal as mosquito control contractor for Metro Vancouver Regional District (MVRD). The mosquito control program assesses, manages, and mitigates floodwater, saltmarsh, and identified permanent water mosquito and snowmelt mosquito abundance within the program-participating municipalities of the City of Coquitlam, City of Maple Ridge, Metro Vancouver Parks, City of Pitt Meadows, Township of Langley, City of Surrey, and City of Richmond. Most control activity takes place along the Lower Fraser River foreshore, river-associated seepage sites, and saltmarsh sites.

In April 2024, immediately preceding the mosquito monitoring season, the snowpack in most basins contributing to the Fraser River was lower than normal. Snowpack in contributing basins was augmented in April and early May before gradually melting between mid-May and early July. Significant precipitation events in late May resulted in the initial peak of Lower Fraser River levels at 3.04 meters on 7 June, followed by the official peak at 3.07 meters on 2 July. The 2024 Lower Fraser River peak was lower-than-average due to low winter snowpack and cool high elevation temperatures in May and June, delaying the annual freshet. Delayed freshet led to the Lower Fraser River peak levels above three (3) meters for just five (5) days in 2024, resulting in a reduced area of mosquito development habitat. Peak Fraser River levels (Mission) in 2024 were lower than those of 2023, and did not trigger compounded number of floodwater mosquito eggs to hatch. Environmental conditions were not optimal for a high rate of mosquito development in 2024.

Larval mosquitoes were treated between 24 May and 26 August. The total floodwater mosquito habitat and saltmarsh/permanent water mosquito habitat treated by ground was 69.43 hectares (ha). No floodwater mosquito habitat was treated by air in 2024 due to low Fraser River peak levels. Area treated by ground in 2024 was approximately 7 ha more than 2023, ground coverage increasing slightly this season, without the need for an aerial campaign. At all known sites, efficacy was assessed as high. A real-time monitoring and treatment data dashboard was provided to the managers of all MVRD participating municipalities. The dashboard enables partner municipality managers to view up-to-date treatment information and ensure quality control.

Residential concern was low in 2024, with twelve (12) concern calls and no concern emails received from local residents. Most of the concern calls were from the Langley and Richmond areas. The calls were likely the result of mosquitoes dispersing from Brae/McMillan Island and Kanaka Creek Regional Park. MBL staff responded to both calls and emails within a timely manner.

While no known sites were missed, low river levels can create micro-sites within river debris which are difficult to identify and may have gone untreated. Additionally, a 95% efficacy rate still leaves 5% of mosquitoes that may escape treatment.

A total of 80 trap nights were conducted this year. Adult mosquito trap specimen identification indicated that mosquito abundance was relatively low in May and June

trapping events. The highest adult mosquito collection event occurred on 10 July at Derby Reach Regional Park, the most abundant species identified was *Coquillettidia perturbans,* a local floodwater mosquito that is influenced by the Lower Fraser River peak levels from early-June to early-July in 2024. A total of 552 mosquito specimens were collected in 2024. Approximately 60 percent of the female mosquitoes identified were cat-tail mosquitoes (*C. perturbans*). The relatively low adult mosquito abundance is a result of low and shortly sustained Fraser River levels. As of 26 October, the BCCDC reported two (2) human travel-related cases of West Nile virus in British Columbia and zero cases of Zika virus.

Communications remain a priority for MBL. In addition to offering informational pamphlets to program residents, MBL continues to provide easy-access to FAQ documents, blogs, and email contact forms on the its website thereby informing MVRD residents of all available local and regional mosquito abatement efforts. MBL staff gave one interview to The Tyee, a provincial media source. Information pertaining to personal protection and habitat reduction was relevant to all MVRD residents.

Season Highlights

- The peak Fraser River level at the Mission gauge occurred on 2 July at 3.07 meters.
- The 2024 peak was approximately 2.46 m lower than the 2023 peak.
- Fraser River levels above 3 meters lasted for 5 days.
- The snowpack in basins contributing to the Fraser River ranged from 56-79% of normal on 1 April, immediately preceding the floodwater mosquito season.
- El Niño Southern Oscillation (ENSO)-neutral weather patterns augmented the snowpack in contributing basins in April and early May.
- Local precipitation accumulation for April, May, and July was below average, while June and August were above average.
- Peak river levels were below those of 2023, with late arrival of freshet, and low peak water levels led to low floodwater mosquito larval abundance in 2024.
- No aerial campaigns were required within the MVRD mosquito program purview during the 2024 mosquito management season.
- Total ground treatments at floodwater mosquito development sites were applied to 69.43 ha (277.72 kg granular Aquabac®).
- Adult mosquito trap efforts in 2024 included a total of 80 trap nights, an increaase from 25 trap nights during 2023.
- Most adult trap sites were set up in inconspicuous locations in 2024, resulting in fewer vandalism challenges.
- A total of 552 adult mosquito specimens were collected from 14 trap site locations.
- Floodwater mosquitoes comprised approximately three (3) percent of trap sites contents.
- This year, the peak of adult mosquito abundance was not related to the official peak of the Lower Fraser River.
- Derby Reach Park had the highest mosquito trap abundance, suggesting potential for treatment of cat-tail development habitat.
- A total of 12 concern calls to the Mosquito Hotline were received in 2024. No emails were received.

- Of those calls, six (6) came from Langley with adult nuisances likely due to floodwater mosquitoes dispersing from Brae/McMillan Island and Kanaka Creek Regional Park.
- MBL staff gave one interview to The Tyee, a provincial media source. Information pertaining to personal protection and habitat reduction was relevant to all MVRD residents.
- The BCCDC has provided an update on West Nile virus cases in the province, reporting two (2) human cases as of 26 October.
- Relatively low levels of WNv activity were reported in Washington State and Idaho State despite a warm spring and summer.

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Introduction

Morrow BioScience Ltd. (MBL) is the longest-operating mosquito control firm in British Columbia, having conducted mosquito control in this province for nearly four decades. The 2024 mosquito season marked MBL's first year in a 3-year renewal contract term with the Metro Vancouver Regional District (MVRD).

The MVRD mosquito control program involves a range of floodwater mosquito habitat, saltmarsh mosquito habitat, considerable program reach, and a high population density. These variables make the MVRD mosquito control program complex. Historical experience with this program and other comparable regional programs has created a strong knowledge base from which to build. That understanding has helped improve floodwater and saltmarsh mosquito development site management within the MVRD. In addition to MBL's knowledge base, MBL's commitment to public engagement, program data transparency through the use of MBL's in-house real-time data collection portal and client dashboard, combined with improved environmental accountability via annual carbon offset purchases further strengthens the MVRD mosquito control program. MBL's goal is to continue to provide effective floodwater mosquito control to Metro Vancouver Regional Parks, City of Coquitlam, City of Maple Ridge, City of Pitt Meadows, Township of Langley, City of Surrey, and City of Richmond while remaining socially and environmentally responsible.

Carbon Offsets

The spatial reach of the MVRD mosquito program is such that driving is an inevitable requirement. The accumulated mileage over the course of 2024 was approximately 25,000 km (ground transportation only).

As an estimation, the 2024 driving requirements for this program resulted in the production of approximately 6.3 tonnes of CO_2 emissions. Of note, MBL used an electric vehicle for all the adult trapping, the highest mileage portion of the program. To offset this addition of CO_2 to the environment, MBL has committed to purchasing carbon offsets. To fulfill this commitment, carbon offsets are purchased through the Neighbours United – formerly West Kootenay Ecosociety[1]. When the carbon offsets are purchased, a proof of purchase and certificate from the offset provider will be delivered to the MVRD.

Methodology

As large areas of the MVRD are within the Lower Fraser River's flood plain, the primary targets of the MVRD mosquito control program are floodwater mosquito larvae. Female floodwater mosquitoes (e.g., *Aedes vexans*, *Ae. sticticus*) deposit their eggs on damp substrate that experiences flooding. Within the MVRD, floodwater mosquito development sites primarily exist along the flooding corridor of the Fraser River, including associated seepage sites and the islands within the Fraser River. When water floods these sites, due to

[1] https://neighboursunited.org

the freshet and/or significant localized precipitation, the result is large-scale floodwater mosquito egg hatching. If numerous seasons have passed between high-water years, then high river levels may trigger a compounded number of mosquito eggs to hatch, resulting in a compounded number of mosquito larvae. While study results vary, Breeland and Pickard (1967) estimate that *Aedes vexans* eggs can remain viable for up to four (4) years while they await necessary hatching cues.

Additional targets of the MVRD mosquito control program are twofold : 1) Permanent water mosquito species (e.g., *Anopholes punctipennis, Culex pipiens, Culex tarsalis*), found specifically within City of Richmond ditches, and (2) Saltmarsh mosquitoes (e.g., *Aedes dorsalis*), found in saltmarsh habitat within the cities of Richmond and Surrey. Female permanent water mosquitoes lay their eggs in rafts on the surface of quiescent water. Most permanent water mosquito species within the MVRD are univoltine. Alternately, many saltmarsh mosquito species may have multiple independent hatches each season. Saltmarsh mosquitoes lay eggs on the damp substrate next to calm brackish or saltwater sites that flood. When water floods the sites due to tidal influences or precipitation, the result is large-scale mosquito egg hatching.

MBL field technicians began monitoring floodwater mosquito development sites within the MVRD prior to the Fraser River levels rising in the spring. Similarly, saltmarsh and permanent water mosquito development sites were monitored beginning in the early spring when maximum daily temperatures were more consistently near 15°C. Mosquito development sites are adaptively managed; regional river levels and local temperatures largely dictate how frequently sites are visited, as opposed to a prescribed monitoring schedule. At the height of the mosquito season, MBL staff may monitor highly productive sites multiple times a week. Adaptive management techniques allow MBL staff to most accurately time treatments, if necessary. Prescribed monitoring methods increase the risk of missing optimal treatment windows due to potential accelerated mosquito development rates with rising temperatures (Read and Moon 1996). Hence, as regional river levels and ambient temperatures begin to rise consistently, monitoring efforts increase accordingly.

Image 1. Standard dip (350 ml) with 2nd and 3rd instar floodwater mosquito larvae (7 June 2022).

Larval mosquitoes in sufficient number (i.e., >4/dip; Image 1) are treated by ground applications of a microbial larvicide product, Aquabac®. This product has the active ingredient *Bacillus thuringiensis* var. *israelensis* (Bti). In 2024, only the granular formulations of Aquabac® was used. The granular form is carried on a corncob mixture and the liquid form is water-based. The mode of action is relatively simple and with a high degree of target species specificity. Receptors within the mid-gut region of the mosquito larvae are compatible with the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval mid-gut cells occurs. This event causes damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert 2000).

As the season progresses and more mosquito eggs are triggered to hatch, it becomes increasingly difficult to treat sites by ground in a timely manner due to access challenges and concurrent site activation. At this point, a helicopter is used to conduct aerial treatments. Aerial campaigns use the same pesticide as ground applications, although typically with a higher application rate to permeate canopy cover.

Treatments are timed to target the 3rd and 4th larval instars. If treatments are applied too early, the larvae will not have reached their highest feeding rate and may not ingest the Bti spore. If applied too late, the larvae molt into pupae (i.e., non-feeding stage). Both circumstances may result in the development of adult mosquitoes. Additionally, by waiting until mosquito larvae are in the 3rd and early 4th instar stages, early instar larvae are available as food sources in the ecosystem.

Sites are treated when a standard dip (350ml) collects >4 late instar (3rd or 4th instar) larvae per dip. When flooding commences and ambient temperatures rise, many dips easily exceed this threshold. Larval densities within the range of 200-500 per dip are commonly detected (Image 1). All sites are checked within one or two days of the initial treatment to ensure treatment efficacy. If necessary, touch-up treatments are conducted.

Environmental Conditions

Lower Fraser River levels are the main environmental condition that impact floodwater mosquito sites - the great majority of mosquito development areas within the MVRD mosquito control program purview are associated with Lower Fraser River levels. The main environmental conditions that affect the Lower Fraser River levels throughout the mosquito season (i.e., April – August) are: 1) snowpack in basins contributing to the Lower Fraser River, 2) local precipitation, and 3) ambient temperature in snow basins contributing to the Lower Fraser River. Local ambient temperature is also of interest due to the effect that local ambient temperature can have on mosquito egg hatching and larval development rates. Each condition provides insights into the onset of floodwater mosquito egg hatching, development rate, and success. As such, all noted conditions are tracked throughout the season.

Snowpack

The water levels of the Lower Fraser River are largely dictated by the freshet released from the Fraser, Thompson, and Nechako Plateaus between April and July. The Fraser River is also influenced by tidal variations and high, spatially concentrated precipitation accumulation, although to a lesser degree. When snowpack exceeds 100 percent of normal and when regional precipitation accumulation is above average, higher-than-average Lower Fraser River levels are expected during the mosquito season. Similarly, high ambient temperatures within contributing basins can compress the melt timeline, resulting in high Lower Fraser River levels even if the snowpack in the contributing basins do not exceed 100 percent.

On April 1, immediately preceding the 2024 MVRD mosquito monitoring season, the snowpack within basins influencing the Lower Fraser River ranged from 0-80 percent of normal (**Table 1**). The lower-than-average snowpack was likely a result of the impacts of the El Niño weather pattern that was in place during the winter of 2024. Above-average ambient temperatures in April - July were recorded locally, with high elevations snowmelt between May and early-July in contributing snow basins. Cool, high elevation ambient temperatures resulted in the depletion of snowpack nearly a month later than 2023. Despite

warm and wet conditions, low peak levels for the Lower Fraser River were recorded at Mission gauge in 2024.

Table 1. Snow basin indices (2023 and 2024, 1 April % of normal) for basins that directly affect the Lower Fraser River flood plain, determined by the River Forecast Centre.

Basin	2023 April Snowpack	2024 April Snowpack
Upper Fraser East	79	59%
Upper Fraser West	91	0%
Lower Fraser	88	67%
Middle Fraser	87	59%
North Thompson	82	71%
South Thompson	90	80%
Nechako	101	70%

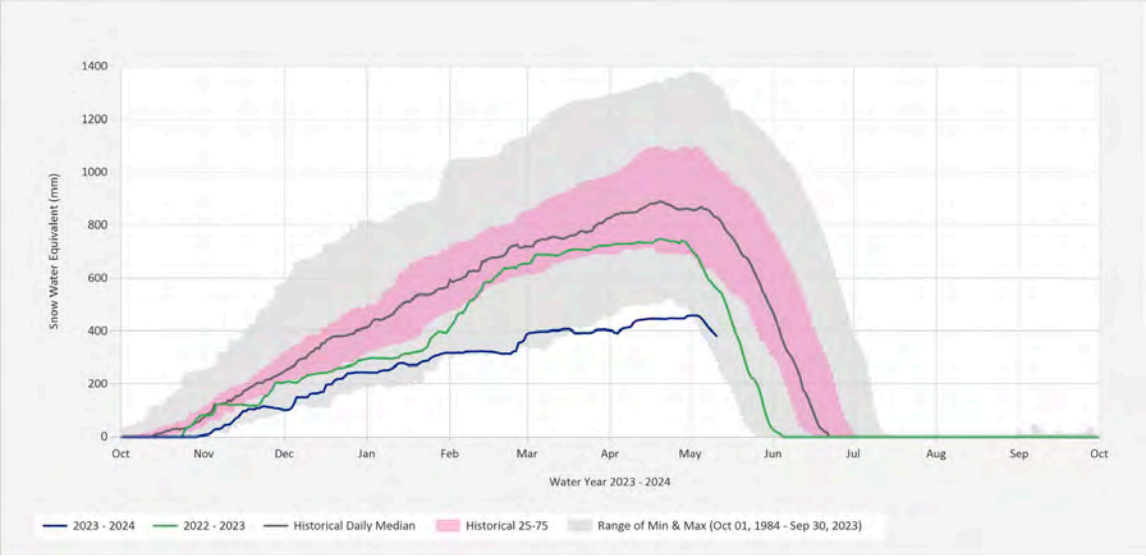

Figure 1 Snow Water Equivalent (SWE; mm) at the Revolution Creek snow survey station (ID: 1A17P) within the Upper Fraser East basin. The upper blue line indicates SWE data for 2023-2024.

The Revolution Creek snow survey station (ID: 1A17P) reflects weather trends in the Upper Fraser snow basin (**Figure 1**). The snow basin contributes approximately 30 percent of the Fraser River flow at Hope[2]. The Revolution Creek snow survey station serves as a representative site for the regional snowmelt trajectory for high-elevation snowpack. Notably, snowpack slightly increased through April and then rapidly depleted through

[2] 2024_may1.pdf

May. The trend in visible snowpack reduction started in early May, with the depletion of high elevation snowpack by early July (**Figure 1**).

Warm weather in May and June resulted in the depletion of most high elevation snowpack in the Revolution Creek snow survey station[3] by early-July. This trend is consistent with other high elevation snow survey station data throughout the influential basins. Lower elevation snowpack showed signs of considerable melting in April and May.

With warm ambient temperatures in most contributing snow basins in June, snowpack at high elevation snow stations were completely depleted by mid-July. The June 15 snow basin indices ranged from 0 – 69 percent of normal[4]. This low range reflects the abnormality of snow remaining in those basins in mid-June. Warm ambient temperatures within influential snow basins continued in June and early July resulted in the exhaustion of remaining of snowpack.

Generally, the snowpack remained for one week longer-than-normal within Fraser River-associated basins. The 2024 Fraser River freshet was set apart in two ways: 1) lower than average snowpack within contributing basins and 2) and a briefly sustained freshet above 3 meters. Both features led to lower-than-average Lower Fraser River peak that was sustained long enough to provide environmental hatching cues to floodwater mosquito eggs at some sites within MVRD.

