Metro Vancouver Regional District Mosquito Control Program

2025 Year-End Report

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Executive Summary

Morrow BioScience Ltd. (MBL) has now completed its second 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 2025, immediately preceding the mosquito monitoring season, the snowpack in most basins contributing to the Fraser River was lower than normal and, by June, the snowpack was depleted. River levels (Mission gauge) in 2025 were higher than those of 2024 and peaked at 4.003 meters on 6 June. Environmental conditions were not optimal for a high rate of mosquito development and did not trigger compounded number of floodwater mosquito eggs to hatch, although small permanent water mosquito hatching events in 2025 continued into July and August.

Larval mosquitoes were treated between 22 May and 27 August. The total floodwater mosquito habitat and saltmarsh/permanent water mosquito habitat treated by ground was 32.65 hectares (ha). No floodwater mosquito habitat was treated by air in 2025 due to low Fraser River peak levels. Area treated by ground in 2025 was approximately 37 ha less than in 2024, 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 2025, with three Mosquito Reports received from local residents; two from Surrey and one from Richmond MBL staff responded to the calls 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 62 trap nights were conducted this year. Adult mosquito trap specimen identification indicated that mosquito abundance was relatively low in throughout the season, with only 26 of the events collecting mosquitoes. The highest adult mosquito collection event occurred on 11 July in south Surrey (12 mosquitoes), followed closely by 9 July in Kanaka Creek (11) and 19 July in Kanada Creek (10). The most abundant species identified was *Aedes vexans* (21 total), a local floodwater mosquito that is influenced by the Lower Fraser River peak. A total of 81 mosquito specimens were collected in 2025 (compared to 552 in 2024). The coarse breakdown of species is as follows; 26% a. vexans (floodwater), 18.5% c. tarsalis (container), 13.6% c. perturbans (cattail), 10% c. pipiens (container), with the remaining ~30% being low density or unidentifiable. The relatively low adult mosquito abundance is a result of low and shortly sustained Fraser River

levels. As of the 29 September update, the BCCDC reported zero human cases of West Nile virus in British Columbia and zero cases of Zika virus.

The Climate Prediction Center (CPC) at the U.S. National Weather Service / NOAA noted La Niña conditions were present in February 2025 and persisted through the Northern Hemisphere summer. These conditions are favored to remain through December 2025 - February 2026, with a transition to ENSO-neutral likely in January-March 2026.

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 its website thereby informing MVRD residents of all available local and regional mosquito abatement efforts.

Season Highlights

- The peak Fraser River level at the Mission gauge occurred on 5 June at 4.003 meters.
- The 2025 peak was approximately .93 m higher than the 2024 peak.
- Fraser River levels above 3 metres lasted in excess of 5 days.
- The snowpack in basins contributing to the Fraser River ranged from 67-94% of normal on 1 April, immediately preceding the floodwater mosquito season.
- Local precipitation accumulation for April, May, and June was below average, while July and August was above average.
- No aerial campaigns were required within the MVRD mosquito program purview during the 2025 mosquito management season.
- Total ground treatments at floodwater mosquito development sites were applied to 32.65 ha (130.6 kg granular Vectobac®).
- Adult mosquito trap efforts in 2025 included a total of 62 trap nights, an increaase from 25 trap nights during 2023, but a decrease from 80 in 2024.
- A total of 81 adult mosquito specimens were collected from 14 trap site locations.
- Floodwater mosquitoes comprised approximately twenty-six (26) percent of trap sites contents.
- Three Mosquito Reports were received to the new Mosquito Reporter, none appeared related to floodwater mosquitoes.
- As of 29 September, the BCCDC reported zero human cases of West Nile Virus (WNV) originating within British Columbia. Four travel-related cases of WNV were reported among Canadian residents.
- In July 2025, BCCDC and multiple partners commenced a pilot project to monitor mosquito-borne viruses in B.C.'s Sea to Sky region following 4 encephalitis cases reported in that area in late 2024.
- The CDC reported zero human cases of WNV in Washington State and seven in Idaho State as of 7 October 2025.

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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 2025 mosquito season marked MBL's second 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, extensive program coverage area, 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 2025 was approximately 25,000 km (ground transportation only).

As an estimation, the 2025 driving requirements for this program resulted in the production of approximately 6.3 tonnes of CO_2 emissions. To offset this addition of CO_2 into the environment, MBL has committed to supporting a local environmental charity (TBD) by purchasing carbon offsets. When the carbon offsets are purchased, a proof of purchase and certificate from the offset provider will be delivered to the MVRD. Of note, MBL used an electric vehicle for all the adult trapping, the highest mileage portion of the program.

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 the freshet and/or significant localized precipitation, the result is large-scale floodwater mosquito egg hatching. If numerous

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

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 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 freshwater 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 inc rease 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.

Larval mosquitoes in sufficient number (i.e., >4/dip; Image 1) are treated by ground applications of a microbial larvicide product, Vectobac®. This product has the active ingredient *Bacillus thuringiensis* var. *israelensis* (Bti). In 2025, only the granular formulations of Vectobac® 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 development sites become flooded, it is increasingly difficult to treat sites by ground due to access challenges and concurrent site activation. At this point, a helicopter can be used to conduct aerial treatments. The aerial treatments use the same pesticide as ground applications, although typically with a higher application rate to penetrate canopy cover. All sites are checked within 1 or 2 days of the initial treatment to ensure treatment efficacy. If necessary, touch-up treatments are conducted.

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).

Environmental Conditions

Lower Fraser River levels are the main environmental conditions 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

Basin	2024 April Snowpack	2025 April Snowpack
Upper Fraser East	75%	79%
Upper Fraser West	87%	94%
Lower Fraser	69%	85%
Middle Fraser	66%	75%
North Thompson	78%	85%
South Thompson	78%	86%
Nechako	64%	67%

Table 1. Snow basin indices (1 April % of normal - 2024, 2025) for basins that directly affect the Lower Fraser River flood plain, determined by the River Forecast Centre[1] .

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

[1] 2025_apr1.pdf

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 2025 MVRD mosquito monitoring season, the snowpack within basins influencing the Lower Fraser River ranged from 0-85 percent of normal (**Table 1**). The June 2025 Snow Survey and Water Supply Bulletin identified the average of all snow measurements for the entire Fraser River basin (e.g., upstream of the Lower Mainland and inclusive of Upper Fraser West, Upper Fraser East, Nechako, Middle Fraser, Lower Fraser, North

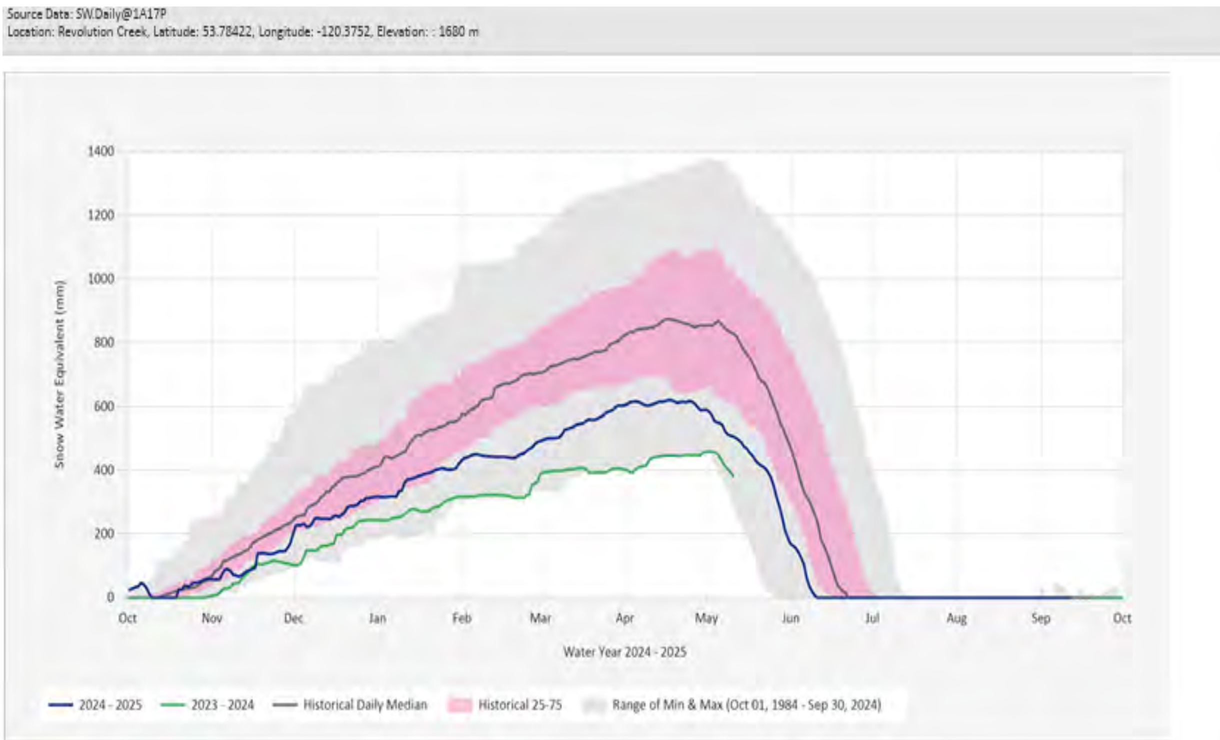

Figure 1 Snow water equivalent for the 2024/2025 winter. Note the levels (blue line) were significantly below average for the second season in a row.

Thompson, and South Thompson) was 42%, decreasing from 63% on May 15th[2]. Lower elevation snowpack melted from warm weather in late March and April. Higher elevation snowmelt was initially trending later than normal with generally seasonal temperatures, until heat in late May resulted in a rapid melt.

The Revolution Creek snow survey station (ID: 1A17P) reflects weather trends in the Upper Fraser snow basin and is a representative site for the regional snowmelt trajectory for high-elevation snowpack. Notably, snowpack slightly increased through April. By early May, the snow basin

[2] 2025_jun1.pdf

index was 70% of normal[3]. The trend in snowpack reduction started in early May, with the depletion of high elevation snowpack by mid-June. (**Figure 1**).