Local Precipitation

Substantial temporally and spatially concentrated precipitation accumulation may elevate Lower Fraser River levels and increase seepage site levels. Tracking local precipitation accumulation can aid MBL field staff in determining how long mosquito development sites may require management. The Mission West Abbey weather station (ID: 1105192) provides both historical precipitation accumulation averages (i.e.,1981 – 2010) and current-year totals, allowing for the comparison between the two. This comparison facilitates some level of prediction regarding larval mosquito hatching and treatment timing requirements. When more-than-average precipitation is received within peak hatching months additional floodwater mosquito eggs may be triggered to hatch.

Precipitation received to the Mission West Abbey weather station in April (127.6 mm) was higher than average (**Figure 2**). It is unlikely that local precipitation impacted target mosquito development in April due to low Fraser River levels. Local precipitation in May was also above average (127.0 mm), with significant rainfall events that may have influenced regional river levels below three (3) meters. High precipitation values were noted in June (157.0 mm), likely influencing already elevated regional river and lake levels, while precipitation in July (35.6 mm) was below the station average. Together, the precipitation received in June and July was approximately 86 mm higher than the average sum of the two months. Precipitation received during the Lower Fraser River freshet was higher than average, and likely augmented river levels above those that would have been observed due to the freshet alone. Variable precipitation accumulation was noted

[3] https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=c15768bf73494f5da04b1aac6793bd2e

throughout the Fraser River watershed, adding to Fraser River levels along the system. Other target mosquito development habitat (e.g., permanent water and container mosquito habitat) was also likely amplified due to specific rainfall events in May through August.

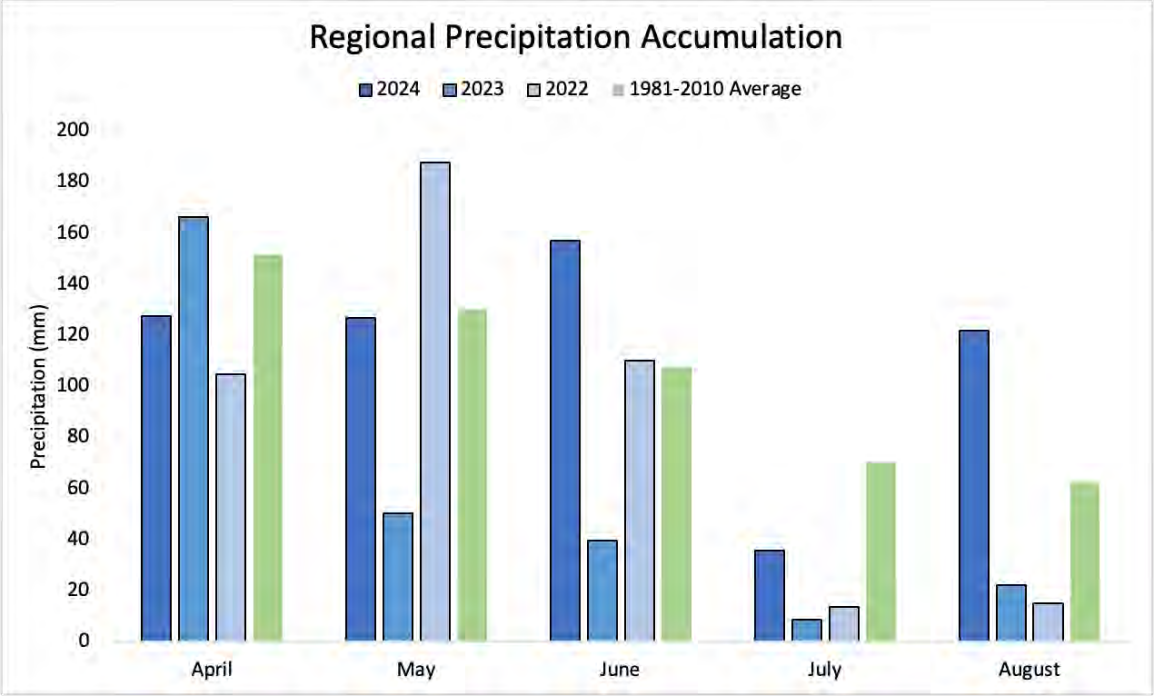

Figure 2 2024 precipitation values (rainfall and snow accumulation; mm) recorded at the Mission West Abbey Station (ID: 1105192) for 01 April – 31 August (dark blue) 2023, 2022 and average station precipitation values (1981-2010; green).

Precipitation accumulated in July at the Mission West Abbey station (35.6 mm), was slightly just below the station's July average by 4.4 mm. August precipitation was approximately double the average with 122 mm recorded (**Figure 2**). Precipitation received during August was of little consequence to the regional Fraser River levels and associated mosquito development sites because the univoltine floodwater mosquito species had already hatched and/or seepage sites had returned to dry states. However, it is possible that precipitation received in August created habitat for container mosquito species to reproduce. Thus, adult mosquito presence toward the end of the season was likely due to multi-voltine mosquitoes from these sites, not floodwater mosquito species in certain areas.

Ambient Temperature

Tracking ambient temperatures at all basins associated with the Lower Fraser River is important. Local ambient temperature fluctuations from April through August can affect mosquito egg hatching, larval development rates, adult dispersal, and adult survival within MVRD mosquito development habitat. Within contributing snow basins, ambient temperature dictates the commencement and often the intensity of the freshet, which directly impacts floodwater mosquito development habitat.

Fraser River Watershed Temperatures

The 2024 mosquito monitoring season began in April with near average ambient temperatures within most basins contributing to the Lower Fraser River. The weather in April was relatively stable across much of the province [4], with ambient temperatures ranging from +0.5 to -0.5°C of average[5].

Warm temperatures with variable low-pressure systems took hold in April with above average temperatures continuing into August. The ambient temperatures were above average in all months locally, however, cool high elevation temperatures delayed melting in eastern snow basins in April. High-elevation snowmelt during May and June within the Fraser River watershed provided gradual freshet to the Fraser River. Continued warm temperatures throughout July depleted remaining high elevation snowpack in contributing snow basins.

July and August were above average in temperature, with below-average precipitation, providing very little input to the Lower Fraser River, helping to dry the majority of floodwater mosquito development sites within the program purview. Ambient temperature data are consistent with 2024 automated snow station data depicting snowmelt points correlating with regional ambient temperature spikes[6].

MVRD Temperatures

Local ambient temperature is a predictive tool when gauging floodwater egg hatch commencement. If the ground proximate to the Fraser River contains floodwater mosquito eggs and if hatching conditions are present (i.e., low dissolved oxygen, higher ambient temperatures), then floodwater mosquito egg hatching will commence (Mohammad and Chadee 2011). Local ambient temperature data are acquired from the Mission West Abbey weather station (ID: 1105192).

To illustrate the effect of ambient temperature on floodwater mosquito egg hatching events, Trpis and Horsfall (1969) exposed submerged eggs of a common univoltine floodwater mosquito species, *Aedes sticticus*, to various constant air temperatures and recorded hatching success. Results revealed that eggs began to hatch at 8°C, although larval development was slow and survivorship was low. Eggs held at 21°C provided the optimal temperature, of the five temperatures tested, for hatching and larval development.

While *Ae. sticticus* is not the sole floodwater species present in the MVRD, it serves as a representative species for our purposes and provides general developmental benchmarks.

[4] 2024_may1.pdf
[5] 2024_june1.pdf
[6] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-science-data/water-data-tools/snow-survey-data/automated-snow-weather-station-data

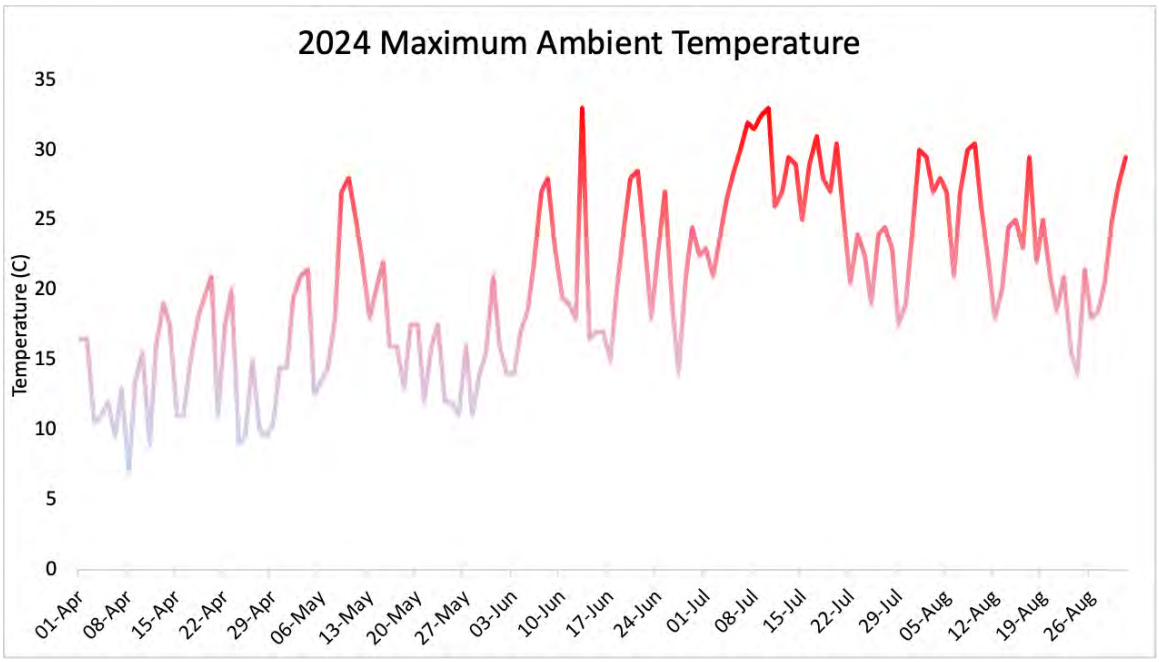

Figure 3 Maximum daily ambient temperatures (C) as recorded at the Mission West Abbey Station (ID: 1105192) 01 April – 31 August 2024.

The MVRD 2024 season began with above average ambient temperatures for April. The monthly average for April (13.6°C) was 4.2°C warmer than the historical station average for April of 9.4°C. Given that April temperatures frequently were above the lower temperature bound for successful floodwater mosquito egg hatching, floodwater mosquito eggs within the MVRD were likely activated within April if exposed to flooding conditions (**Figure 3**). If mosquito eggs were exposed to water during this month, the larval development at cooler temperatures would have been slow (Trpis and Horsfall 1969).

Local ambient temperatures in May were warm and within the temperature range for favourable larval development conditions for target mosquito species (**Figure 3**). The average maximum daily temperature of 17.3°C for May 2024, was 4.4°C warmer than the historical station average. Thus, mosquito egg hatching and larval development rates increased within May, larval development was likely faster than normal for that point in the season. Appropriately, larval mosquito treatments increased in mid-May as local ambient temperatures approached the upper bounds of temperatures associated with higher floodwater mosquito hatching success rates (**Figure 3**).

Ambient temperatures during June were also warm, providing sufficient hatching cues for all target mosquito eggs exposed to water. Warm weather in June corresponded with levels briefly above 3 meters for the Lower Fraser River at Mission. When river levels remain high during periods of warm ambient temperature, the result is large-scale mosquito egg hatching events and increased larval development rates. Therefore, because considerable floodwater development sites were at peak levels during periods of warm ambient temperature, there was a need to treat mosquito larvae in June.

High ambient temperatures, such as those noted in later July and August, are likely to decrease the lifecycle of adult mosquitoes (Ciota et al. 2014). Thus, any mosquitoes that successfully emerged would have had a reduced lifespan with the heightened ambient temperatures through August (**Figure 3**).

While not a target of the MVRD mosquito control program, container mosquito abundance typically increases in July and August. Container mosquito habitats near residential homes can be created throughout warmer summer months whenever the presence of water is coupled with high ambient temperatures. MBL technicians regularly inform residents that container-bred mosquitoes can be reduced around homes by ensuring conducive environments (i.e., bird baths, kiddy pools, flowerpot holders, etc.) are either free of water or refreshed frequently.

River Levels

Floodwater mosquito development sites within the MVRD are found along the flooding corridors of the Fraser River and within associated seepage sites. As the presence of water is the main hatching cue for floodwater mosquito eggs, springtime Fraser River levels provide predictions about the timing and extent of floodwater mosquito egg hatching. The 2024 Lower Fraser River freshet began in early-May as a result of warm high elevation temperatures within contributing basins through early July. Snowmelt input marked the gradual rise of the Lower Fraser River (Mission gauge; 08MH024), as the result of seasonably warm weather conditions throughout most of British Columbia in the spring and summer.

Warm trends occurred in April with the trend continuing into early July. Warm temperatures, accompanied by above average precipitation, resulted in the initial peak of the Lower Fraser River (Mission gauge; 08MH024) at 3.04 meters on 7 June, with the official peak at 3.07 meters on 2 July (**Figure 4**). Of note, cool high elevation weather resulted in relatively low and briefly sustained Fraser River peaks above three (3) meters.

By mid-June 2024, nearly all snow basins contributing to the Fraser River were depleted of snow, with the exception of eastern contributing basins which showed 53% - 74% percent of average snowpack[7]. This gradual depletion corresponded with a marked decline in the Lower Fraser River levels starting in early July at Mission gauge (**Figure 4**). When the Lower Fraser River levels consistently remain below 3 m, associated seepage sites reduce quickly and by July many of the mosquito development sites were dry.

[7] http://bcrfc.env.gov.bc.ca/data/asp/realtime/

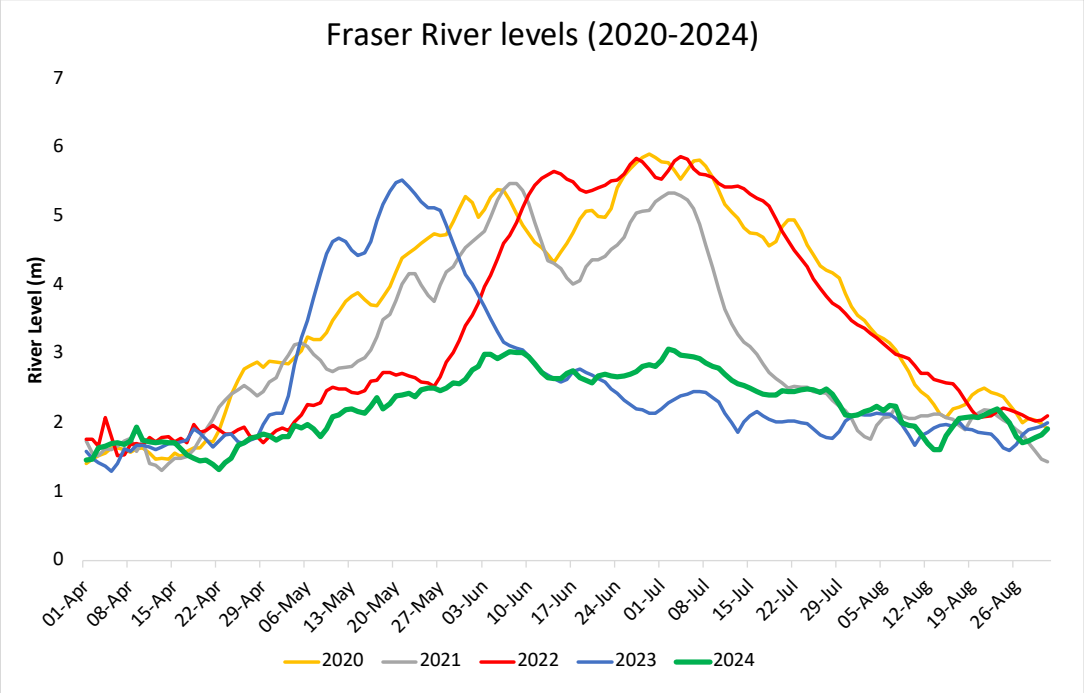

Figure 4 2024 river levels (m) as recorded for the Lower Fraser River (Mission gauge, 08MH024) from 1 April – 31 August. Compared to previous 4 seasons (2020-2024).

The level at which mosquito development sites within the MVRD have been observed to become active is approximately 3m. In 2024, the Fraser River reached 3 meters on 7 June, more than a month later than 2023 (**Figure 4**).

The length of time that the Fraser River at Mission remains higher than 5 meters (during more typical years) helps predict the extent of mosquito larval abundance within a given year. The Fraser River never rose above the 5-meter threshold in 2024. In average years, such as 2021, Lower Fraser River levels may remain above 5 m for closer to 20 days. River levels were sustained over the critical 3-meter Lower Fraser River level long enough to provide suitable conditions for floodwater mosquito development at associated floodwater and seepage sites.

The Fraser River's peak height relative to recent seasons is another predictive variable that may help explain an associated year's larval mosquito abundance. If the current year's peak regional river levels far exceed those of preceding season's, mosquito eggs laid between the high-water mark of both years could have remained dormant until current-year freshet trigger their hatching. Because the 2024 peak of the Fraser River was approximately 2.46 meters lower than the 2023 peak, the 2024 high water likely did not trigger additional dormant floodwater mosquito eggs to hatch (**Figure 4**). Low and briefly sustained high water levels occurred during a period of seasonably warm weather, providing hatching cues for floodwater mosquito eggs at a reduced number of sites. Thus, river levels that occurred during warm ambient temperatures led to a hatching of floodwater mosquitoes at a reduced number of sites in 2024.

Larval Control

Monitoring within the MVRD began on 22 April at floodwater mosquito development sites. Permanent water and saltmarsh mosquito development sites were first visited on 30 April. Although most of the floodwater mosquito development sites are not active until the Fraser River (Mission gauge) exceeds three meters, sites are monitored prior to peak levels to evaluate site conditions and catch the leading edge of any potential hatching events that may have resulted from the considerable precipitation received in April and May. Local ambient temperatures higher than approximately 10°C trigger the monitoring season for saltmarsh and permanent water mosquito development sites (Richmond, Surrey). Ambient daily high temperatures were regularly above 10°C starting in April. Warm ambient temperatures continued through May, coinciding with an increased in monitoring and larval mosquito treatments.

Appendix I shows a map of average larval densities found throughout the 2024 season. Larval abundance is assessed in the field using a system of ranges (0, 1-4, 5-49, 50+) for early and late instar mosquito larvae. In order to transfer these data to a map (**Appendix I A-F**), data are summarized and assigned to a hexbin (i.e., hexagonal polygons) representing an area of 21.65 ha. Only wet sites were included in the analysis. An intensity value representing the relative number and life stage of the mosquito larvae are assigned to each single sample. For each sample, late instar larvae ranges are weighted more heavily than early instar larvae ranges to indicate targeted life stage and treatment urgency. In this way, each sample is assigned an intensity value from 0 to 1. All sample intensity values are then averaged by hexbin. Thus, each hexbin is also assigned an average intensity value from 0-1. The intensity value thresholds within **Appendix I** denoting 'low', 'moderate', 'high', and 'very high 'were assigned based on biological significance and operational urgency. Of note, the areas with highest recorded larval abundance amongst known sites are within Brae Island Regional park, Langley, and Kanaka Creek Regional Park (**Appendix I A-G**). Fifteen (15) new mosquito development sites were identified throughout the MVRD program purview in 2024.

Hexbins are used to aggregate point data, making general data trends visible at large scales. The primary drawback and disclaimer to hexbin analysis is that generalizations must be made. In general, hexbins denoted as 'None Detected '(i.e., white) or 'Low '(i.e., light sandy colour) indicate the average sample contained < 5 larval mosquitoes per dip. In most cases, hexbins with a moderate frequency (0.2875 - 0.525 intensity value; light orange colour) or greater indicate those which had an average of > 5 mosquito larvae per dip. Hexbins can contain one or greater sample points, may contain sample points that lie directly on hexbin borders, or contain treatment area associated with a point that is officially housed within a neighbouring hexbin; each of these circumstances may create skewed results.

Low and briefly sustained Lower Fraser River peak levels coupled with warm ambient temperatures in May and June resulted in less floodwater treatments than average. A total of approximately 69 ha (277 kg) were treated within the MVRD in 2024. No known sites were missed in ground-based or aerial treatment efforts.

Appendix II is a collection of maps by municipality depicting where and how frequently treatments took place in 2024. In certain cases, hexbins denoted as 'Non-Detected 'or 'Low 'do have treatments associated with them (**Appendix II A-G**). In these cases, treatments may have been triggered by the larval activity of a representative site. Historically, when representative sites become active the other sites in the area have proven to also be active. Thus, sites with a previous designation of 'Non-Detected 'or 'Low 'may require a later treatment due to representative sites 'activity level without the need to sample. However, maps provide a high-level understanding of where treatments were concentrated.

Ground Application Summary

Floodwater mosquito development sites within the MVRD are visited on a weekly basis unless conditions required more frequent monitoring (i.e., Fraser River levels > 5m, ambient temperatures > 20°C, large precipitation event). Sites are treated when a standard dip (350ml) collects 5 or more late instar (3rd or 4th instar) larvae per dip. All sites are checked within 2 days of the initial treatment to ensure high treatment efficacy. If necessary, touch-up treatments are conducted.

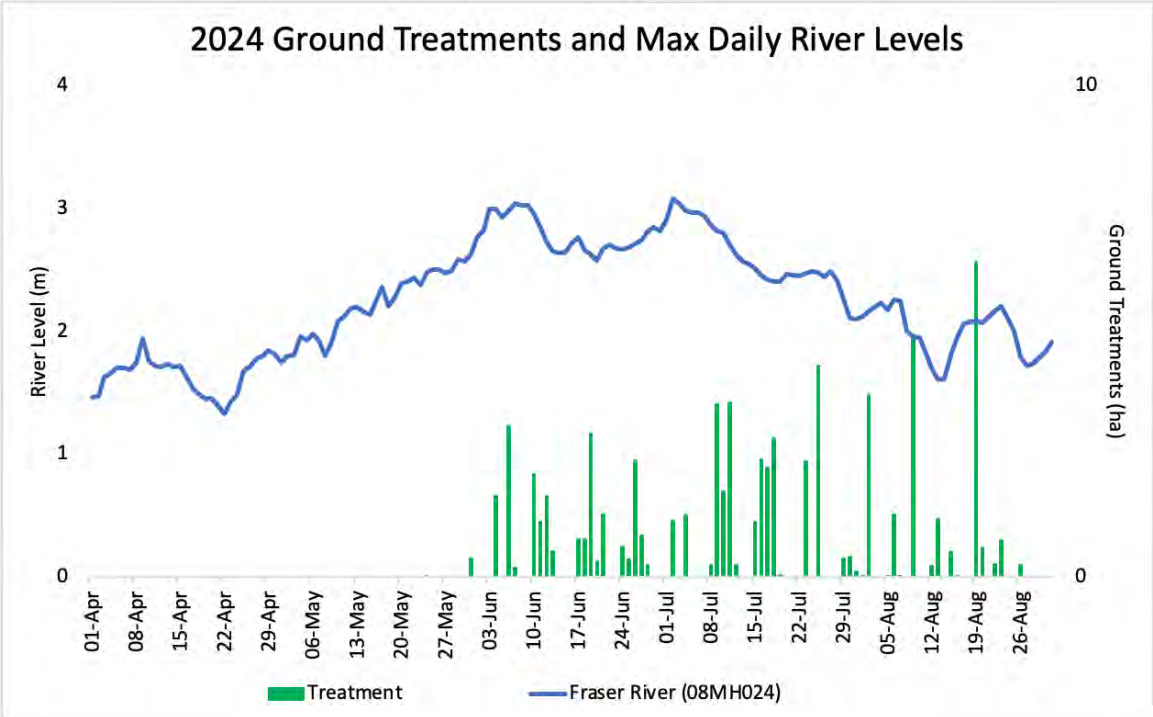

Figure 5 Fraser River levels (m; Mission gauge) with total mosquito development area treated by ground (ha) from 1 April – 30 August 2024. Note that ground treatments (ha) are recorded on the alternate y-axis.

The first floodwater mosquito development site was treated by ground on 24 May (**Figure 5**). Most ground treatments > 1 ha took place between 19 June and 25 July, as dictated by

peak Lower Fraser River levels. However, due to low and briefly sustained Lower Fraser River peak levels in 2024, treatments were low in August (**Figures 5**).

Aquabac® (a.i., *Bacillus thuringiensis* var. *israelensis* (Bti)) is the product used for all larval mosquito treatments conducted by MBL. Bti has a high target specificity and achieves 95% - 100% efficacy in typical field conditions (Aquabac® Mosquito Biolarvicide - Technical Bulletin). Within the MVRD's highly organic water conditions, MBL staff note an average field efficacy rate of approximately 85% - 90%. The granular formulation was used in 2024. Certain sites in the MVRD require an application rate of 6 kg/ha, although the majority require 4 kg/ha.

The total area treated by ground at mosquito development sites in 2024 was approximately 69 ha (277 Kg Aquabac®; 4 kg/ha) (**Figure 5**). Real-time data associated with each treatment are available through MBL's client-registered, real-time program portal.

Relative to the high freshet year of 2023, floodwater mosquito development habitat was greatly reduced in 2024. The snowpack within influential basins was lower-than-average, with snow augmentation in April and early-May before gradually melting between mid-May and early-July. Those conditions across much of the province led to low and late peak Lower Fraser River levels above three meters, for just five (5) days. Significant rainfall events in late-June may have slightly elevated the Lower Fraser River peak beyond the freshet alone. The briefly sustained Lower Fraser River peak was enough to provide floodwater mosquito development hatching cues at some sites. However, environmental cues were not present long enough to provide multiple floodwater mosquito hatching events, resulting in less adult floodwater mosquitos compared to 2023.

Aerial Application Summary

Floodwater mosquito development sites are treated by air when multiple large-scale sites become active at once and/or when site-access by ground is unsafe. Due to record low water levels, no aerial treatments were required within MVRD along the Fraser River corridor in 2024. The low mosquito larval abundance was due to low and briefly sustained Fraser River levels above three (3) meters that did not trigger the hatch of a compounded number mosquito eggs. For comparison, four aerial campaigns were required in 2023.

Aerial treatments during normal seasons are conducted using granular Aquabac®. To compensate for increased canopy cover, aerial treatments are applied at an average rate of 10 kg/ha.

Adult Mosquito Trapping

The primary objective of the adult mosquito trapping program is to assess adult mosquito abundance, which operates as a quality assurance/quality control (QA/QC) measure for larval mosquito control activities conducted by MBL technicians. The trap data allow MBL to compare intra and inter-annual nuisance levels. Additionally, species composition data

elucidates species present in the region, their primary habitat, and contributes to the general knowledge bank of mosquito science in the region.

Trap locations have changed since the beginning of MBL's contract tenure with the MVRD. While trap locations were initially located as close as possible to historical trap sites, many were moved in subsequent years to target areas of higher noted larval mosquito abundance and/or increased residential concern notifications. A total of 14 trap locations were selected in 2024.

All adult mosquitoes were collected using battery operated Center for Disease Control (CDC) traps with dry ice as bait. A black light (night-operating only) and dry ice (i.e., CO_2) act to attract adult mosquitoes. A continuously working fan ensures that attracted mosquitoes are pulled into an attached basket. Basket contents were collected the following morning. As per MBL collection and shipping protocol, adult mosquito specimens were collected from traps, stored in a freezer, then sent to the MBL head offices for counts and later identification. A real-time data collection application was developed to track trap set-up, take-down, and content shipments. Additionally, one consistent MBL staff member was responsible for all mosquito trap efforts, improving field efficiency and reducing operator error.

Traps were monitored approximately every 1 - 2 weeks between May and August. A total of 80 trap nights were conducted. A total of 528 adult female mosquito specimens collected. Approximately 412 less mosquito specimens were collected in 2024 than 2023. The low sustained Lower Fraser River peak was responsible for the decreased in adult mosquito trap abundance.

The initial Fraser River peak occurred on 7 June and due to the extreme low river levels there was no related increase in floodwater mosquitoes. The sample containing the largest number of adult specimens occurred on 10 July with a species composition primarily comprised of permanent water species *Coquillettidia perturbans* (~360). The majority of specimens from the Derby Reach trap collection event had dispersed from a cat-tail site. The species representing the highest percentages of specimens was *Coquillettidia perturbans* (~100%) (**Figure 6**).

Adult mosquito traps with the greatest number of specimens were from Derby Reach. The adult trap numbers at this location suggests that a cat-tail site was missed. MBL recommends treating cat-tail sites in May with Vectolex CG. No hotline calls suggested that this was a significant source of annoyance.

The adult mosquitoes collected from traps were generally well-preserved in 2024. Approximately 4% of specimens were damaged in 2024, as compared to approximately 14% in 2020, and nearly half in 2019. Some specimens were damaged upon identification but the vast majority were in good shape, a marked improvement.

Specimen identification was conducted and verified by trained professionals using a 60X microscope. The primary resources for species identification were Wood et al (1979),

Darsie, and Ward (2005). All female specimens were identified from samples with <50 female mosquitoes. Approximately 30% of female specimens were selected for identification from trap contents with high mosquito counts. Twelve (12) species were confirmed in the 2024. Certain indistinguishable specimens were either unknown or identified as either the *Aedes* or *Culex* genus.

Aedes japonicus was not detected in any MVRD (or FVRD) adult mosquito traps in 2024.

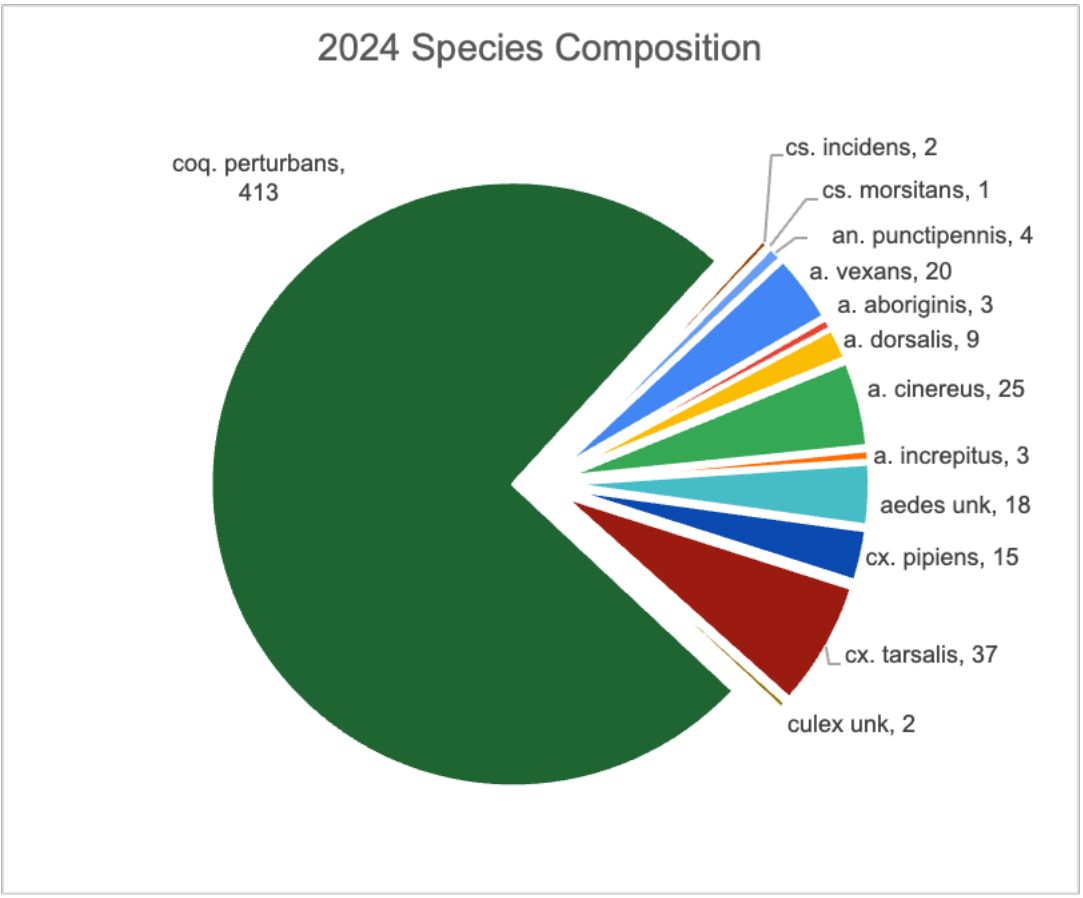

Figure 6 2024 over-all mosquito species composition from adult mosquito trap established throughout the MVRD.

Overall, floodwater *Cq. perturbans* species comprised the majority of the species in 2024 traps (i.e., ~75%; **Figure 6**). The primary habitat for *Cq. perturbans* is emergent vegetation, and more specifically *Typha* species (Batzer and Sjogren 2012).

RPAS (Drone) Update

Unfortunately, the news on RPAS (drone) treatments is not the positive news we would like to deliver. Internally, we have worked throughout the year to prepare for deploying drones for treatment work in 2025; we have nearly completed SFOC (Special Flight Operation Certificate) for flying drones over 25kg, we are insured, and our main drone pilot (Dirk Lewis) has his advanced pilot certificate for complex drone operations. With

MBL's transition to Valent products (we previously used and distributed Aquabac) we have several products available for use with drones, as RPAS is a permitted use on all their labels.

That said, the Province reprioritized some of their work and, despite a strong start early in 2024, shelved further work on the certification category for pesticide applications utilizing drones. To date, the only provinces that have categories for pesticide applications with drones are New Brunswick and Quebec. This work was further stalled by the Provincial election, with no direction during the interregnum. MBL is informed that it is likely a year out on the certification category being finalized (pers. comm. with Jon Mullan, Integrated Pest Management Unit Head). This would suggest that the earliest expected treatments would be for the 2026 mosquito season.

Given the financial and environmental savings this technology presents, we will continue to work with the Province to help develop this certification category.

Public Relations

Maintaining positive public relations continues to be a high priority for MBL. Public relations occur on several levels: in-person communication with members of the public, the mosquito hotline(s), presentations to staff and politicians, email correspondence, and social media presence. MBL continues to look for new areas to expand this aspect of our program.

Phone Calls and Emails

MVRD residents have multiple venues to communicate with MBL. MVRD set up an in-house mosquito control hotline number (604-432-6228), which is forwarded directly to the MBL Mosquito Hotline. The MVRD Mosquito Hotline number is specified on the education outreach postcard. MBL's Mosquito Hotline (877-986-3363) and email form, are outlined prominently on the contact tab of the MBL website (www.morrowbioscience.com).

There was a total of seventeen (17) calls received to either the MVRD Mosquito Hotline or directly to the MBL Mosquito Hotline in 2024. No concern emails were received from MVRD residents in 2024. Twelve (12) calls were designated as concern and five (5) were designated as inquiry-based (**Appendix V**). MBL's goal is to return all concern calls within 24 hours. This goal was achieved and the calls and email were returned within 72 hours.

The total number of calls and emails received in 2024 was low and reflects a reduced area of floodwater mosquito development habitat (**Figure 7**). The low number of concern calls and emails is due to the low adult mosquito abundance, a result of shortly sustained Lower Fraser River levels above three meters during warm ambient temperatures.