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. Snow Basin Indices (SBI) for June 15th throughout the province were all below 30% of normal[4].

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 greater-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 lower than average (**Figure 2**). Due to low Fraser River levels, it is unlikely that local precipitation impacted target mosquito development in April. Local precipitation in May and June was also below average (127.0 mm, 157.0 mm, respectively.) Precipitation received in July (35.6 mm) and August (122 mm) registered above the 5-year average.

[3] 2025_may1.pdf
[4] 2025_jun15.pdf

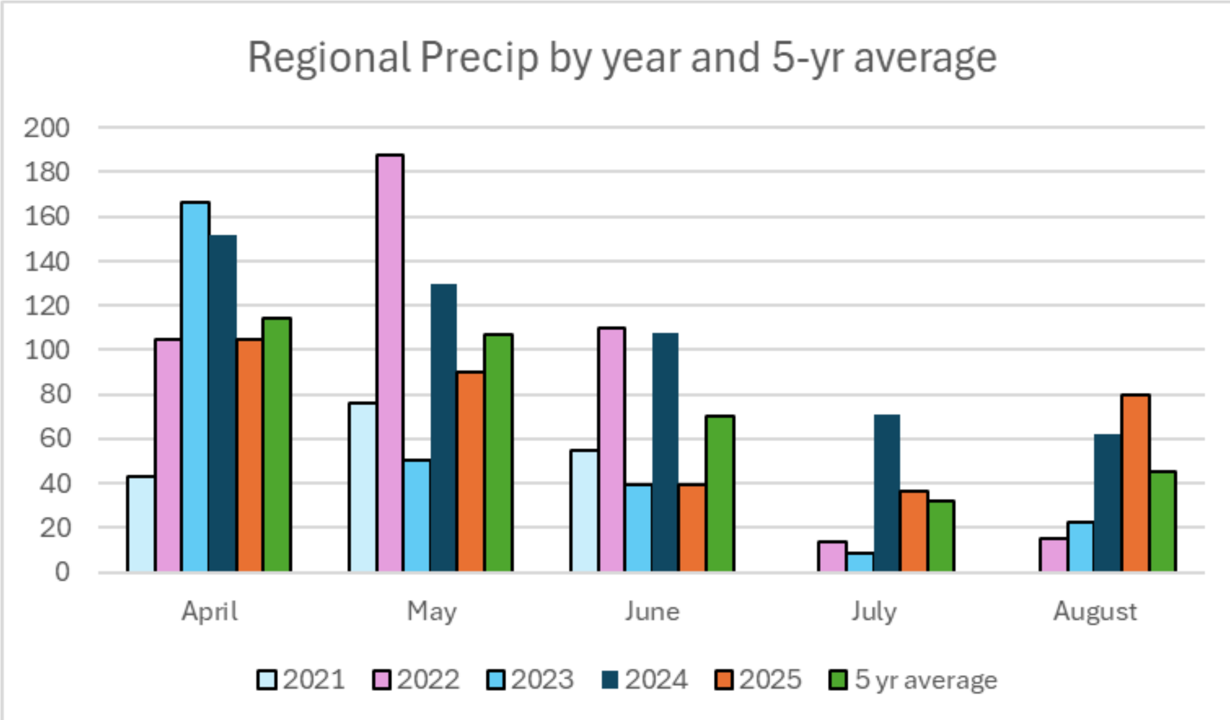

Figure 2. Precipitation values (rainfall and snow accumulation; mm) recorded at the Mission West Abbey Station (ID: 1105192) for 01 April – 31 August; 2025 (orange) and 5-year average (2021-2025; green).

Precipitation accumulated in July at the Mission West Abbey station (36.4 mm), was slightly above the station's 5-year average for July by 4.4 mm. August precipitation was approximately almost double the average (79.8 mm). (**Figure 2**), though it was of little consequence to the regional Fraser River levels and associated mosquito development sites because the univoltine[5] floodwater mosquito species had already hatched and/or seepage sites had returned to dry states. It is possible, however, 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 multivoltine 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 since local 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.

[5] Univoltine refers to species that have one generation per year. Multivoltine refers to species that have multiple generations per year, often more than two

Fraser River Watershed Temperatures

The 2025 mosquito monitoring season began in April accompanied by slightly above normal to above normal temperatures (+0.5°C to +2.5°C) throughout British Columbia in April due to generally stable weather conditions[6]. Warm and drier weather occurred at the start of May before switching to primarily seasonal temperatures and unstable conditions through to the middle of May. The first week of June brought dry and seasonally warm temperatures before returning to a variable weather pattern[7]. La Niña conditions remained throughout this period and were expected to transition to ENSO-Neutral for the summer months (June to August)[8].

Low-elevation snowmelt during May and June within the Fraser River watershed provided gradual freshet to the Fraser River. Continued warm temperatures throughout June depleted remaining high elevation snowpack in contributing snow basins. Ambient temperature data are consistent with 2025 automated snow station data depicting snowmelt points correlating with regional ambient temperature spikes[9].

July and August were above average in temperature, with slightly above average precipitation, providing very little input to the Lower Fraser River and helping to dry the majority of floodwater mosquito development sites within the program purview.

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. These temperature boundaries are depicted in black on **Figure 3**, below.

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.

[6] 2025_may1.pdf
[7] 2025_jun15.pdf
[8] 2025_jun15.pdf
[9] 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

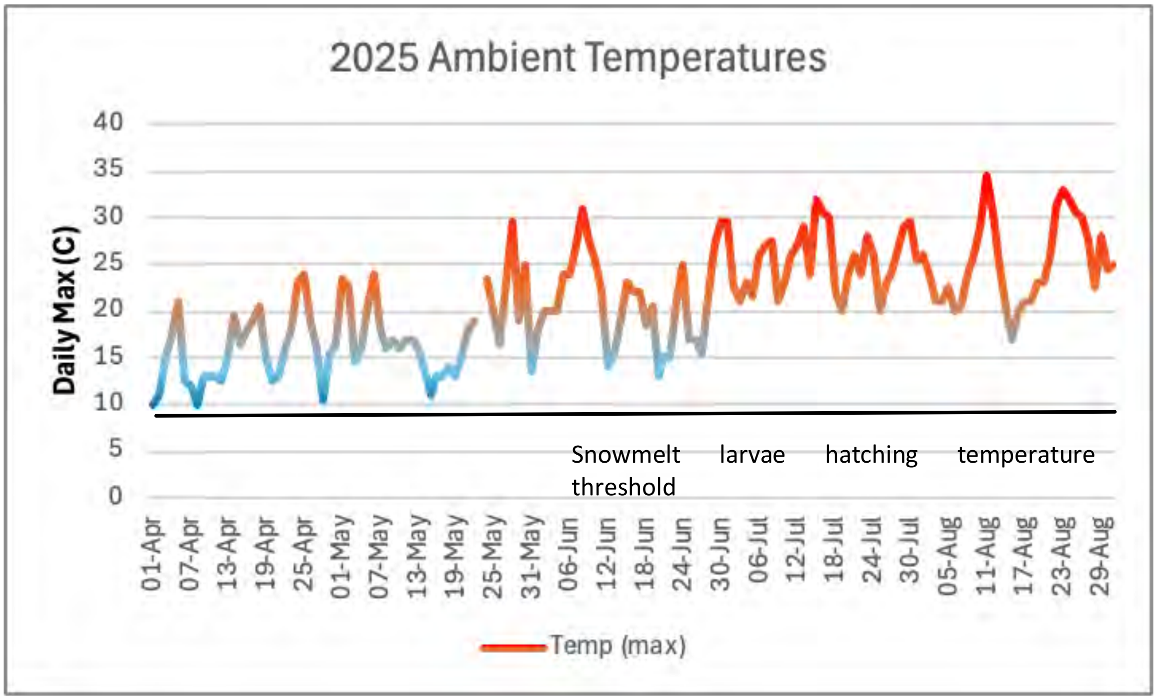

Figure 3. Maximum daily ambient temperatures (C) as recorded at the Mission West Abbey Station (ID: 1105192) 01 April – 31 August 2025.

The MVRD 2025 season began with above average ambient temperatures for April. The monthly average for April (15.6°C) was 2.29° C warmer than the 1990-2024 historical station average. Given that April temperatures frequently were above the lower temperature threshold 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 17.92° C for May 2025, was 0.76° C warmer than the 1990-2024 historical station average. Thus, mosquito egg hatching and 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 thresholds 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 consistently above 3 metres 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 temperatures, there was a need to treat mosquito larvae in June.

High ambient temperatures, such as those noted in late 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 2025 Lower Fraser River freshet began in early-May as the result of warm high elevation temperatures within contributing basins causing snowmelt and the gradual rise of the Lower Fraser River (Mission gauge; 08MH024. The official peak of the Lower Fraser River (Mission gauge; 08MH024) registered at 4.003 meters on 5 June. (**Figure 4**).

By mid-June 2025, nearly all snow basins contributing to the Fraser River were depleted of snow, with the exception of eastern contributing basins which showed 30% - 0% percent of average snowpack[10].

Despite seasonal temperatures and average precipitation, low peak levels for the Lower Fraser River were recorded at Mission gauge in 2025[11]. 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.