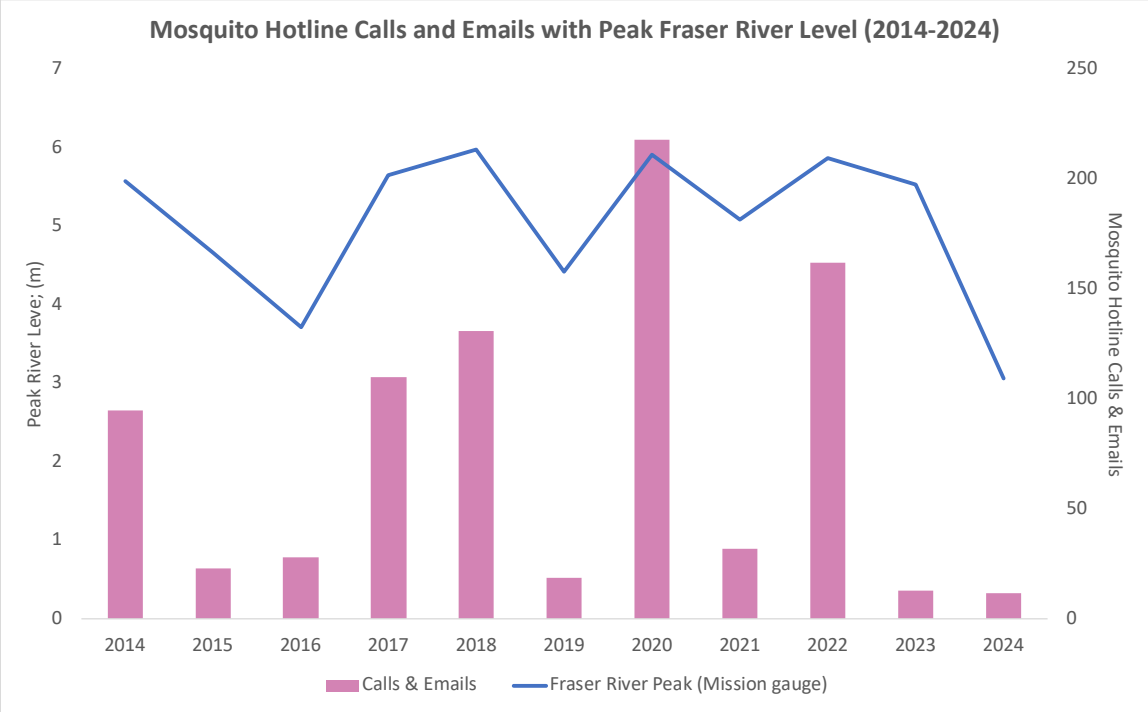

Figure 7 Peak Fraser River levels (m; Mission gauge) with total Mosquito Hotline calls and emails (2014-2024).

Concern calls were received pertaining to the Township of Langley (**Appendix V**; **Appendix VI**). The Township of Langley has extensive and dynamic floodwater mosquito habitat. As such, a considerable amount of control effort – including aerial campaigns – was focused on mosquito habitat within the Township of Langley. If product efficacy reaches its highest reported rate of 95%, the residual 5% in a year with high larval mosquito abundance can still amount to significant nuisance. Concerns coming from Township of Langley residents were generalized regarding the high abundance of adult mosquitoes; MBL staff followed-up with reconnaissance visits and located no new sites on residential properties. No concern emails were received in 2024.

In the early portion of the season, it typically takes 2 - 3 weeks for mosquitoes to emerge and disperse following hatching events associated with peak river levels. When rivers rise to peak levels in the warmer part of the season as occurred in late-May this year, floodwater mosquitoes eggs may hatch during a shorter period of peak river levels. Thus, the potential timeline for mosquito emergence and dispersal in 2024 likely ranged from early-June through late-July. Hotline calls were concentrated after the dispersal of adult mosquitos around early-July (02 July – 06 August). The peak Hotline call volume was associated with adult mosquitoes that likely dispersed as a result of high water between early-June and early-July. Two (2) calls received in August were likely associated with container and, or permanent water mosquito species.

MBL remains committed to continuing reconnaissance efforts to identify floodwater mosquito development sites, adaptive site management, and expanding in-house knowledge of sites. Expanding public engagement reach may also result in the

identification of new sites and reduction of mosquito larvae in the region. Through these efforts, MBL aims to further reduce adult mosquito nuisance within the MVRD purview.

Direct Communications

Direct communication between MBL staff and the public can occur in many situations. The most common direct interfacing with the public occurs when technicians are in the field. While conducting site visits, MBL technicians are often asked questions by residents. These encounters provide an excellent opportunity for public relations. An important outcome of these interactions can be the identification of new mosquito development sites.

MBL contact information is disseminated when field technicians have direct communication with the public. Contact information for MBL includes the website address, an email, phone number, and social media sites (Facebook and Instagram). Additionally, MBL staff may provide residents with an outreach pamphlet. The pamphlet includes information about the larval control product used, mosquito biology, and personal protective tips. MBL staff also disseminated MVRD mosquito control postcards.

Social Media

MBL maintains a presence on social media with a Facebook account (facebook.com/morrowbioscience) and Instagram account (morrowbioscience), which are regularly updated. There are five goals for MBL's social media presence: 1) provide timely and up-to-date information regarding conditions pertinent to mosquito production, 2) relay MBL's current efforts to control mosquitoes, 3) inform the public about MBL's efforts at environmental sustainability, 4) provide the community with opportunities to get involved with related public events, and 5) offer a platform for mosquito-related discussion amongst program residents and the MBL team.

Facebook remains the primary avenue for MBL to disseminate mosquito-related information on social media. Regular updates on mosquito abundance began in early April.

MBL Website

The MBL website (**www.morrowbioscience.com**) was launched in 2015 and redesigned in 2021 and is currently under another redesign. This site was developed to allow clients and the public to have access to information about MBL's background, activities, outreach, and company. To further support residents in contract areas, the homepage includes visible tabs for resources and the contact information. The 'Contact' tab allows users to directly send a message to MBL. Additionally, there are links to MBL's Facebook account so residents have access to real-time updates on MBL's activities.

The website specifically highlights two sets of FAQs focused on (1) mosquito biology and disease transmission, and (2) the active ingredient used in control efforts (*Bacillus thuringiensis* var. *israelensis*). MBL has added new blogs discussing relevant education

outreach topics. Information dedicated specifically to mosquitoes and COVID-19 (published in May 2020) remains available on the website.

Education / Outreach

Communication with program residents remains a priority for MBL. On 2 September, 2024, Christopher Cheung with The Tyee, an independent daily news website based in Vancouver, BC, published an in-depth article on mosquito abatement, past and present. The article included excerpts from an interview with MBL's owner and lead biologist, Dirk Lewis. The interview provided advice specific to personal protective measures and mosquito habitat reduction tips.

If opportunities arise, MBL staff ensure that the MVRD mosquito program manager is consulted prior to agreeing to an interview. Every effort will be made to accommodate interviews which assist in raising awareness about mosquito control efforts and personal protective measures.

All interview requests are approved by the MVRD program manager. Every effort is made to accommodate interviews which assist in raising awareness about mosquito control efforts and personal protective measures.

Discussion

This season was one for the record books. A relatively slow start to the season was a nice change for field staff, allowing everyone to get up to speed before the freshet came into the system. That said, the record setting part of the year was the very low water. Typically, floodwater sites do not activate until the Fraser rises to over 3m at the Mission gauge. With a maximum height just over 3m, very few sites became active. Treatments along the Fraser corridor were limited to pockets of water resulting from a combination of ground water, precipitation, and the higher tides. A total of 277kg (~15 bags) of Aquabac, for ground treatments along the Fraser, were used this year. For reference, in most years this would be considered a few large hand treatments at a few large sites.

The only issue of note this season was a wave of *Cq perturbans* from Derby Reach. MBL suggests that these sites are treated with Vectolex CG in the coming seasons. However, it is important to note that this wave of *Cq. perturbans* did not result in an uptick of complaint phone calls.

The low water this year could present an issue for the 2025 season, with another La Nina taking hold in the Province, we expect that water levels will again be high, and none of the habitat much above 3m was cleared of mosquito eggs laid in previous season. As such, we anticipate seeing higher larval densities than in recent seasons.

West Nile Virus Summary

Although floodwater mosquito species in Canada are not the main West Nile virus (WNv) vectors, it is important to remain current in regional mosquito-related diseases. Along with its partners, Health Canada compiles on-going provincially reported surveillance data of WNv cases in humans, animals, and mosquito pools between 1 January and 29 September.

As of 26 October, two travel-related human cases of West Nile Virus (WNv) were reported in the province of British Columbia.[8] Canada's National Microbiology Lab (NML) is currently working alongside provincial and territorial health authorities to conduct weekly mosquito surveillance and monitoring to regularly assess the risk of mosquito-borne diseases in Canada[9].

Of note, mosquito pool surveillance data are not reported to Health Canada from British Columbia, and it is possible that other information is not reported by the BCCDC to Health Canada.

As Washington State and Idaho State share a border with British Columbia, it is important to follow WNv activity in those areas, as well. According to the Center for Disease Control, as of 8 October, two human cases of WNv were reported in Washington State. No mammals or birds tested positive for WNv. Idaho identified six human WNv cases [10]. All cases were identified within counties in the southern and southwestern portion of Idaho.

Zika Virus Summary

No information regarding Canadian Zika cases has been reported by the Public Health Agency of Canada since 2017 and Heath Canada will no longer be updating case counts[11]. HealthLinkBC reports that no Zika cases have originated in Canada due to presumed lack of vector mosquito species[12]. There have been human Zika cases reported in Canada prior to 2024, however those were determined to have been acquired while traveling.[13]

According to Peach (2018), the primary Zika mosquito vectors (i.e., Aedes aegypti, Ae. albopictus) are not found in British Columbia. Ae. albopictus has been found on east coast but tested negative for Zika. There is currently a low risk for Zika virus to circulate within British Columbia.

[8] Seasonal update - Mosquito-borne disease surveillance - Vector-borne disease surveillance in Canada — Canada.ca
[9] Fight the bite: Mosquito borne diseases are on the rise in Canada (science.gc.ca)
[10] Current Year Data (2024) | West Nile Virus | CDC
[11] https://www.canada.ca/en/public-health/services/diseases/zika-virus/health-professionals.html#_Surveillance_in_Canada
[12] https://www.healthlinkbc.ca/health-feature/zika-virus
[13] Zika Virus Facts & Resources | HealthLink BC

2025 Program Recommendations

- If necessary, produce targeted social media posts directed at community group pages noting acknowledgement of any issues, site visit results, and follow-up plans.

- Notify the Ministry of Environment of the MVRD intent to treat mosquitoes in 2025 under the MVRD Pest Management Plan. Notification should take place 2 months before the start of the season (the end of February at the latest).

- Consider revision of MVRD Pest Management Plan to include the use of RPAS (Remotely Piloted Aircraft System – a.k.a "Drones") for larval treatments.

- It is important to attach copies of all the mosquito development site maps with the Notice of Intent to Treat (NIT). NOTE: all sites have been re-mapped. These new data should be used to reprint maps for the purposes described above.

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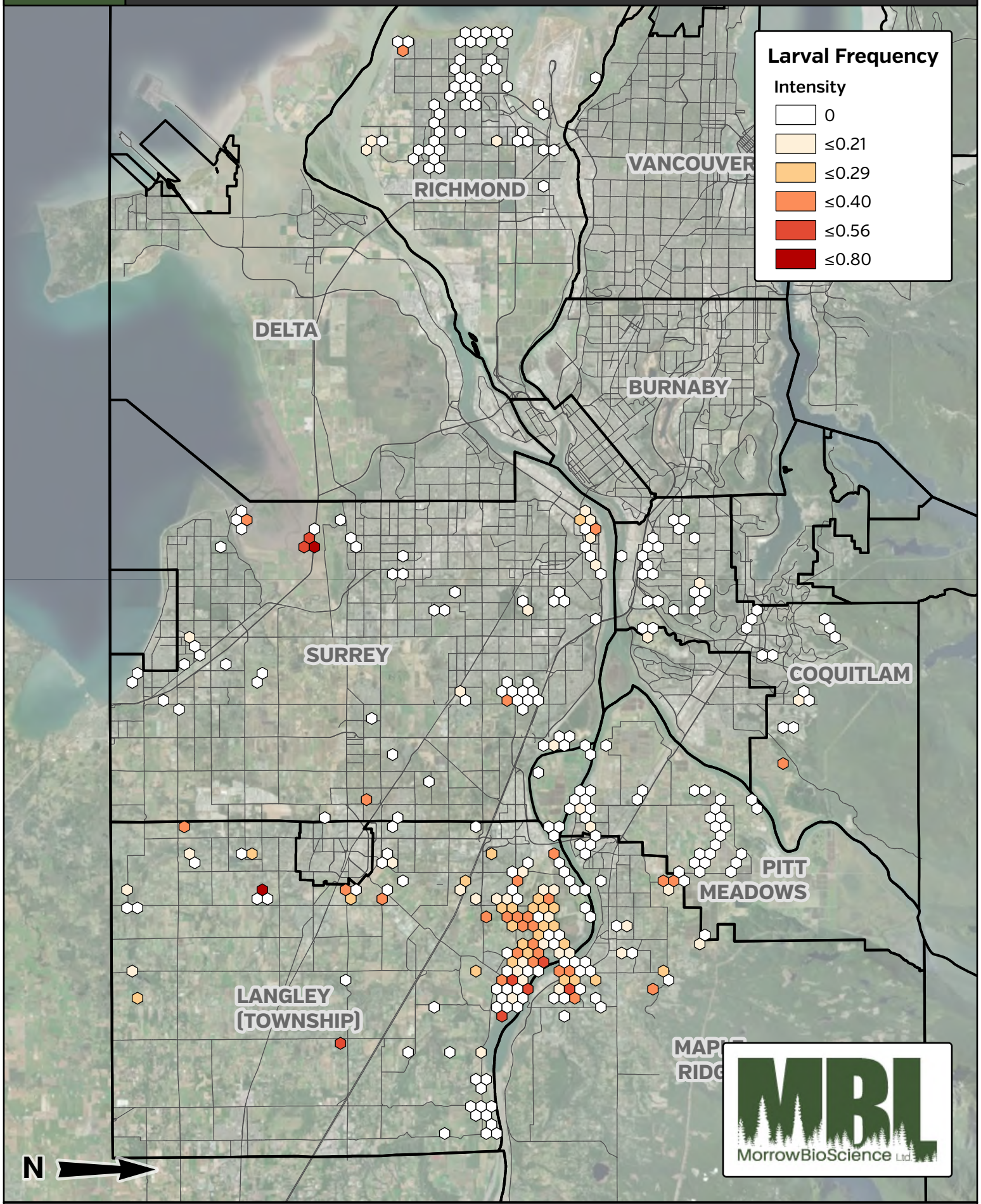
Appendix I-A

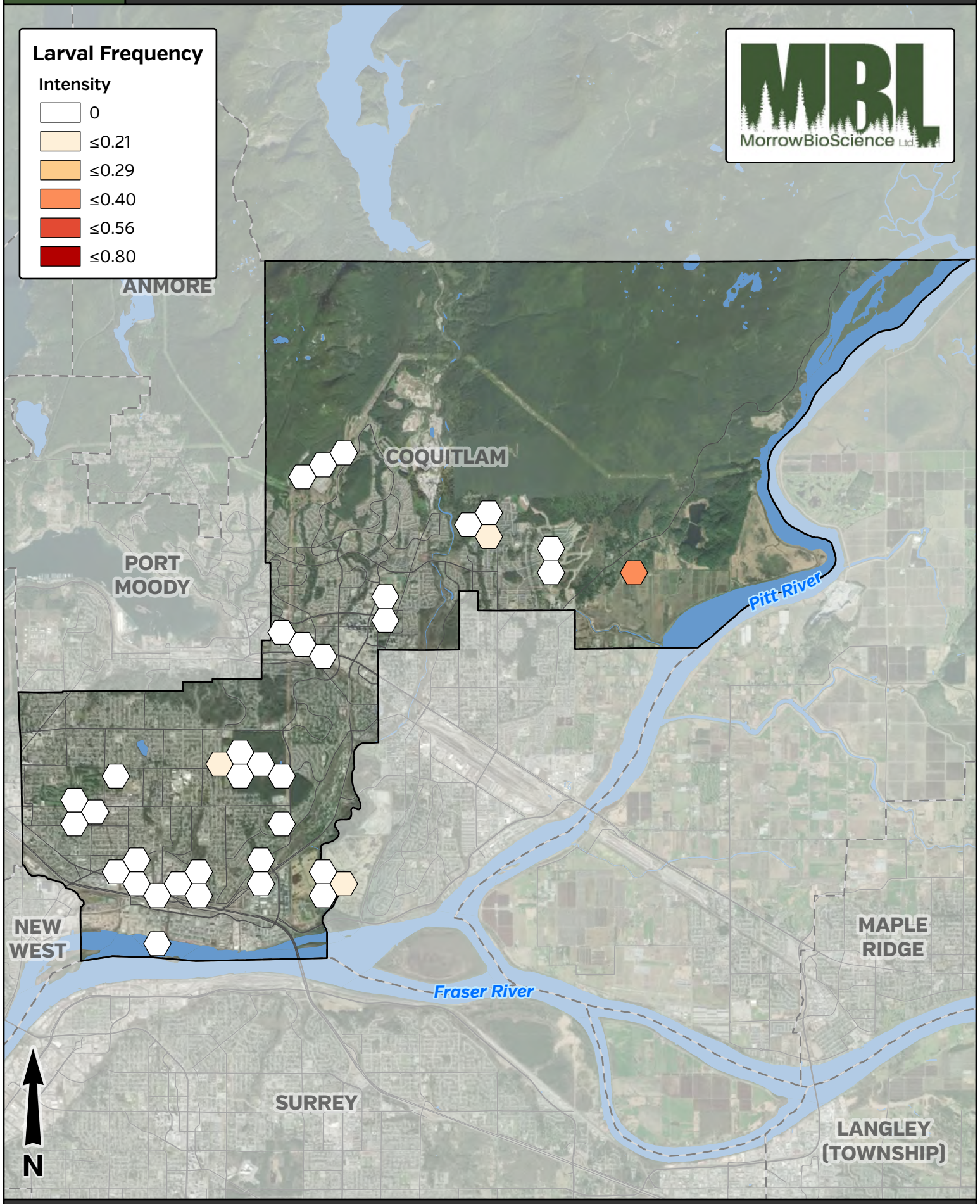
2024 Larval Frequency - MVRD



Scale = 1:230,000 | NAD 1983 UTM Zone 10N | Contains information licensed under the Open Government Act - Canada | Printed: 2024-11-17