[10] 2025_jun15.pdf
[11] Historical Hydrometric Data Search Results - Water Level and Flow - Environment Canada

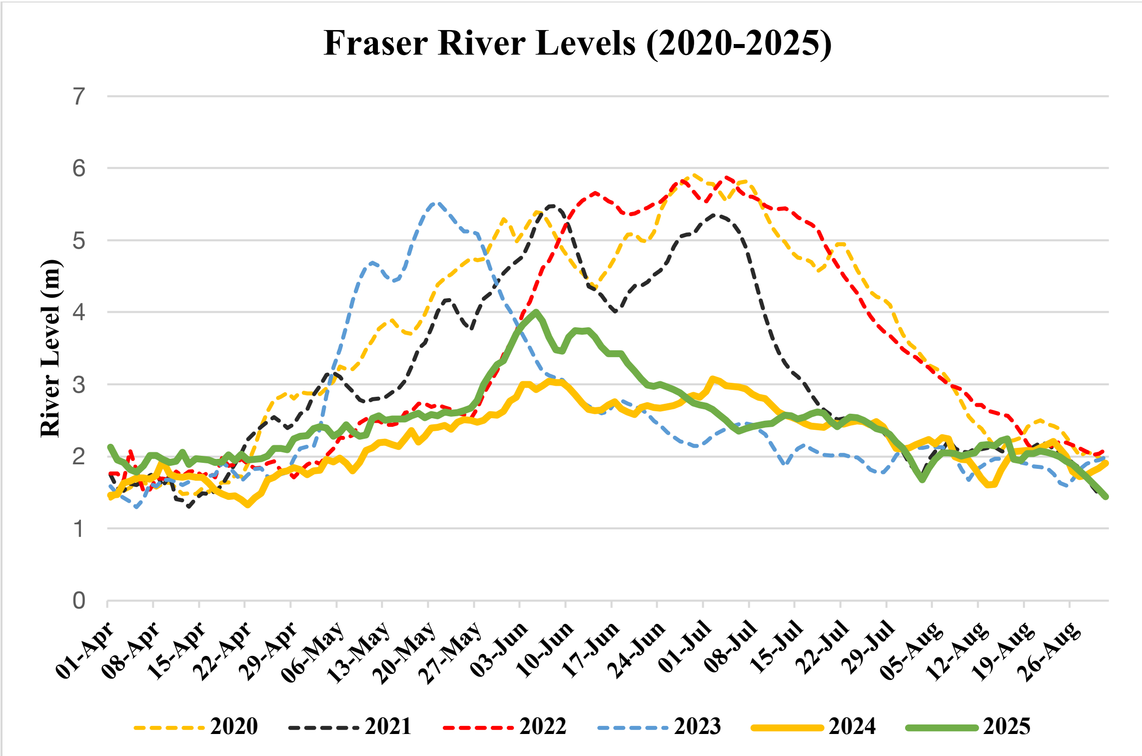

Figure 4. 2025 river levels (m) as recorded for the Lower Fraser River (Mission gauge, 08MH024) from 1 April – 31 August, 2025 (green). Compared to previous 5 seasons (2020-2025).

The level at which mosquito development sites within the MVRD have been observed to become active is approximately 3m. In 2025, the Fraser River reached 3.13 meters on 29 May. (**Figure 4**). River levels were sustained over the critical 3-metre Lower Fraser River level long enough to provide suitable conditions for floodwater mosquito development at associated floodwater and seepage sites.

The length of time that the Fraser River at Mission remains higher than 5 metres (during more typical years) helps predict the extent of mosquito larval abundance within a given year. The Fraser River never rose above the 5-metre threshold in 2025. In average years, such as 2021, Lower Fraser River levels may remain above 5m for closer to 20 days.

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, mosquito eggs laid between the high-water mark of both years could have remained dormant until current-year freshet trigger their hatching. Because the 2025 peak of the Fraser River was only approximately .93 meters higher than the 2024 peak, the 2025 high water likely did not trigger additional dormant floodwater mosquito eggs to hatch (**Figure 4**). Nevertheless, 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.

Larval Control

Monitoring within the MVRD began on April 28 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 2025 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**).

Appendix II is a collection of maps by municipality depicting where and how frequently treatments took place in 2025. 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 later treatment due to representative site's 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.

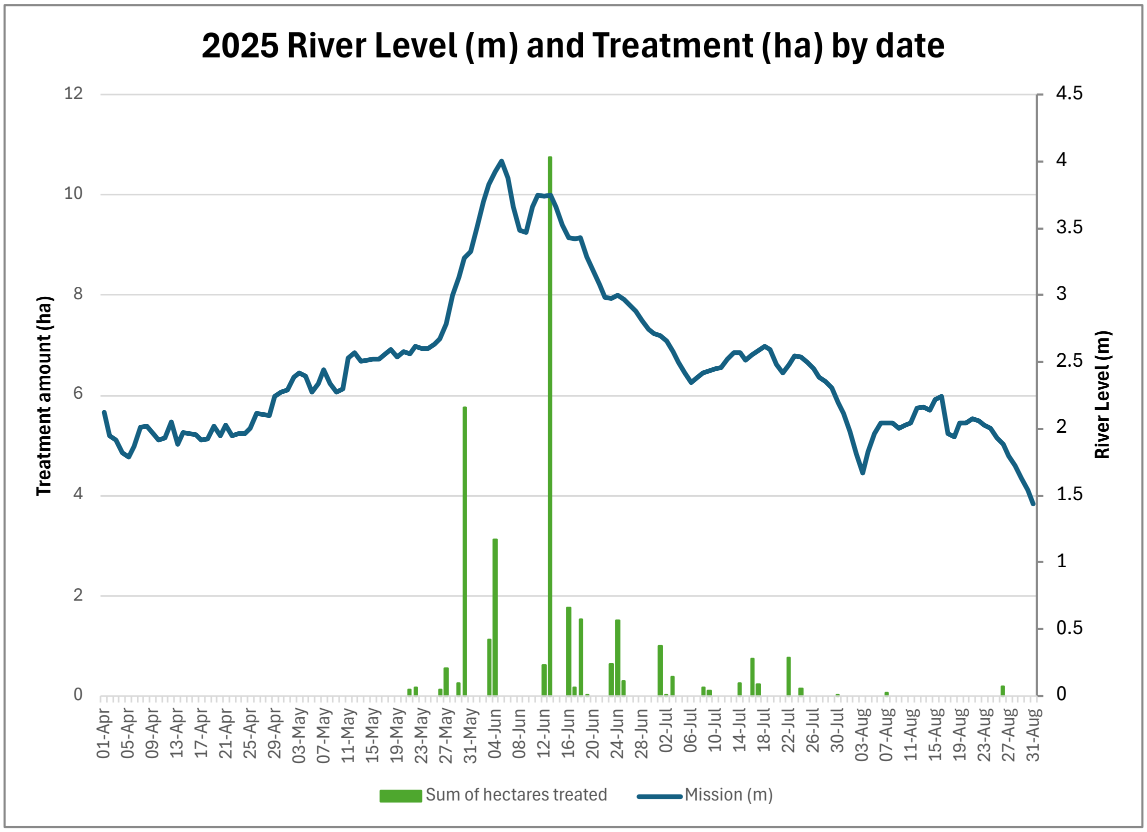

Figure 5. Fraser River levels (m; Mission gauge) with total mosquito development area treated by ground (ha) from 1 April – 31 August 2025. Note that ground treatments (ha) are recorded on the alternate y-axis.

The first floodwater mosquito development site was treated by ground on 22 May. (**Figure 5**). Most ground treatments > 1 ha took place between 31 May and 25 June, as dictated by peak Lower Fraser River levels. However, due to low Fraser River peak levels in 2025, treatments were low in August. (**Figure 5**).

Vectobac® (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 (Vectobac® 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 2025. 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 2025 was approximately 32.65 ha (186 kg Vectobac®; 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 low water year of 2024, floodwater mosquito development habitat increased in 2025. The 2025 snowpack within contributing snow basins was lower than the historical average. Records were slightly augmented through April before rapidly melting during mid-May through early June. Similar conditions across much of contributing snow basins resulted in relatively low Lower Fraser River levels through August. A compounded number of floodwater mosquito eggs hatched in 2025 as environmental triggers (i.e., gradual freshet, sustained water levels, high ambient temperatures) were in place for continued hatching events through July. Below-average to average precipitation from April through June, however, likely did not increase mosquito development activity at seepage sites.

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. No aerial treatments were required within MVRD along the Fraser River corridor in 2025. The low mosquito larval abundance was due to low and briefly sustained Fraser River levels above four (4) metres that did not trigger the hatch of a compounded number of mosquito eggs

Aerial treatments during normal seasons are conducted using granular Vectobac®. 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 19 trap locations were selected in 2025.

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 62 trap nights were conducted. A total of 81 adult female mosquito specimens collected. Approximately 447 less mosquito specimens were collected than in 2024 and 859 less than in 2023. The relatively low sustained Lower Fraser River peak (4.003m) was responsible for the decrease in adult mosquito trap abundance.

The initial Fraser River peak occurred on 5 June and due to the extremely low river levels there was no related increase in floodwater mosquitoes. The sample containing the largest number of adult specimens occurred on 11 July with a species composition primarily comprised of container species, an only 13 mosquitoes (1 male and 12 female).

Adult mosquito traps with the greatest number of specimens were from Kanaka Creek. The adult trap numbers at this location suggest that there was a small localized late season hatch of floodwater mosquitoes, or that *A. vexans* became more active at the end of their lives.

The adult mosquitoes collected from traps were generally well-preserved in 2025. Two trap events that contained high levels of small moths seemed to correlate with moldy samples. For 2026, staff will attempt to remove the moths before shipping.

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).

Aedes japonicus may have been detected, via one male, in Tynehead Park on June 3. MBL recommends increased trapping efforts at this location to resolve the probable identification.

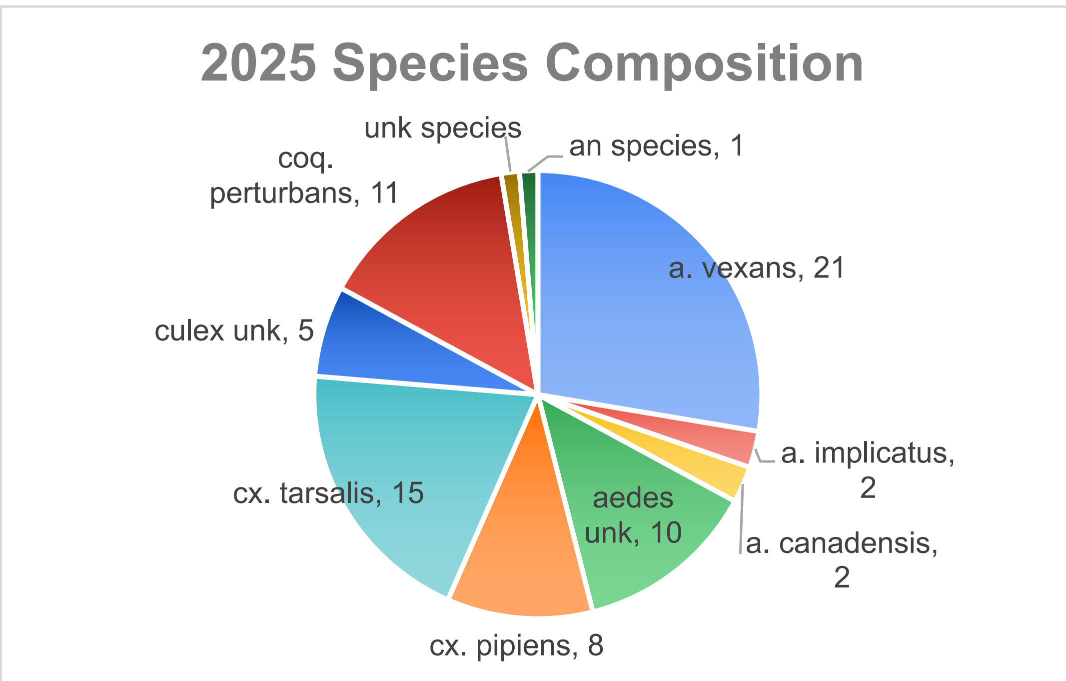

Figure 6. 2025 over-all mosquito species composition from adult mosquito trap established throughout the MVRD.

Overall, floodwater *A. vexans* species comprised the majority of the species in 2025 traps (i.e., ~26%; **Figure 6**). This year the abundance of *Cq. perturbans* was only 13.5% (down from 75% in 2024). The primary habitat for *Cq. perturbans* is emergent vegetation, and more specifically *Typha* species (Batzer and Sjogren 2012).

RPAS (Drone) Update

Despite a promising start in early 2024, the Province reprioritized its efforts in 2025 and paused further development of a certification category for pesticide applications using drones for the foreseeable future. The latest mandate letters from the Ministers did not include advancing RPAS

(Remotely Piloted Aircraft Systems) certifications to support larvicide applications with this technology. While some other provinces have established categories for drone-based pesticide applications, others have simply adapted their existing “aerial application” classifications to include drones.

Currently, the only barrier preventing MBL from using drones to treat larval mosquitoes as part of its mosquito control program is the absence of a drone-specific pesticide applicator certification from the Province. In response to inquiries from several local governments, Minister Tamara Davidson (Minister of Environment and Parks, Nov. 3, 2025) indicated that, while this is on their radar, it is not happening imminently. Further, in response to a question at the IVMA (Integrated Vegetation Management Association) forum in Prince George, Ministry staff suggested that this is a priority for their work beginning March 2026 (Nov. 5, 2025).

Given the significant financial and environmental benefits this technology offers, MBL remains committed to working with the Province to help establish the necessary certification framework.

Discussion

This season was another one for the record books. As with 2024, treatments along the Fraser corridor were limited to pockets of water resulting from a combination of ground water, precipitation, and higher tides. A total of 130.6kg (~7 bags) of Vectobac, were used for ground treatments along the Fraser this year. For reference, in most years this would be considered a few large hand treatments at a few large sites.

There were no issues of note for the 2025 season, other than a dramatically reduced mosquito catch and correlated reduction in mosquito reports.

The new Mosquito Reporter has provided an excellent venue for logging resident and business reports, allowing for a better opportunity to analyze the data. While there were few reports from the MVRD program, other programs had much different experiences and MBL was able to assess the efficacy of the Mosquito Reporter.

As with the start of the season, the low water this year could present an issue for the 2026 season, that said, snow levels are currently at or below average throughout the province.

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.

Mosquito Reporter

To strengthen public engagement and improve operational efficiency, MBL introduced the Mosquito Reporter tool in 2025 (https://www.mbl-gis.com/reporter/). This platform provides residents and visitors with a simple, user-friendly way to submit georeferenced mosquito observations online. By streamlining the reporting process, Mosquito Reporter reduces reliance on phone calls and emails while generating structured, location-specific data. These reports enhance the program's ability to identify active mosquito development sites, support adaptive management decisions, and contribute to more robust seasonal analysis.

A link has been provided that allows residents and visitors to easily create a comprehensive, georeferenced mosquito report that staff are able to easily follow up on. We also continue to offer a toll-free Mosquito Hotline (877-986-3363).

This year saw three (3) reports come in to the Mosquito Reporter. One report in May suggested the mosquitoes were bad near a school in Richmond, and two in September commented on the mosquitoes in Surrey. The reports requested a follow-up; crews visited the sites and have added it to our monitoring efforts going forward.

Phone Calls and Emails

MVRD residents have multiple venues to communicate with MBL. MVRD set up an in-house mosquito control hotline (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).

The total number of reports received in 2025 was low and reflects a reduced area of floodwater mosquito development habitat (**Figure 7**). The low number of reports is due to the low adult mosquito abundance, a result of a short peak in Lower Fraser River levels.

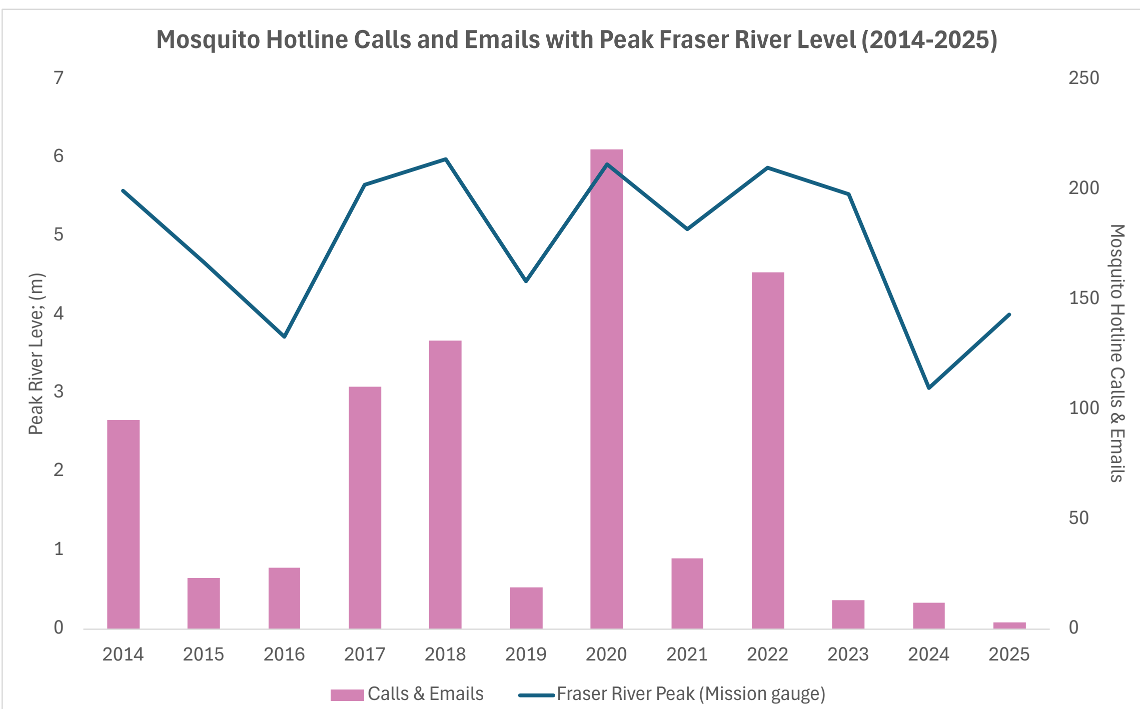

Figure 7. Peak Fraser River levels (m; blue, Mission gauge) with total Mosquito Hotline calls and emails (2014-2025, pink).

Three concern reports were received in 2025 - Surrey (2), and Richmond (1). MBL staff followed-up with reconnaissance visits and located no new sites on residential properties.

In the early part 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 2025 likely ranged from early-June through late-July. The email received in early May and the two calls received in September 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

In 2023, MBL made the decision to move away from posting on social media. We have found that the negative aspects of social media far outweigh the positive aspects. MBL has, upon request, provided material for the MVRD to post updates for program activities. This was not requested in 2025.

MBL Website

The MBL website (**www.morrowbioscience.com**) was launched in 2015 and redesigned in 2025 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 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.

Image 2. MBL Outreach Booth at Pitt Meadows Day – 01 Jun 2025.

This year's Education/Outreach campaign included hosting booths at several regional community events, including Goodbye Chums (04/28/25), Richmond Public Works (05/10/25), May Day (05/19/25) and at MVRD's popular June 1st Pitt Meadow's Day. (**Image 2.**)

Morrow BioScience Ltd staff engaged in discussions, provided key personal protection tips, and distributed educational pamphlets regarding non-pesticide mosquito control and invasive plant management.

To provide residents with further avenues of contact, MBL has developed a simple to use "Mosquito Reporter". A link has been provided that allows residents and visitors to easily create a comprehensive, georeferenced mosquito report that staff are able to easily follow up on. We also continue to offer a toll-free Mosquito Hotline (877-986-3363).

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. Monitoring West Nile virus nationally is a joint effort between the Government and its partners, including provincial and territorial ministries of health, First Nations authorities, and blood supply agencies[12]. Along with its partners, Health Canada compiles on-going provincially reported surveillance data of WNV cases in humans, animals, and mosquito pools[13].

As of the 29 September 2025 update, zero human cases of WNV have been reported originating from British Columbia and four cases have been reported among residents of Canada who

[12] Surveillance of West Nile virus - Canada.ca
[13] Id.

became infected while travelling outside of the country.[14]

Washington State and Idaho State share a border with British Columbia, so it is important to follow WNV activity in those areas, as well. According to the Center for Disease Control, as of 7 October, zero human cases of WNV have been reported in Washington and seven in Idaho [15].

BCCDC Mosquito Surveillance Study

In late 2024, four cases of encephalitis, originating from the Sea to Sky corridor of BC, were reported to Vancouver Coastal Health (VCH) and the BC Centre for Disease Control (BCCDC).