Appendix I-B

2024 Larval Frequency - Coquitlam



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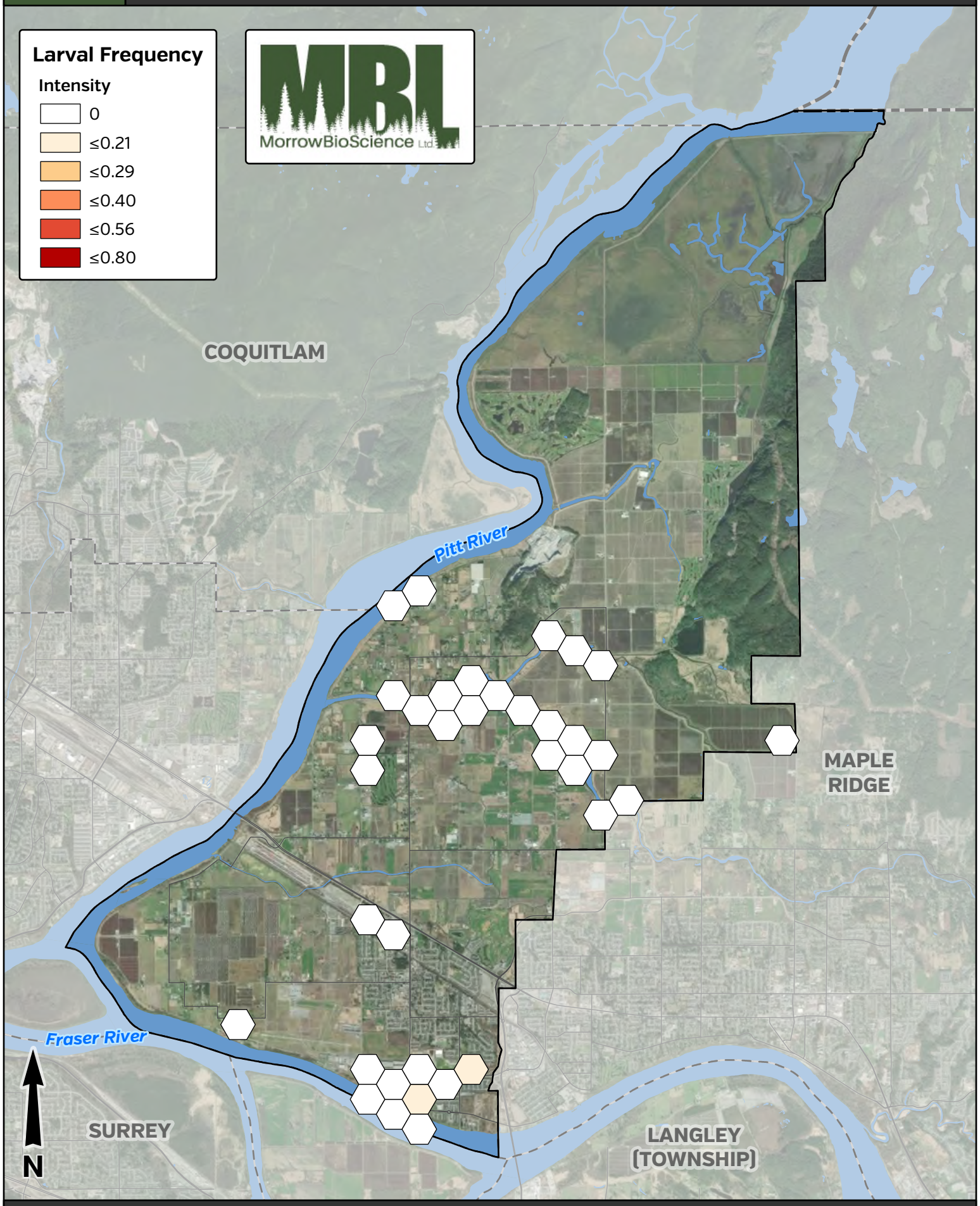
Appendix I-C

2024 Larval Frequency - Pitt Meadows



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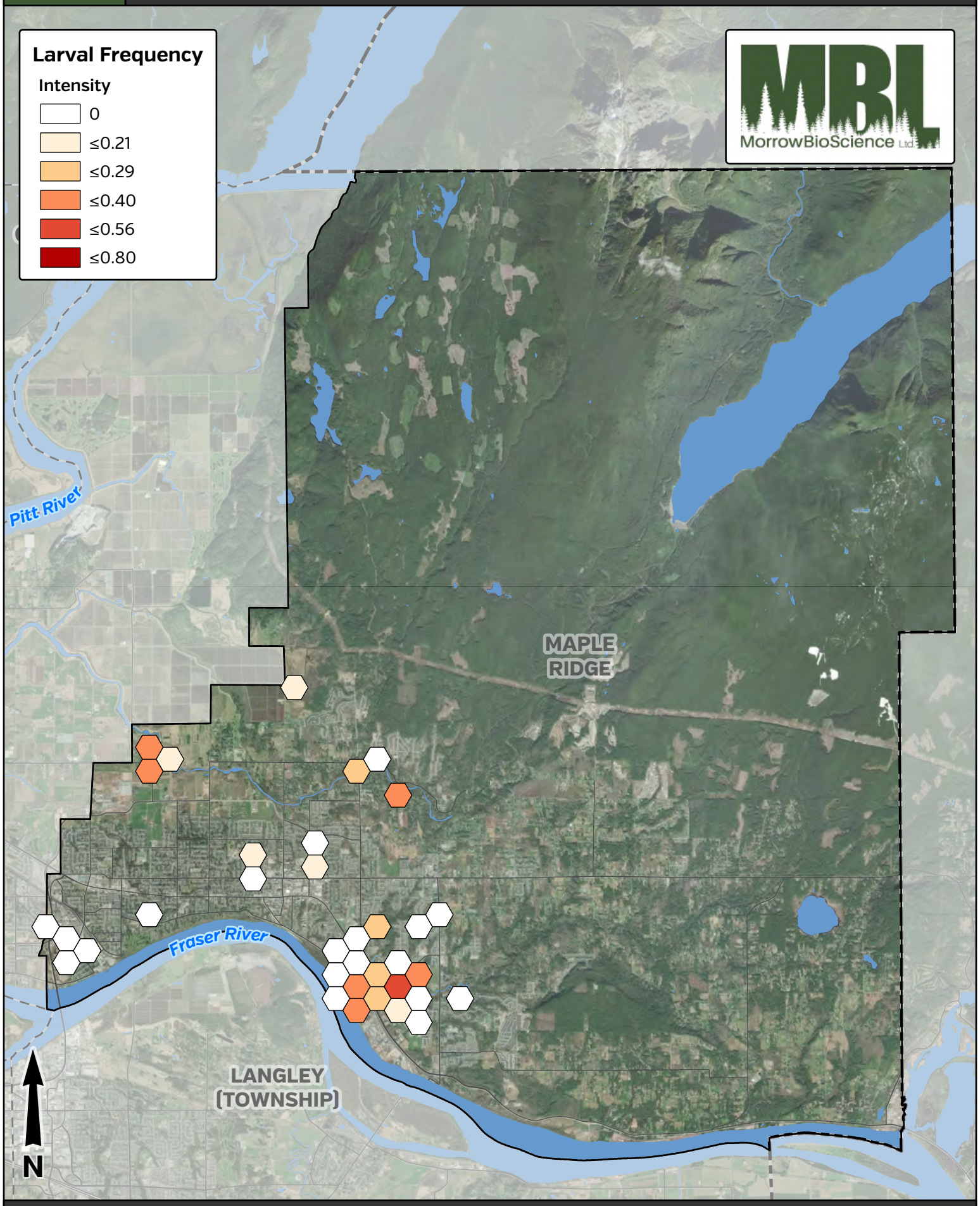
Appendix I-D

2024 Larval Frequency - Maple Ridge



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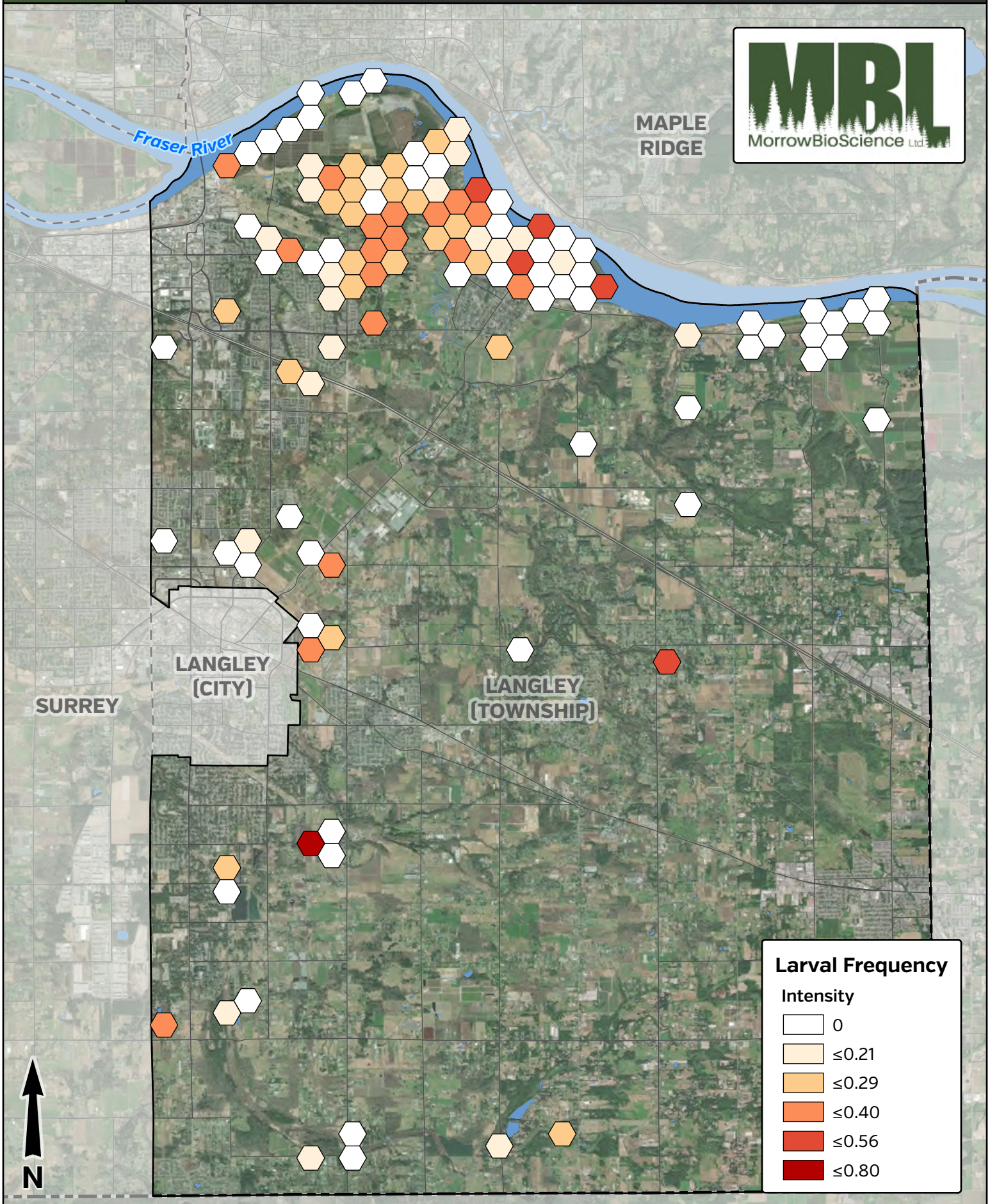
Appendix I-E

2024 Larval Frequency - Langley



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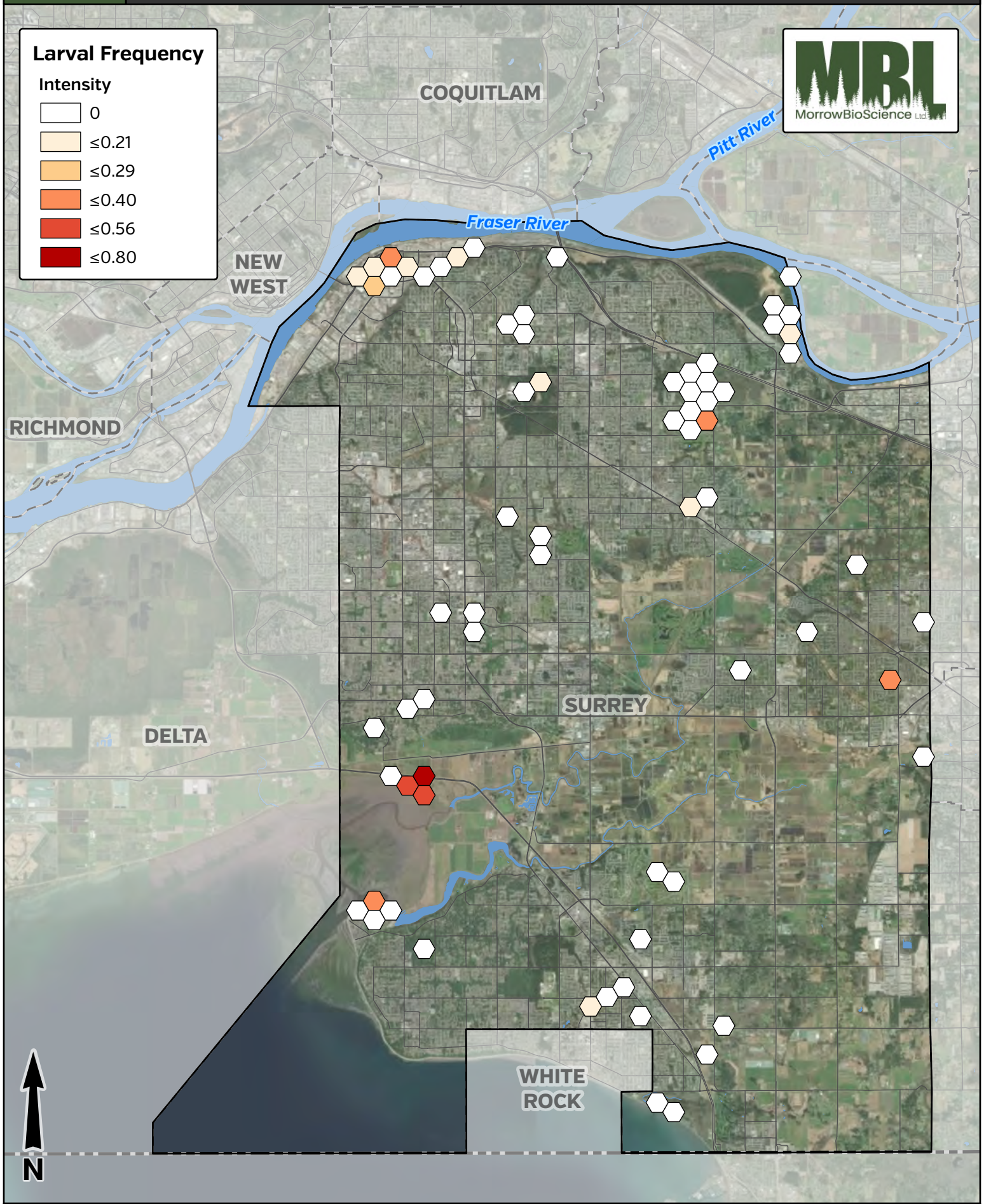
Appendix I-F

2024 Larval Frequency - Surrey



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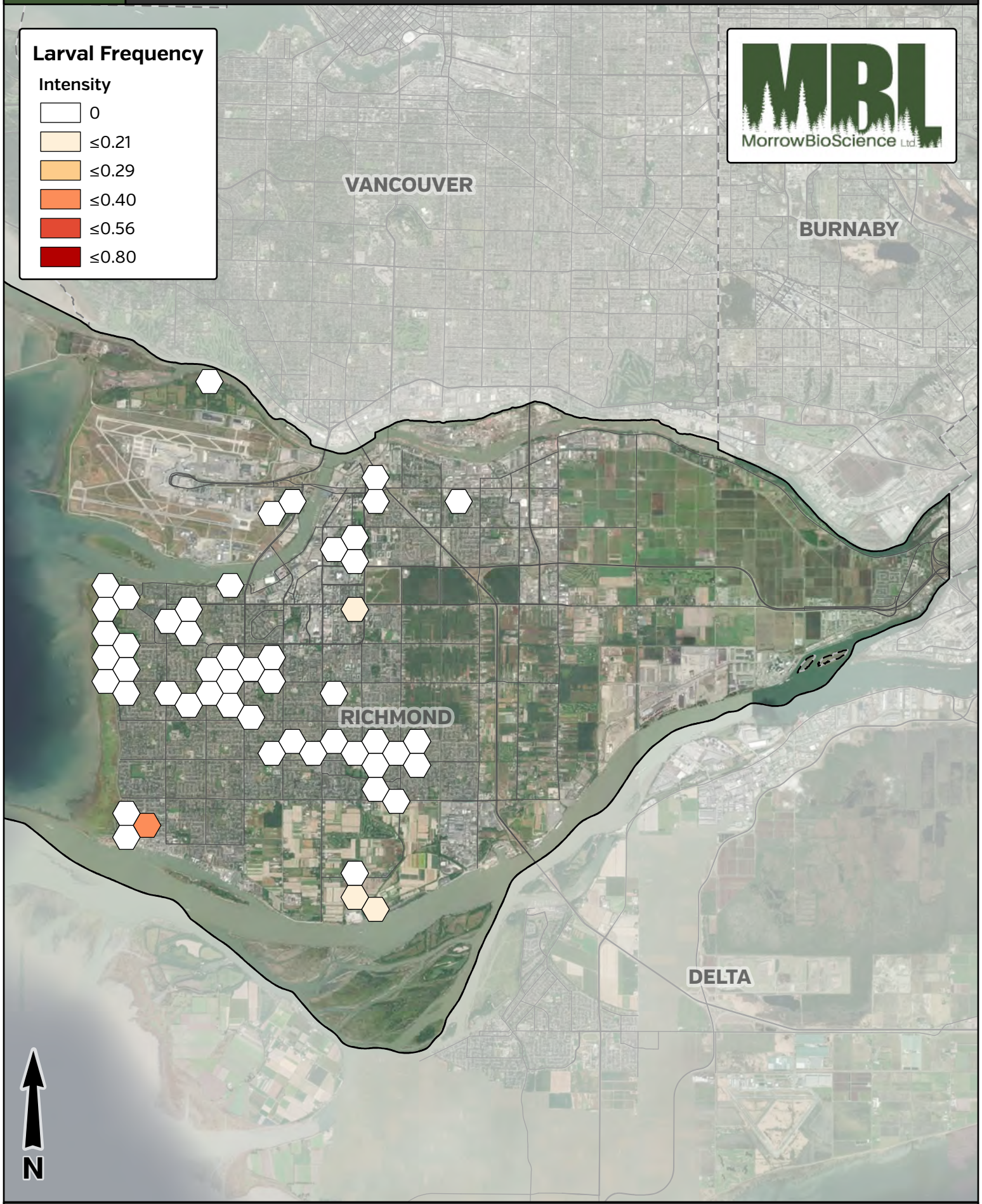
Appendix I-G