In July 2025, VCH and the BCCDC, together with partners from Lilwat Nation, Squamish Nation, and the University of BC, commenced a mosquito surveillance pilot project in the Sea to Sky region to better understand the local mosquito population and the viruses they carry[16]. The study implements the use of Encephalitis Virus Surveillance (EVS) mosquito traps.

Zika Virus Summary

According to the CDC, Canada is not known to have mosquitos that transmit Zika[17]. HealthLinkBC reports that no Zika cases have originated in Canada due to presumed lack of vector mosquito species[18]. Peach (2018) identifies the primary Zika mosquito vectors (i.e., *Aedes aegypti*, *Ae. albopictus*) are not found in British Columbia, consequently there is currently a low risk for Zika virus to circulate within British Columbia. *Ae. albopictus* has previously been found on the east coast but tested negative for Zika.

2026 Program Recommendations

- Sharing the Mosquito Reporter more widely through MVRD social and news channels
- Notify the Ministry of Environment of the MVRD intent to treat mosquitoes in 2026 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).
- 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.

[14] Seasonal update: Mosquito-borne disease surveillance in Canada — Canada.ca
[15] Current Year Data (2025) | West Nile Virus | CDC
[16] https://www.vch.ca/en/news/new-pilot-project-study-mosquito-population-sea-sky-region
[17] Countries & Territories at Risk for Zika | Zika Virus | CDC
[18] Zika Virus | HealthLink BC

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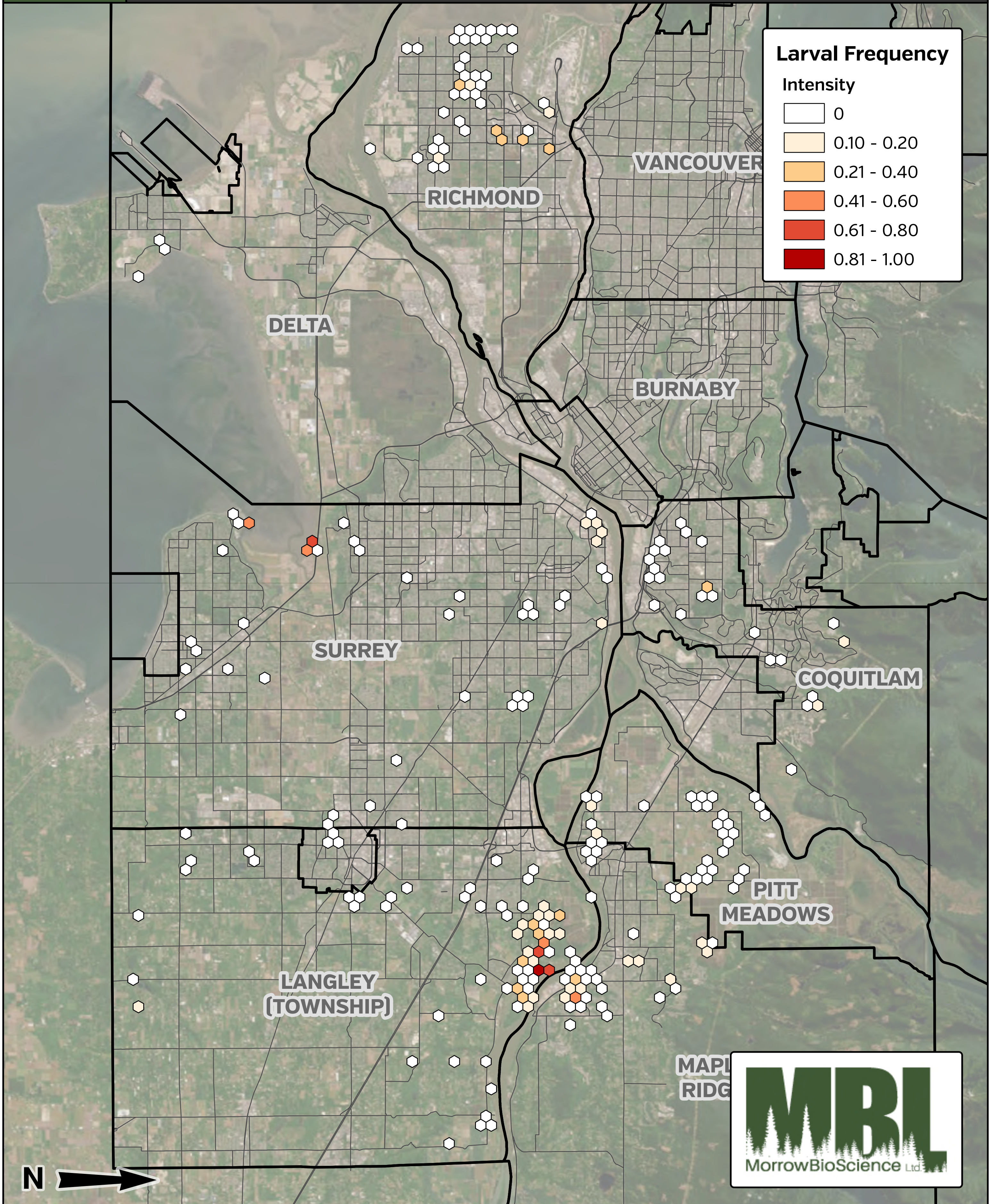
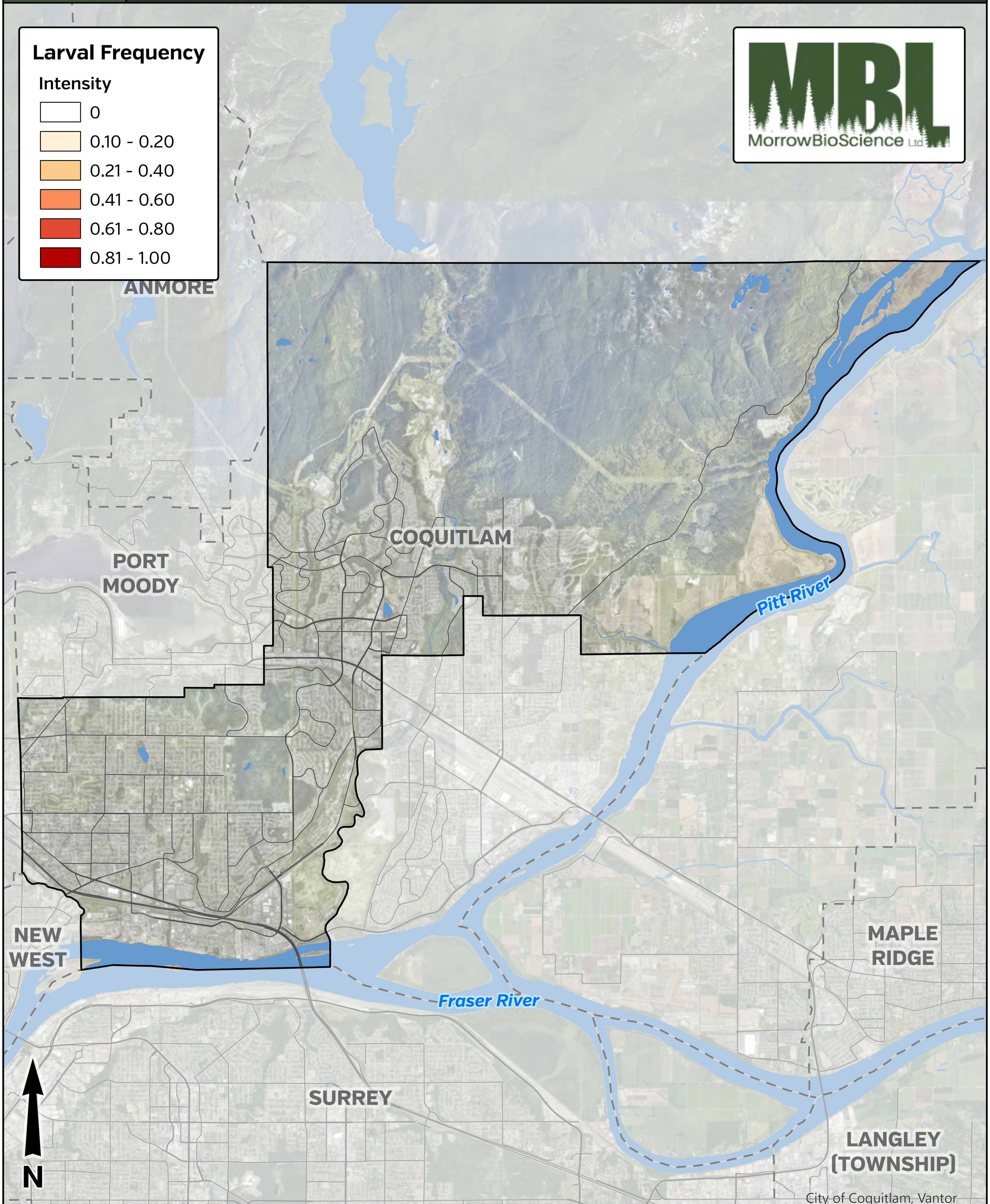
Appendix I-A

2025 Larval Frequency - MVRD



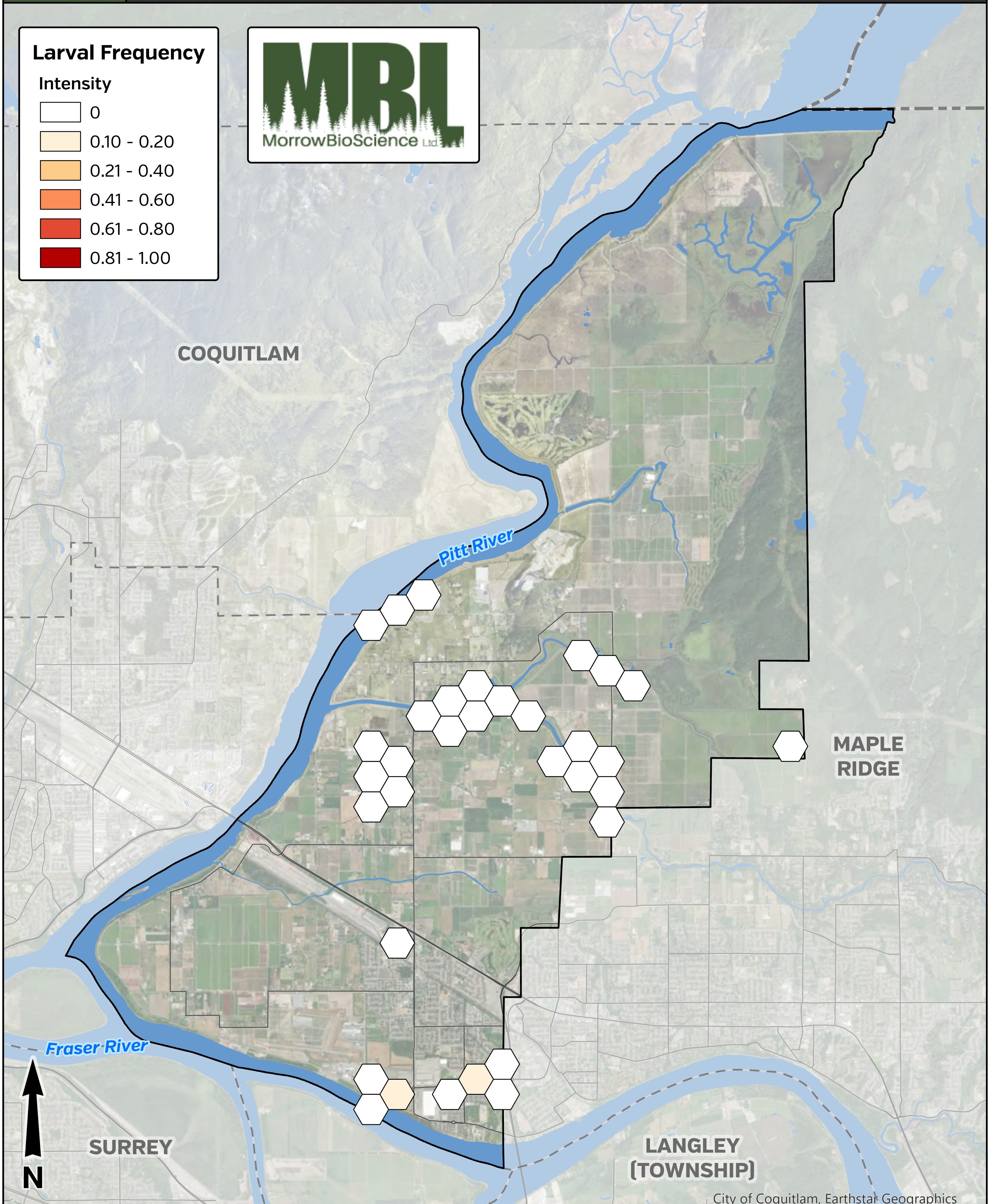
Scale = 1:230,000 | NAD 1983 UTM Zone 10N | Contains information licensed under the Open Government Act - Canada | Printed: 2025-11-27

2025 Larval Frequency - Coquitlam



Appendix I-C

2025 Larval Frequency - Pitt Meadows



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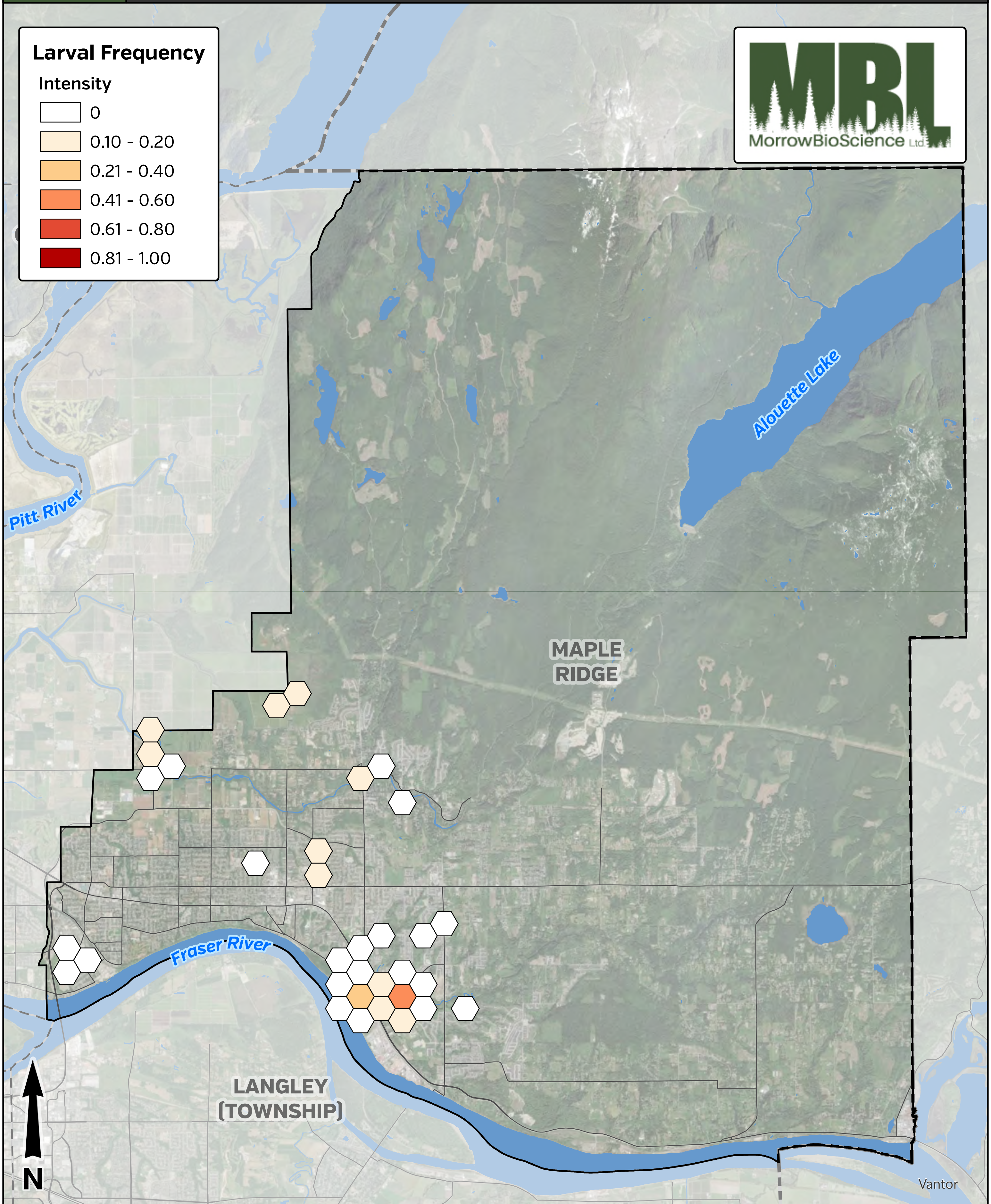
Appendix I-D

2025 Larval Frequency - Maple Ridge



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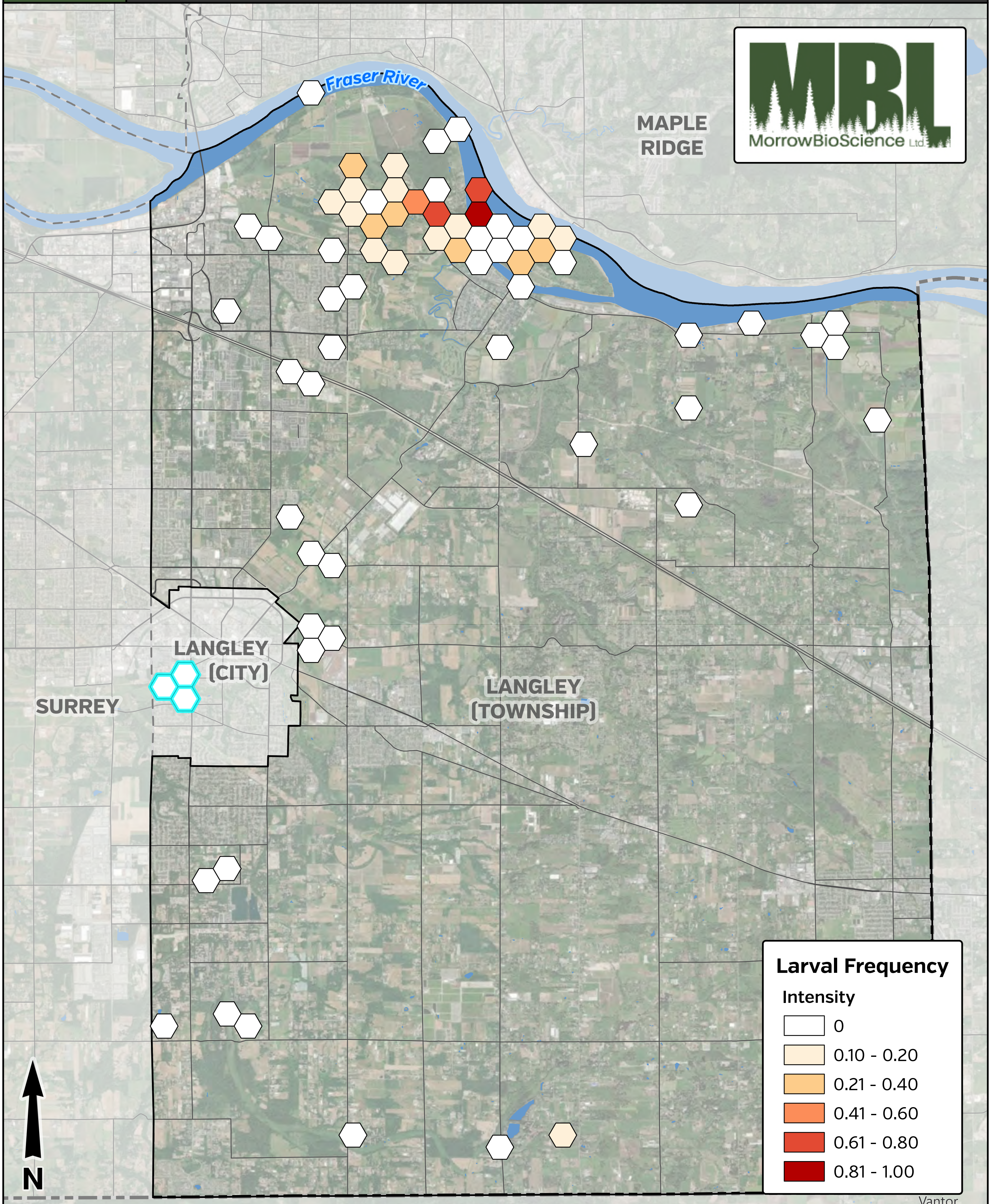
Appendix I-E