2024 Larval Frequency - Richmond



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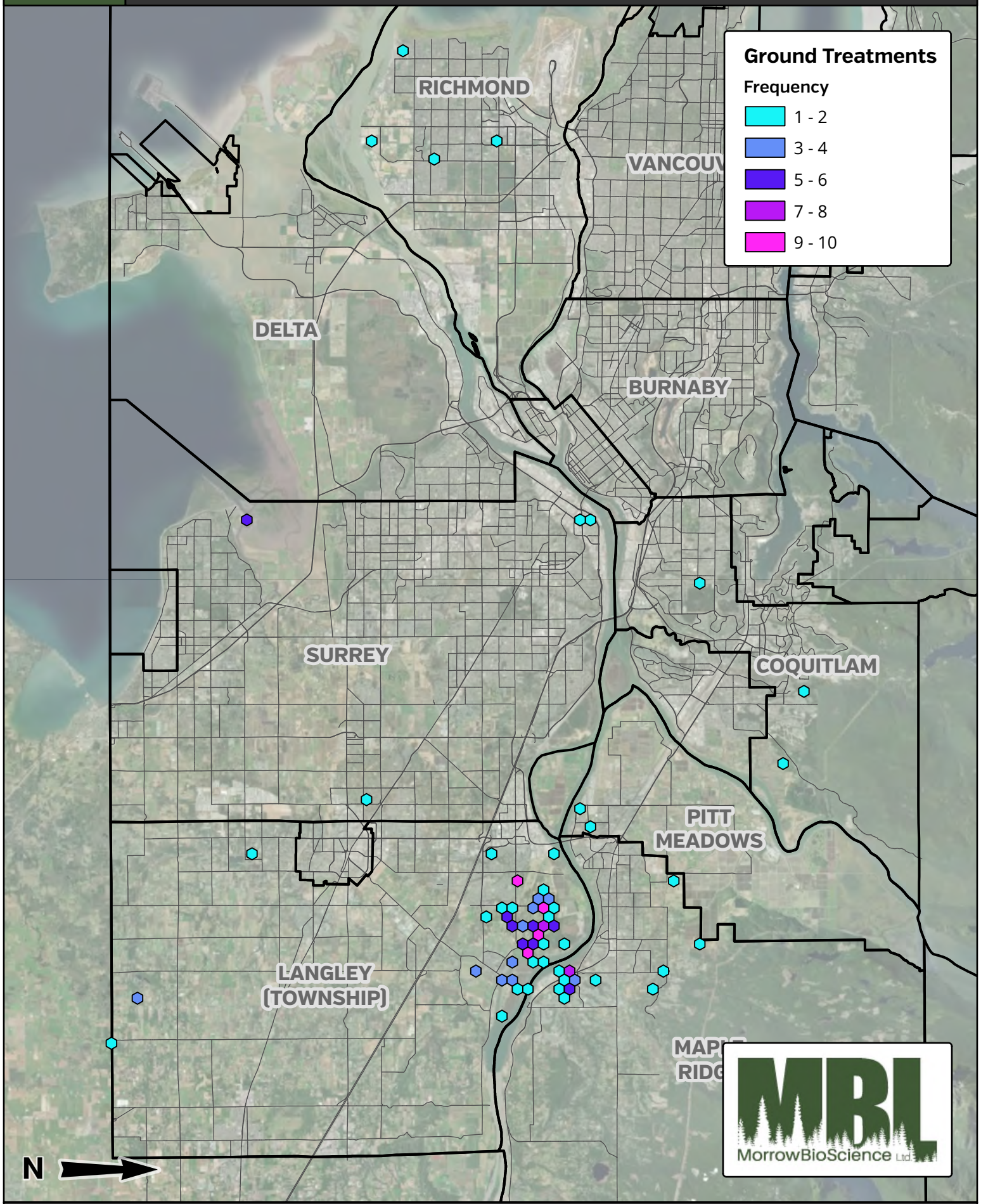
Appendix II-A

2024 Larvicide Treatments - MVRD



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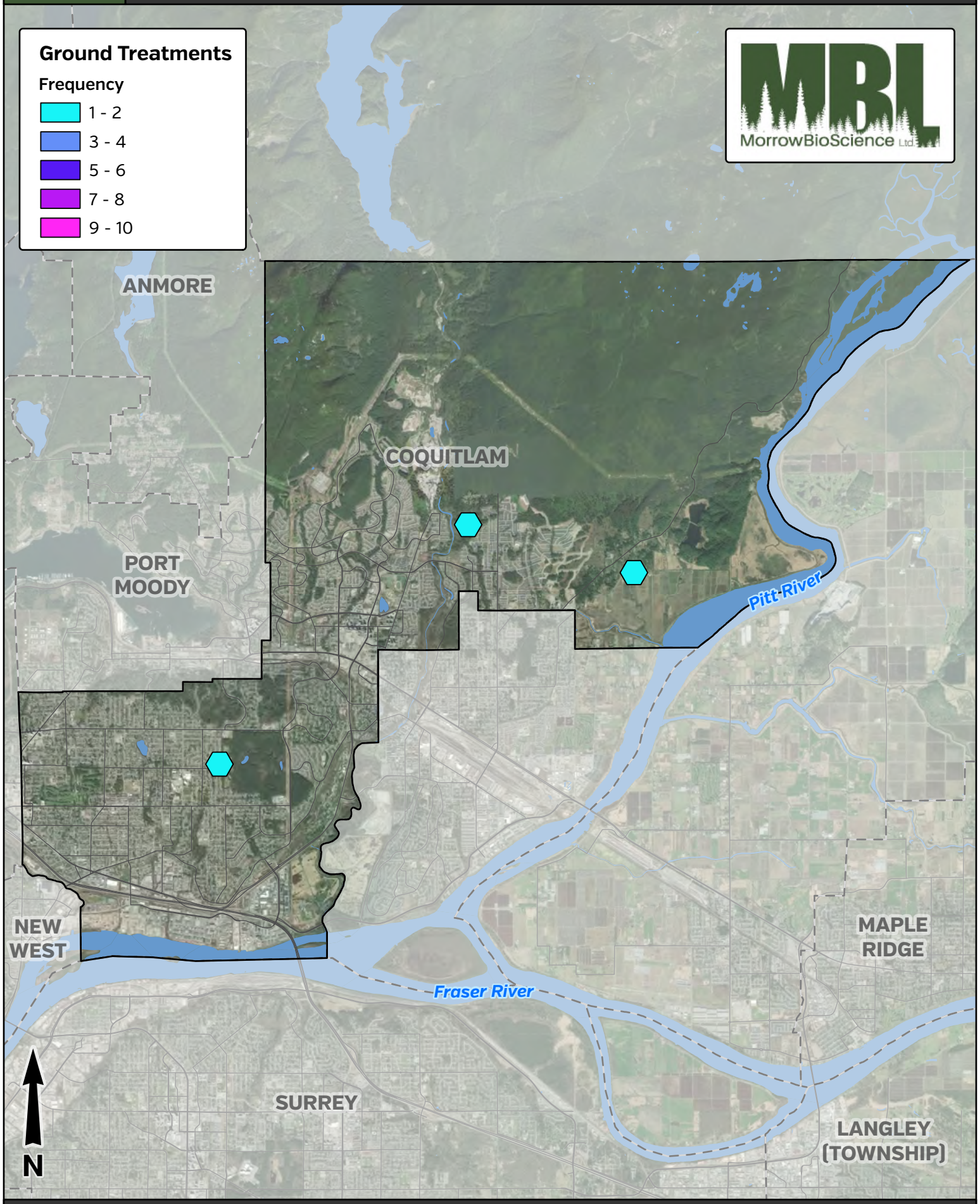
Appendix II-B

2024 Larvicide Treatments - Coquitlam



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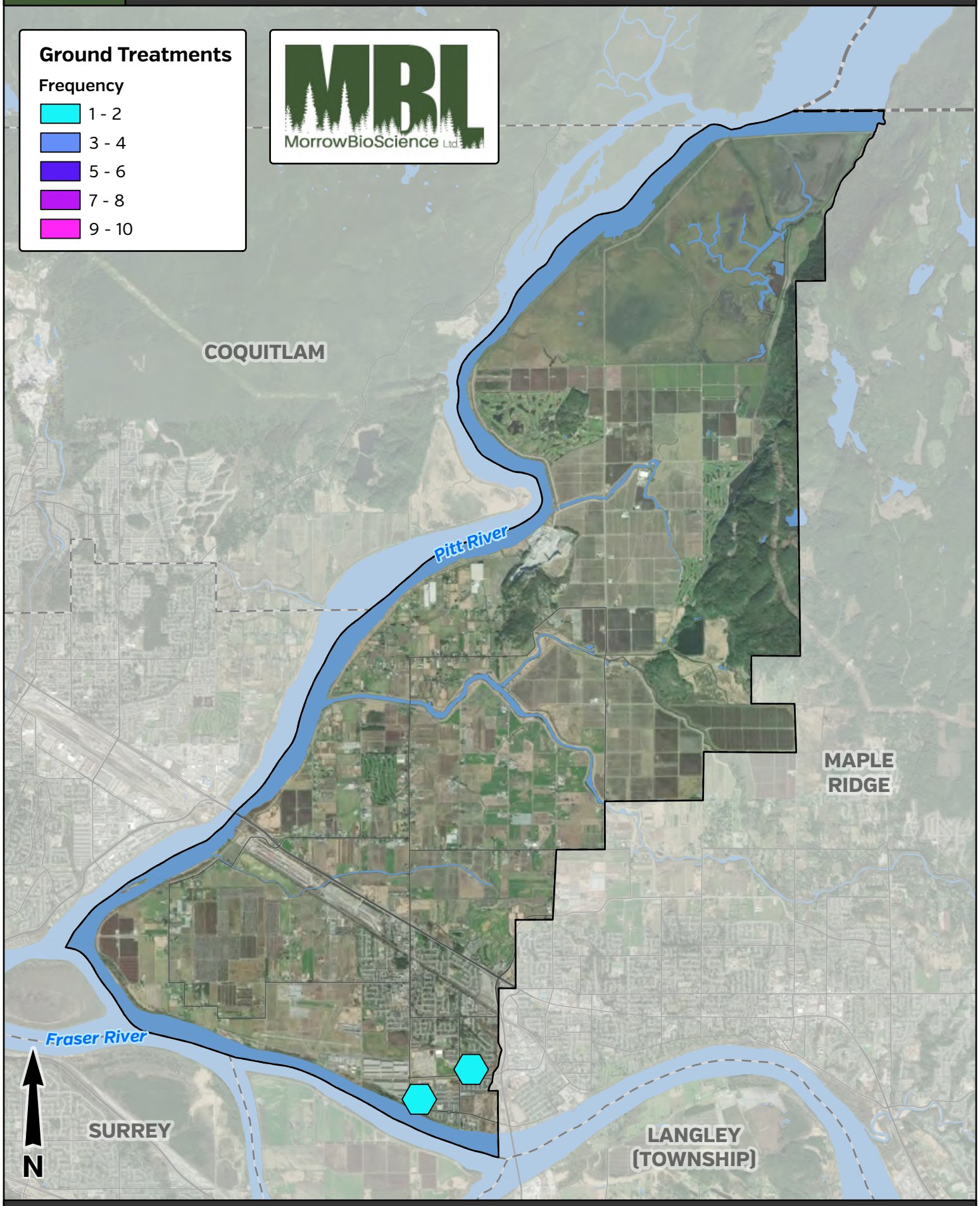
Appendix II-C

2024 Larvicide Treatments - Pitt Meadows



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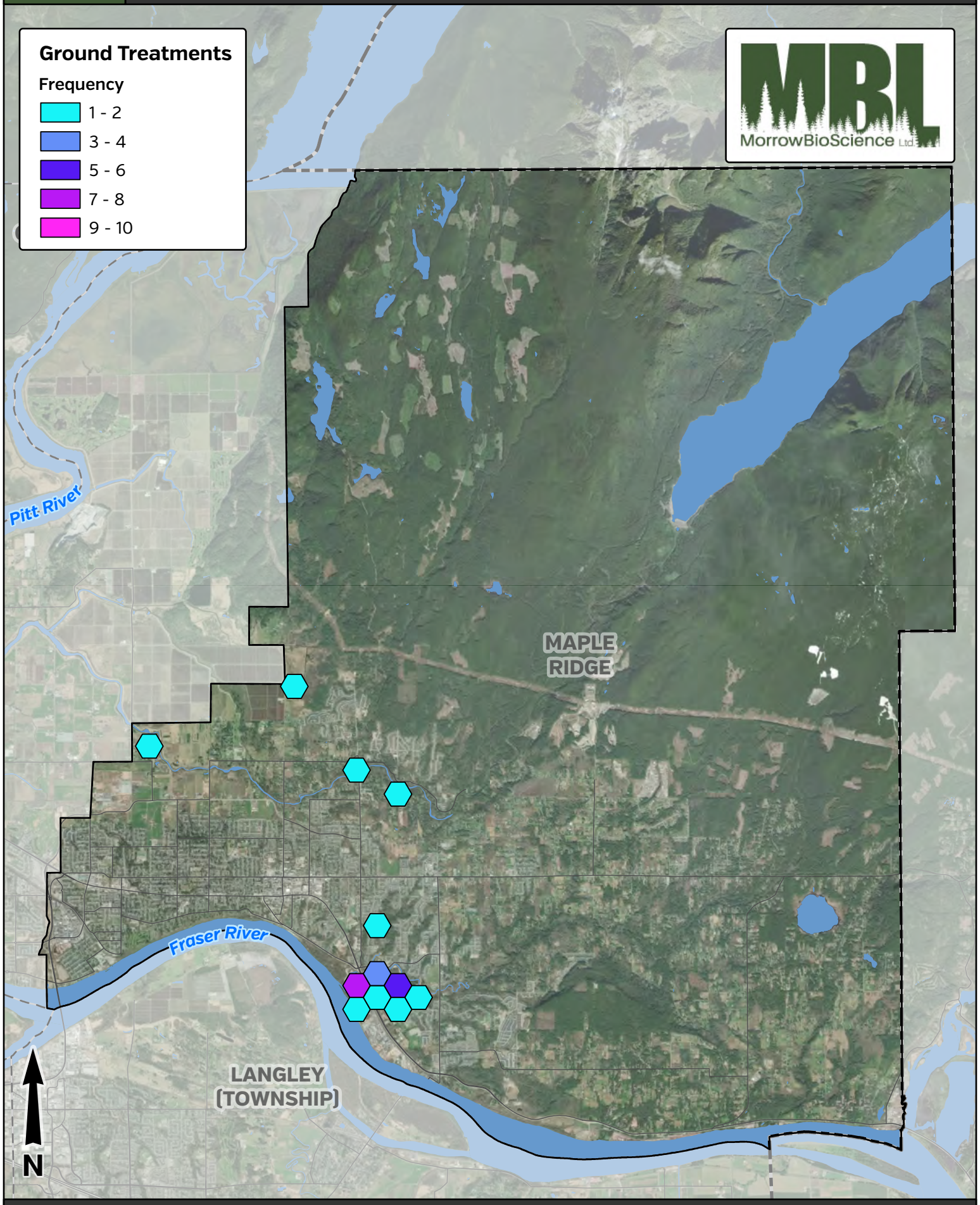
Appendix II-D