2025 Larval Frequency - Langley



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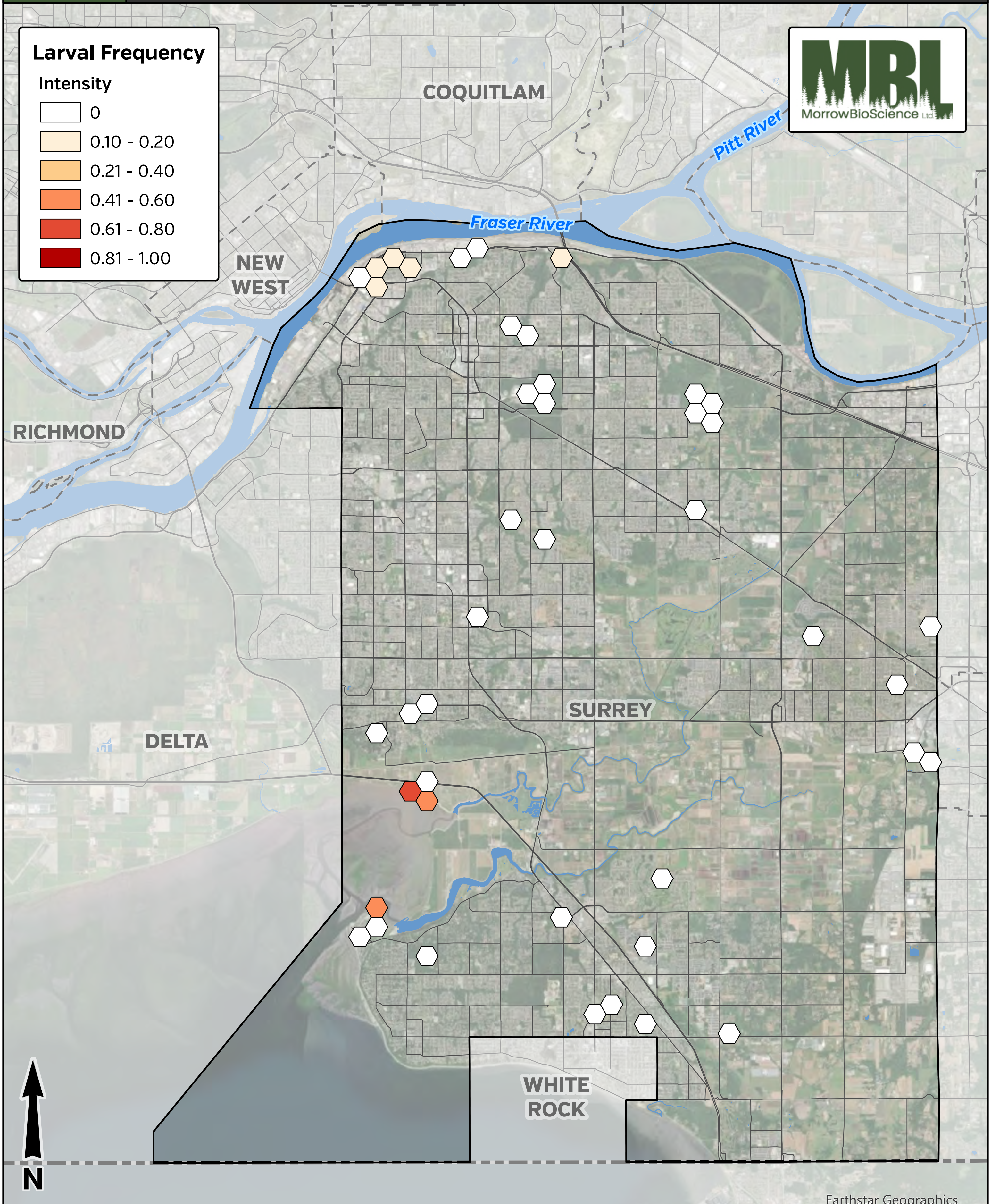
Appendix I-F

2025 Larval Frequency - Surrey



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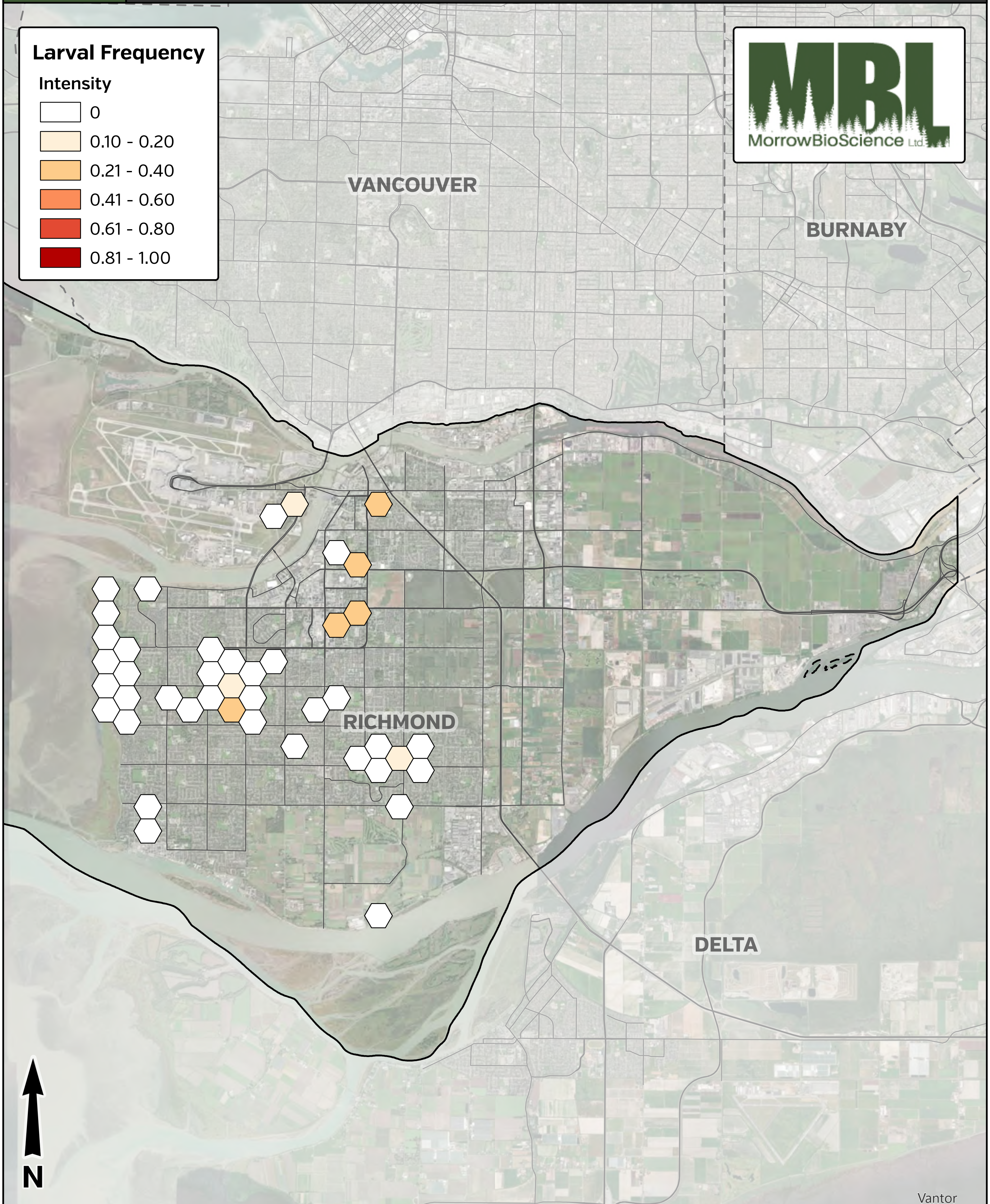
Appendix I-G