2024 Larvicide Treatments - Maple Ridge



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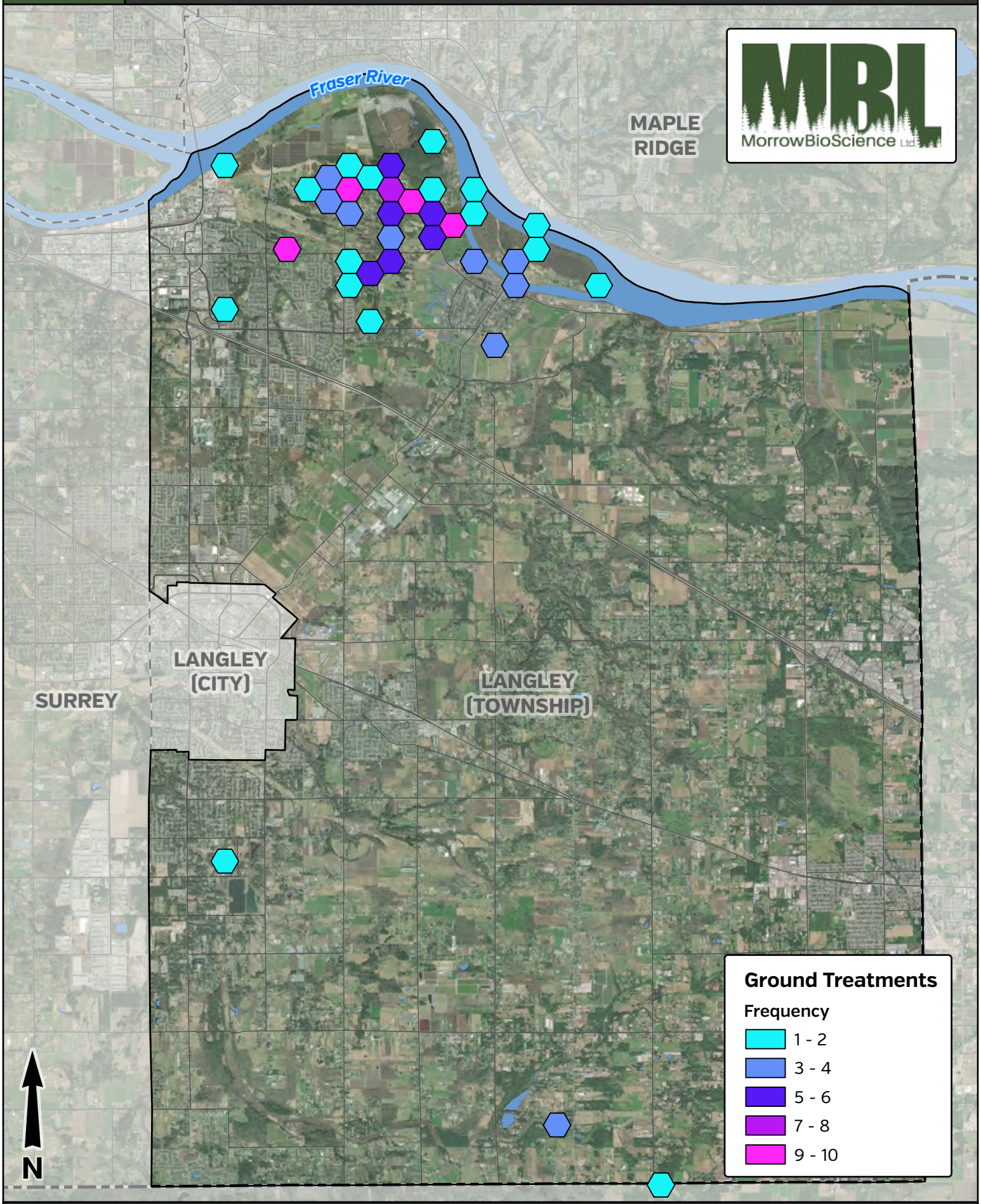
Appendix II-E

2024 Larvicide Treatments - Langley



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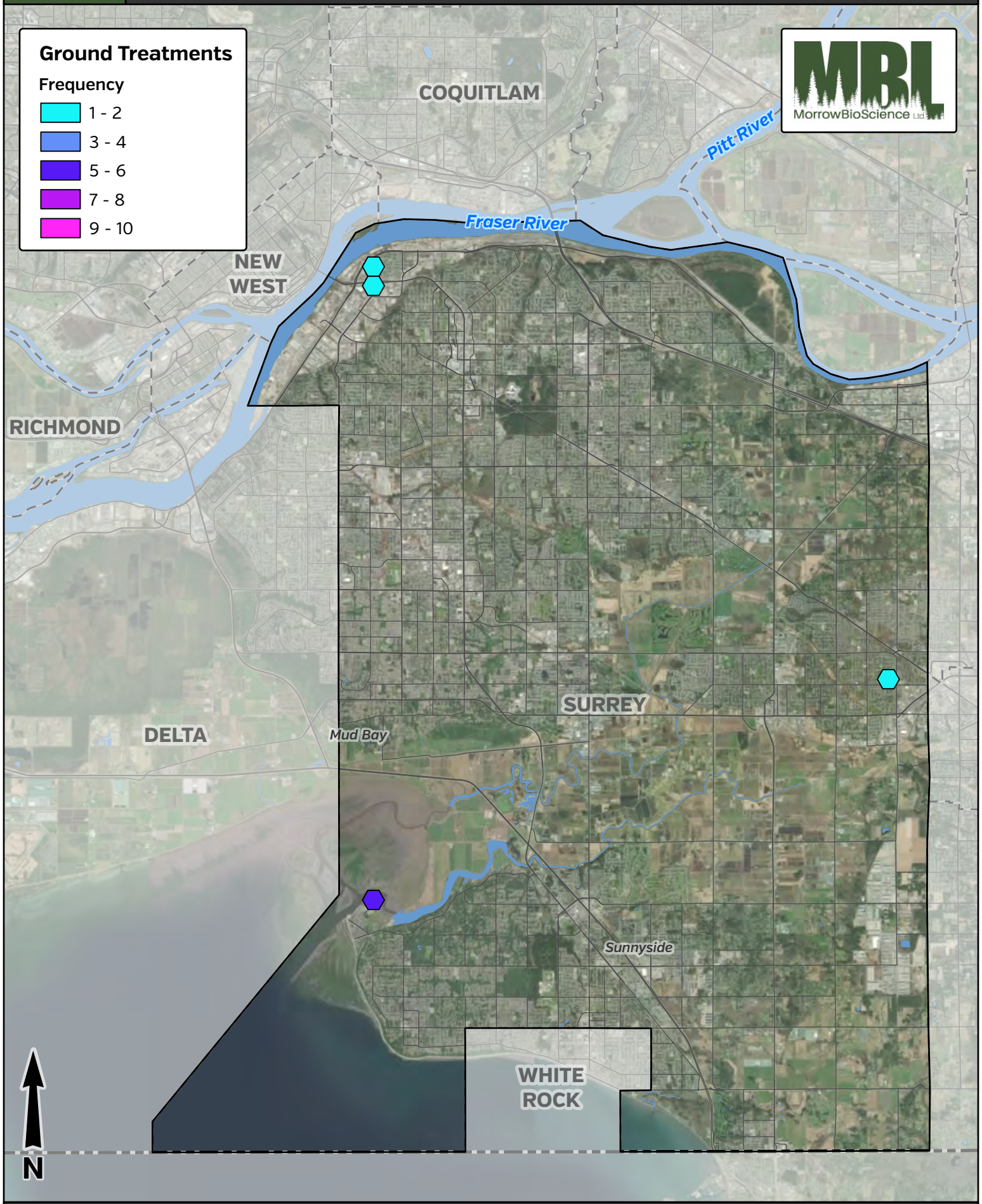
Appendix II-F

2024 Larvicide Treatments - Surrey



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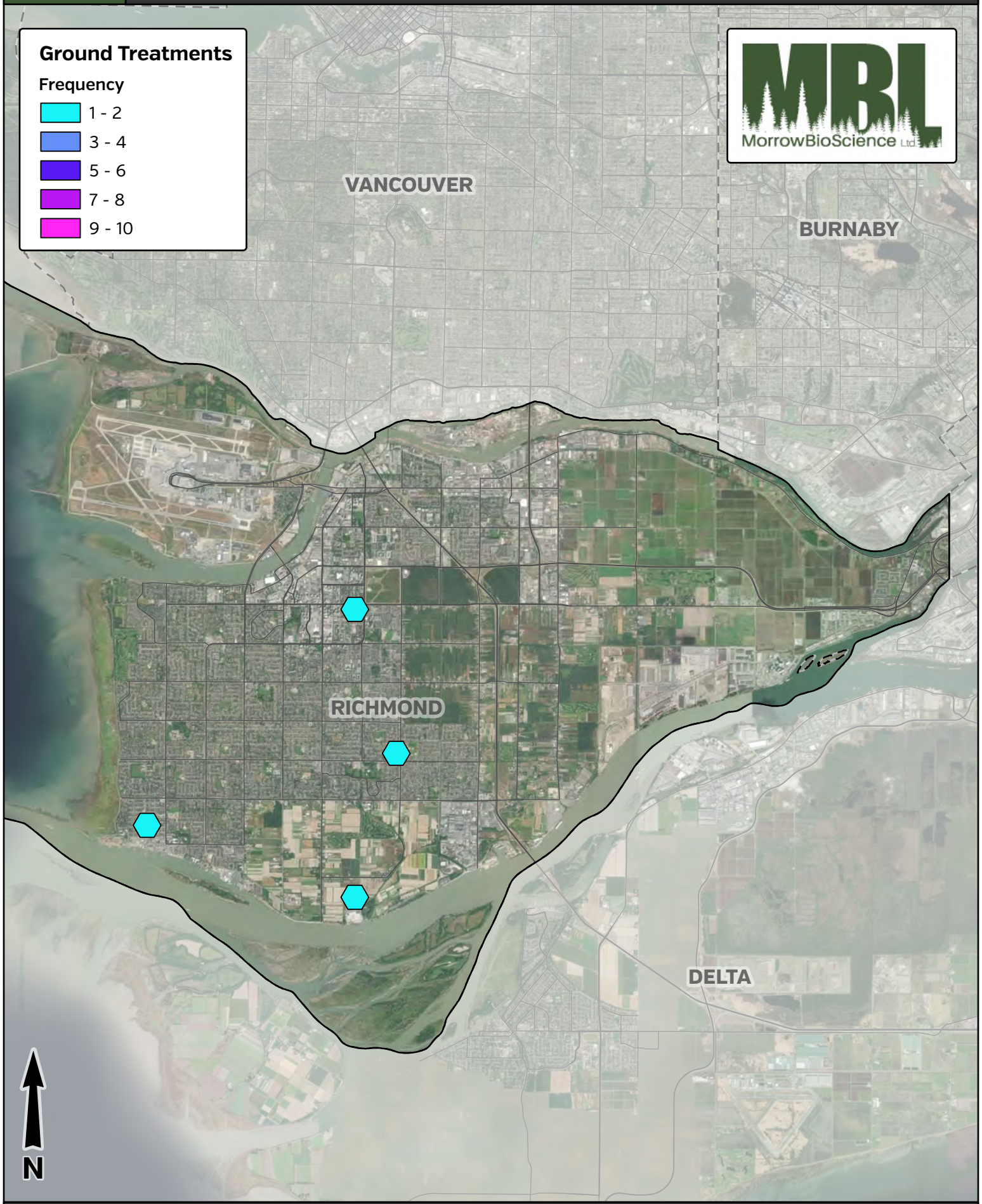
Appendix II-G

2024 Larvicide Treatments - Richmond



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Appendix III – Ground treatments by date and site (kg and ha)

	Site Code	Date	Treatment (kg)	Treatment (ha)
MVRD - Coquitlam	COQ-001	2024-06-04	2	0.5
MVRD - Coquitlam	COQ-035	2024-06-20	0.4	0.1
MVRD - Coquitlam	COQ-001	2024-06-27	1.5	0.375
MVRD - Coquitlam		2024-06-27	0.2	0.05
MVRD - Coquitlam	COQ-041	2024-07-25	0.5	0.125
MVRD - Langley		2024-05-31	0.6	0.15
MVRD - Langley		2024-05-31	0.6	0.15
MVRD - Langley	TOL-011	2024-05-31	0.1	0.025
MVRD - Langley		2024-05-31	0.1	0.025
MVRD - Langley		2024-06-04	4	1
MVRD - Langley		2024-06-11	0.5	0.125
MVRD - Langley		2024-06-11	0.5	0.125
MVRD - Langley		2024-06-11	3	0.75
MVRD - Langley		2024-06-11	0.5	0.125
MVRD - Langley		2024-06-12	0.2	0.05
MVRD - Langley		2024-06-12	0.4	0.1
MVRD - Langley		2024-06-12	5	1.25
MVRD - Langley		2024-06-12	1	0.25
MVRD - Langley		2024-06-13	0.2	0.05
MVRD - Langley		2024-06-13	0.7	0.175
MVRD - Langley	TOL-240	2024-06-13	0.5	0.125
MVRD - Langley	TOL-023	2024-06-17	0.1	0.025
MVRD - Langley		2024-06-17	3	0.75
MVRD - Langley		2024-06-18	0.1	0.025
MVRD - Langley		2024-06-18	3	0.75
MVRD - Langley		2024-06-19	0.2	0.05
MVRD - Langley	MA-008	2024-06-19	6	1.5
MVRD - Langley		2024-06-19	3	0.75
MVRD - Langley		2024-06-19	0.1	0.025
MVRD - Langley	TOL-011	2024-06-19	0.2	0.05
MVRD - Langley		2024-06-19	0.1	0.025
MVRD - Langley	TOL-011	2024-06-19	0.1	0.025
MVRD - Langley		2024-06-19	1.5	0.375
MVRD - Langley	TOL-011	2024-06-19	0.2	0.05
MVRD - Langley	TOL-011	2024-06-19	0.1	0.025
MVRD - Langley	TOL-011	2024-06-19	0.2	0.05
MVRD - Langley		2024-06-21	0.5	0.125
MVRD - Langley		2024-06-21	0.2	0.05

MVRD - Langley		2024-06-21	3	0.75
MVRD - Langley		2024-06-21	0.4	0.1
MVRD - Langley		2024-06-21	0.7	0.175
MVRD - Langley		2024-06-21	0.3	0.075
MVRD - Langley		2024-06-24	0.1	0.025
MVRD - Langley		2024-06-24	2	0.5
MVRD - Langley		2024-06-24	0.2	0.05
MVRD - Langley	TOL-1077	2024-06-24	0.2	0.05
MVRD - Langley	MA-008	2024-06-25	1	0.25
MVRD - Langley		2024-06-25	0.04	0.01
MVRD - Langley	TOL-015	2024-06-25	0.05	0.0125
MVRD - Langley	TOL-1038	2024-06-25	0.2	0.05
MVRD - Langley		2024-06-26	1	0.25
MVRD - Langley		2024-06-26	0.2	0.05
MVRD - Langley		2024-06-26	0.1	0.025
MVRD - Langley		2024-06-26	6	1.5
MVRD - Langley	TOL-008	2024-06-26	1.5	0.375
MVRD - Langley		2024-06-26	0.5	0.125
MVRD - Langley		2024-06-26	0.2	0.05
MVRD - Langley	TOL-005	2024-06-28	0.02	0.005
MVRD - Langley	TOL-005	2024-06-28	1	0.25
MVRD - Langley		2024-07-02	0.2	0.05
MVRD - Langley		2024-07-02	0.1	0.025
MVRD - Langley		2024-07-02	1	0.25
MVRD - Langley		2024-07-02	0.2	0.05
MVRD - Langley		2024-07-02	3	0.75
MVRD - Langley		2024-07-02	0.1	0.025
MVRD - Langley		2024-07-08	1	0.25
MVRD - Langley	MA-008	2024-07-09	8	2
MVRD - Langley	TOL-005	2024-07-09	3	0.75
MVRD - Langley	TOL-236	2024-07-09	3	0.75
MVRD - Langley		2024-07-10	2	0.5
MVRD - Langley		2024-07-10	5	1.25
MVRD - Langley		2024-07-11	1	0.25
MVRD - Langley	MA-009	2024-07-11	2	0.5
MVRD - Langley		2024-07-11	0.1	0.025
MVRD - Langley		2024-07-11	6	1.5
MVRD - Langley		2024-07-11	1.5	0.375
MVRD - Langley		2024-07-11	0.5	0.125
MVRD - Langley	TOL-011	2024-07-11	0.3	0.075
MVRD - Langley	TOL-011	2024-07-11	1	0.25

MVRD - Langley		2024-07-11	1.5	0.375
MVRD - Langley		2024-07-15	2	0.5
MVRD - Langley		2024-07-15	1	0.25
MVRD - Langley		2024-07-15	1.5	0.375
MVRD - Langley		2024-07-16	0.2	0.05
MVRD - Langley		2024-07-16	0.5	0.125
MVRD - Langley		2024-07-16	0.5	0.125
MVRD - Langley		2024-07-16	2	0.5
MVRD - Langley		2024-07-16	2	0.5
MVRD - Langley	MA-008	2024-07-16	3	0.75
MVRD - Langley		2024-07-16	0.3	0.075
MVRD - Langley		2024-07-16	1	0.25
MVRD - Langley		2024-07-17	2	0.5
MVRD - Langley		2024-07-17	0.1	0.025
MVRD - Langley		2024-07-17	0.2	0.05
MVRD - Langley		2024-07-17	0.1	0.025
MVRD - Langley		2024-07-17	1.5	0.375
MVRD - Langley		2024-07-17	1.5	0.375
MVRD - Langley		2024-07-17	0.05	0.0125
MVRD - Langley		2024-07-17	2	0.5
MVRD - Langley		2024-07-17	1.2	0.3
MVRD - Langley		2024-07-17	0.3	0.075
MVRD - Langley	TOL-212	2024-07-18	1.5	0.375
MVRD - Langley		2024-07-18	0.3	0.075
MVRD - Langley	TOL-008	2024-07-18	0.8	0.2
MVRD - Langley	TOL-005	2024-07-18	0.2	0.05
MVRD - Langley		2024-07-18	2	0.5
MVRD - Langley		2024-07-18	1	0.25
MVRD - Langley		2024-07-18	1	0.25
MVRD - Langley	TOL-005	2024-07-18	1	0.25
MVRD - Langley		2024-07-18	2	0.5
MVRD - Langley		2024-07-18	1.5	0.375
MVRD - Langley		2024-07-19	0.2	0.05
MVRD - Langley		2024-07-23	0.3	0.075
MVRD - Langley	TOL-011	2024-07-23	1.2	0.3
MVRD - Langley		2024-07-23	1.5	0.375
MVRD - Langley		2024-07-23	0.5	0.125
MVRD - Langley	TOL-006	2024-07-23	1.5	0.375
MVRD - Langley		2024-07-23	2	0.5
MVRD - Langley		2024-07-23	1.5	0.375
MVRD - Langley	TOL-011	2024-07-23	0.8	0.2

MVRD - Langley	TOL-011	2024-07-25	4	1
MVRD - Langley	TOL-011	2024-07-25	6	1.5
MVRD - Langley		2024-07-25	0.3	0.075
MVRD - Langley	MA-008	2024-07-25	1.5	0.375
MVRD - Langley		2024-07-25	4.5	1.125
MVRD - Langley		2024-07-30	0.2	0.05
MVRD - Langley		2024-07-30	1	0.25
MVRD - Langley		2024-07-30	0.4	0.1
MVRD - Langley	MA-009	2024-07-31	0.5	0.125
MVRD - Langley	TOL-008	2024-08-02	1	0.25
MVRD - Langley		2024-08-02	0.4	0.1
MVRD - Langley		2024-08-02	0.2	0.05
MVRD - Langley		2024-08-02	6	1.5
MVRD - Langley	TOL-008	2024-08-02	1	0.25
MVRD - Langley		2024-08-02	0.8	0.2
MVRD - Langley		2024-08-02	0.1	0.025
MVRD - Langley	MA-008	2024-08-02	3	0.75
MVRD - Langley		2024-08-02	0.5	0.125
MVRD - Langley		2024-08-02	0.3	0.075
MVRD - Langley		2024-08-02	1	0.25
MVRD - Langley		2024-08-02	0.3	0.075
MVRD - Langley		2024-08-02	0.2	0.05
MVRD - Langley		2024-08-06	0.5	0.125
MVRD - Langley	TOL-023	2024-08-06	0.2	0.05
MVRD - Langley		2024-08-06	0.1	0.025
MVRD - Langley	TOL-011	2024-08-06	2.5	0.625
MVRD - Langley		2024-08-06	1.5	0.375
MVRD - Langley		2024-08-06	0.3	0.075
MVRD - Langley	TOL-341	2024-08-09	2.5	0.625
MVRD - Langley		2024-08-09	1.5	0.375
MVRD - Langley		2024-08-09	3.5	0.875
MVRD - Langley	MA-008	2024-08-09	2.5	0.625
MVRD - Langley	TOL-1038	2024-08-09	0.2	0.05
MVRD - Langley		2024-08-09	0.6	0.15
MVRD - Langley	TOL-1021	2024-08-09	1	0.25
MVRD - Langley	TOL-011	2024-08-09	6	1.5
MVRD - Langley		2024-08-12	0.1	0.025
MVRD - Langley	TOL-601	2024-08-12	0.6	0.15
MVRD - Langley	TOL-1077	2024-08-12	0.2	0.05
MVRD - Langley	TOL-013	2024-08-13	0.05	0.0125
MVRD - Langley		2024-08-13	0.5	0.125

MVRD - Langley		2024-08-13	0.1	0.025
MVRD - Langley		2024-08-13	0.05	0.0125
MVRD - Langley		2024-08-13	0.4	0.1
MVRD - Langley		2024-08-13	0.5	0.125
MVRD - Langley		2024-08-13	0.2	0.05
MVRD - Langley		2024-08-13	0.2	0.05
MVRD - Langley		2024-08-13	0.05	0.0125
MVRD - Langley	TOL-514	2024-08-13	0.1	0.025
MVRD - Langley		2024-08-13	0.05	0.0125
MVRD - Langley	TOL-003	2024-08-15	0.05	0.0125
MVRD - Langley	MA-008	2024-08-16	0.1	0.025
MVRD - Langley	TOL-006	2024-08-19	1.2	0.3
MVRD - Langley	TOL-011	2024-08-19	1	0.25
MVRD - Langley	TOL-006	2024-08-19	0.5	0.125
MVRD - Langley		2024-08-19	4.5	1.125
MVRD - Langley	TOL-008	2024-08-19	1.5	0.375
MVRD - Langley	MA-009	2024-08-19	2	0.5
MVRD - Langley	MA-008	2024-08-19	6	1.5
MVRD - Langley	TOL-011	2024-08-19	0.5	0.125
MVRD - Langley	TOL-011	2024-08-19	4.5	1.125
MVRD - Langley		2024-08-19	4	1
MVRD - Langley		2024-08-20	0.3	0.075
MVRD - Langley		2024-08-20	0.3	0.075
MVRD - Langley		2024-08-20	1	0.25
MVRD - Langley		2024-08-20	0.8	0.2
MVRD - Langley	TOL-550	2024-08-22	1	0.25
MVRD - Langley	MA-008	2024-08-23	3	0.75
MVRD - Maple Ridge		2024-06-06	0.05	0.0125
MVRD - Maple Ridge	MR-503	2024-06-06	12	3
MVRD - Maple Ridge		2024-06-07	0.2	0.05
MVRD - Maple Ridge		2024-06-07	0.2	0.05
MVRD - Maple Ridge	MR-161	2024-06-07	0.1	0.025
MVRD - Maple Ridge	MR-161	2024-06-07	0.1	0.025
MVRD - Maple Ridge		2024-06-07	0.1	0.025
MVRD - Maple Ridge		2024-06-07	0.1	0.025
MVRD - Maple Ridge		2024-06-10	0.3	0.075
MVRD - Maple Ridge		2024-06-10	0.1	0.025
MVRD - Maple Ridge	MR-158	2024-06-10	6	1.5
MVRD - Maple Ridge		2024-06-10	0.5	0.125
MVRD - Maple Ridge		2024-06-10	1.5	0.375
MVRD - Maple Ridge		2024-06-20	0.2	0.05

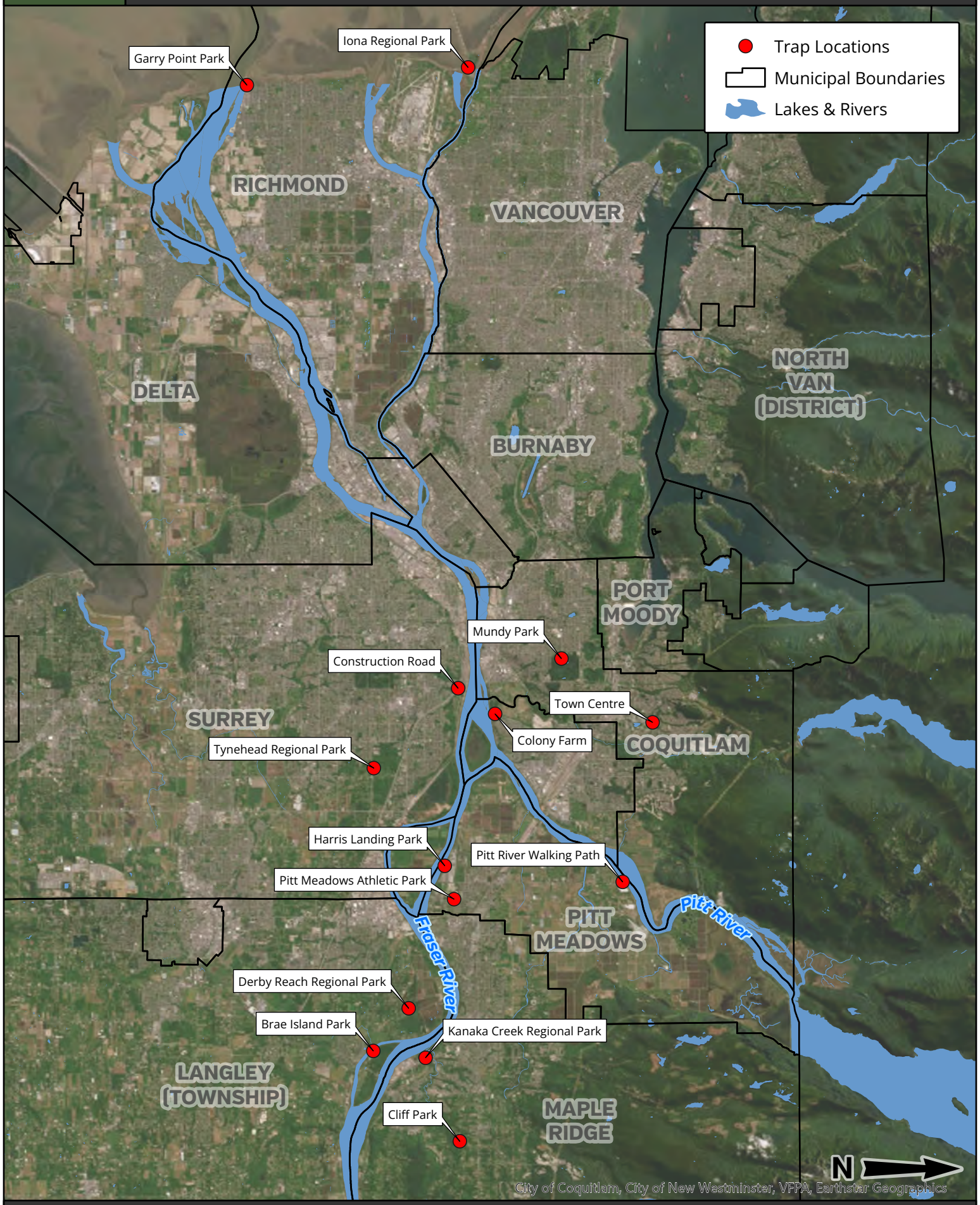
MVRD - Maple Ridge	MR-191	2024-06-20	0.5	0.125
MVRD - Maple Ridge	MR-158	2024-06-20	0.1	0.025
MVRD - Maple Ridge		2024-06-27	1.5	0.375
MVRD - Maple Ridge		2024-06-27	0.2	0.05
MVRD - Maple Ridge		2024-07-04	4	1
MVRD - Maple Ridge	MR-095	2024-07-04	0.1	0.025
MVRD - Maple Ridge		2024-07-04	0.2	0.05
MVRD - Maple Ridge	MR-191	2024-07-04	0.5	0.125
MVRD - Maple Ridge		2024-07-04	0.2	0.05
MVRD - Maple Ridge		2024-07-12	0.5	0.125
MVRD - Maple Ridge	MR-513	2024-07-12	0.5	0.125
MVRD - Maple Ridge	MR-191	2024-07-29	0.5	0.125
MVRD - Maple Ridge		2024-07-29	1	0.25
MVRD - Pitt Meadows	PM-060	2024-06-04	0.3	0.075
MVRD - Pitt Meadows	PM-058	2024-06-04	0.3	0.075
MVRD - Richmond		2024-08-09	2	0.5
MVRD - Richmond	RICH-B5	2024-08-13	2.5	0.625
MVRD - Richmond		2024-08-15	2	0.5
MVRD - Richmond	RICH-B6	2024-08-26	1	0.25
MVRD - Surrey	SR-046	2024-05-24	0.125	0.0313
MVRD - Surrey	SR-630	2024-05-31	0.03	0.0075
MVRD - Surrey	SR-624	2024-05-31	0.03	0.0075
MVRD - Surrey	SR-046	2024-05-31	0.02	0.005
MVRD - Surrey	SR-630	2024-05-31	0.03	0.0075
MVRD - Surrey	SR-630	2024-06-06	0.01	0.0025
MVRD - Surrey	SR-630	2024-06-06	0.13	0.0325
MVRD - Surrey	SR-630	2024-06-06	0.06	0.015
MVRD - Surrey	SR-630	2024-06-06	0.03	0.0075
MVRD - Surrey	SR-046	2024-06-06	0.01	0.0025
MVRD - Surrey	SR-046	2024-06-13	0.03	0.0075
MVRD - Surrey	SR-630	2024-06-13	0.03	0.0075
MVRD - Surrey	SR-630	2024-06-13	0.42	0.105
MVRD - Surrey	SR-630	2024-06-13	0.03	0.0075
MVRD - Surrey	SR-630	2024-06-13	0.19	0.0475
MVRD - Surrey	SR-046	2024-06-13	0.01	0.0025
MVRD - Surrey	SR-630	2024-06-13	0.01	0.0025
MVRD - Surrey	SR-046	2024-06-13	0.01	0.0025
MVRD - Surrey	SR-630	2024-06-20	0.05	0.0125
MVRD - Surrey	SR-630	2024-06-20	0.05	0.0125
MVRD - Surrey	SR-012	2024-06-24	0.02	0.005

MVRD - Surrey	SR-046	2024-06-25	0.03	0.0075
MVRD - Surrey	SR-630	2024-06-25	0.02	0.005
MVRD - Surrey	SR-630	2024-06-25	0.01	0.0025
MVRD - Surrey	SR-630	2024-06-25	0.05	0.0125
MVRD - Surrey	SR-046	2024-06-25	0.02	0.005
MVRD - Surrey	SR-046	2024-06-25	0.04	0.01
MVRD - Surrey	SR-630	2024-07-04	0.02	0.005
MVRD - Surrey	SR-607	2024-07-09	0.02	0.005
MVRD - Surrey	SR-607	2024-07-09	0.02	0.005
MVRD - Surrey	SR-607	2024-07-09	0.02	0.005
MVRD - Surrey	SR-607	2024-07-09	0.02	0.005
MVRD - Surrey	SR-624	2024-07-11	0.08	0.02
MVRD - Surrey	SR-630	2024-07-11	0.09	0.0225
MVRD - Surrey	SR-630	2024-07-11	0.05	0.0125
MVRD - Surrey	SR-630	2024-07-11	0.04	0.01
MVRD - Surrey	SR-624	2024-07-11	0.02	0.005
MVRD - Surrey	SR-624	2024-07-11	0.02	0.005
MVRD - Surrey	SR-607	2024-07-16	0.02	0.005
MVRD - Surrey	SR-607	2024-07-16	0.04	0.01
MVRD - Surrey	SR-607	2024-07-16	0.03	0.0075
MVRD - Surrey	SR-607	2024-07-23	0.02	0.005
MVRD - Surrey	SR-607	2024-07-23	0.03	0.0075
MVRD - Surrey	SR-607	2024-07-23	0.02	0.005
MVRD - Surrey	SR-607	2024-07-23	0.02	0.005
MVRD - Surrey	SR-607	2024-07-23	0.02	0.005
MVRD - Surrey	SR-624	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.03	0.0075
MVRD - Surrey	SR-046	2024-07-25	0.07	0.0175
MVRD - Surrey	SR-630	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.04	0.01
MVRD - Surrey	SR-630	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.02	0.005
MVRD - Surrey	SR-630	2024-07-25	0.16	0.04
MVRD - Surrey	SR-607	2024-07-30	0.02	0.005
MVRD - Surrey	SR-607	2024-07-30	0.02	0.005
MVRD - Surrey	SR-607	2024-07-30	0.01	0.0025
MVRD - Surrey	SR-046	2024-08-01	0.1	0.025
MVRD - Surrey	SR-012	2024-08-05	0.02	0.005
MVRD - Surrey	SR-607	2024-08-07	0.03	0.0075

MVRD - Surrey	SR-607	2024-08-07	0.02	0.005
MVRD - Surrey	SR-607	2024-08-07	0.02	0.005
MVRD - Surrey	SR-103	2024-08-07	0.02	0.005
MVRD - Surrey	SR-607	2024-08-15	0.02	0.005
MVRD - Surrey	SR-630	2024-08-22	0.07	0.0175

Appendix IV

2024 MVRD Mosquito Trap Locations



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Appendix V. 2024 MVRD and MBL Mosquito Hotline call and email summary

Note that there were no emails this year. For the purposes of the report, only calls from May-August have been included.

_project	date	complaint	enquiry	resident_comments
MVRD - Langley	2024-10-18	Yes	No	Lots of mosquitoes in their house the last few weeks. What can be done to
MVRD - Richmond	2024-08-21	No	Yes	Neighbours pool is not being used and they are concerned about mosquitoes coming out of it.
MVRD - Richmond	2024-08-06	Yes	No	Lots of mosquitoes around McKay Park
MVRD - Surrey	2024-08-01	Yes	No	Lots of mosquitoes around. Can we come check out the creek and surrounding areas
MVRD - Langley	2024-07-15	Yes	No	Calling about mosquito spraying as the mosquitoes are bad right now
MVRD - Langley	2024-07-05	Yes	No	Mosquitoes are out of control
MVRD - Langley	2024-07-05	Yes	No	Quite a few mosquitoes in the area
MVRD - Langley	2024-07-04	Yes	No	Mosquitoes are coming out
MVRD - Langley	2024-07-03	Yes	No	Lots of mosquitoes. Could they be coming from the green space or from ditches.
MVRD - Richmond	2024-07-02	Yes	No	Lots of mosquitoes around their horses
MVRD - Langley	2024-07-02	No	Yes	Can you come check out a pond
MVRD - Richmond	2024-06-26	Yes	No	Noticing mosquitoes. Can we check out the park
MVRD - Pitt Meadows	2024-05-28	Yes	No	Slow moving creek around area that is producing mosquitoes.
MVRD - Langley	2024-05-16	Yes	No	Lately there has been a big infestation of mosquitoes coming from the trails by the complex. Can you spray?
MVRD - Langley	2024-05-13	No	Yes	Questions about mosquito control in Langley
MVRD - Coquitlam	2024-03-25	Yes	No	Mosquitoes out in both Parks. Can we check it out.
MVRD - Langley	2024-03-16	No	Yes	Just wondering if we have any idea what the season will be like.
MVRD - Coquitlam	2024-02-01	Yes	Yes	Lots of mosquitoes out right now swarming bird feeder and bushes.