2025 Larval Frequency - Richmond



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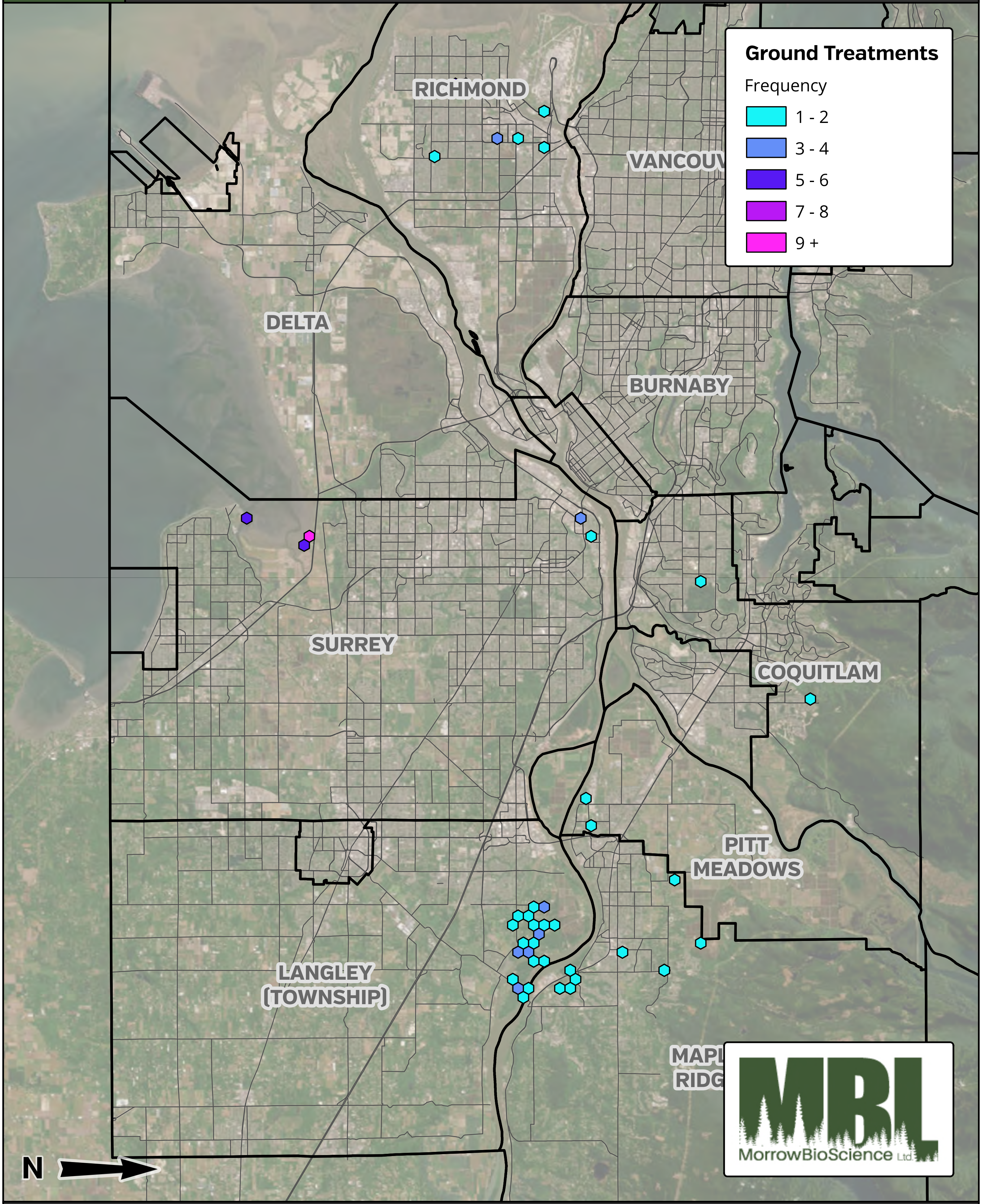
Appendix II-A

2025 Larvicide Treatments - MVRD



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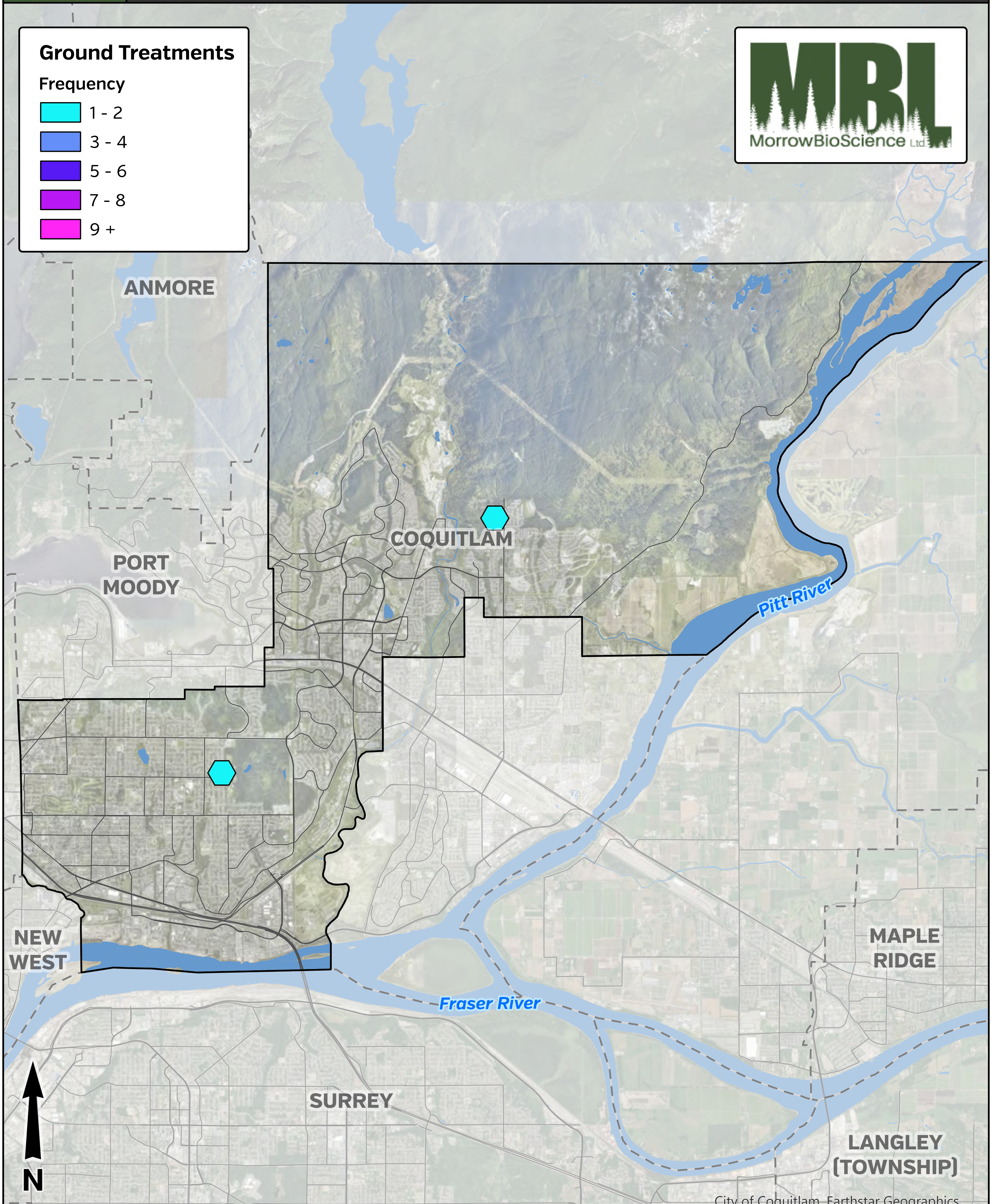
Appendix II-B

2025 Larvicide Treatments - Coquitlam



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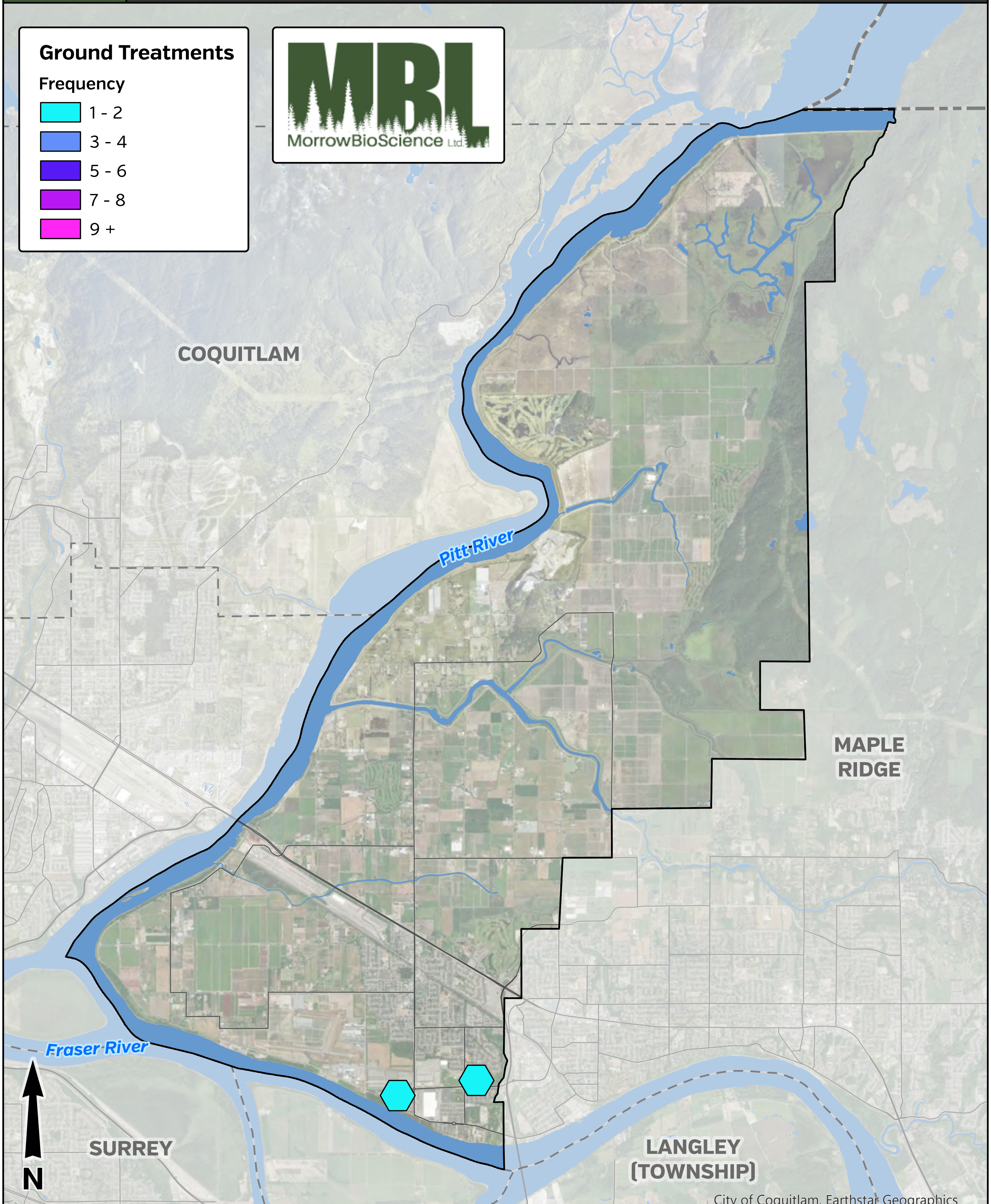
2025 Larvicide Treatments - Pitt Meadows



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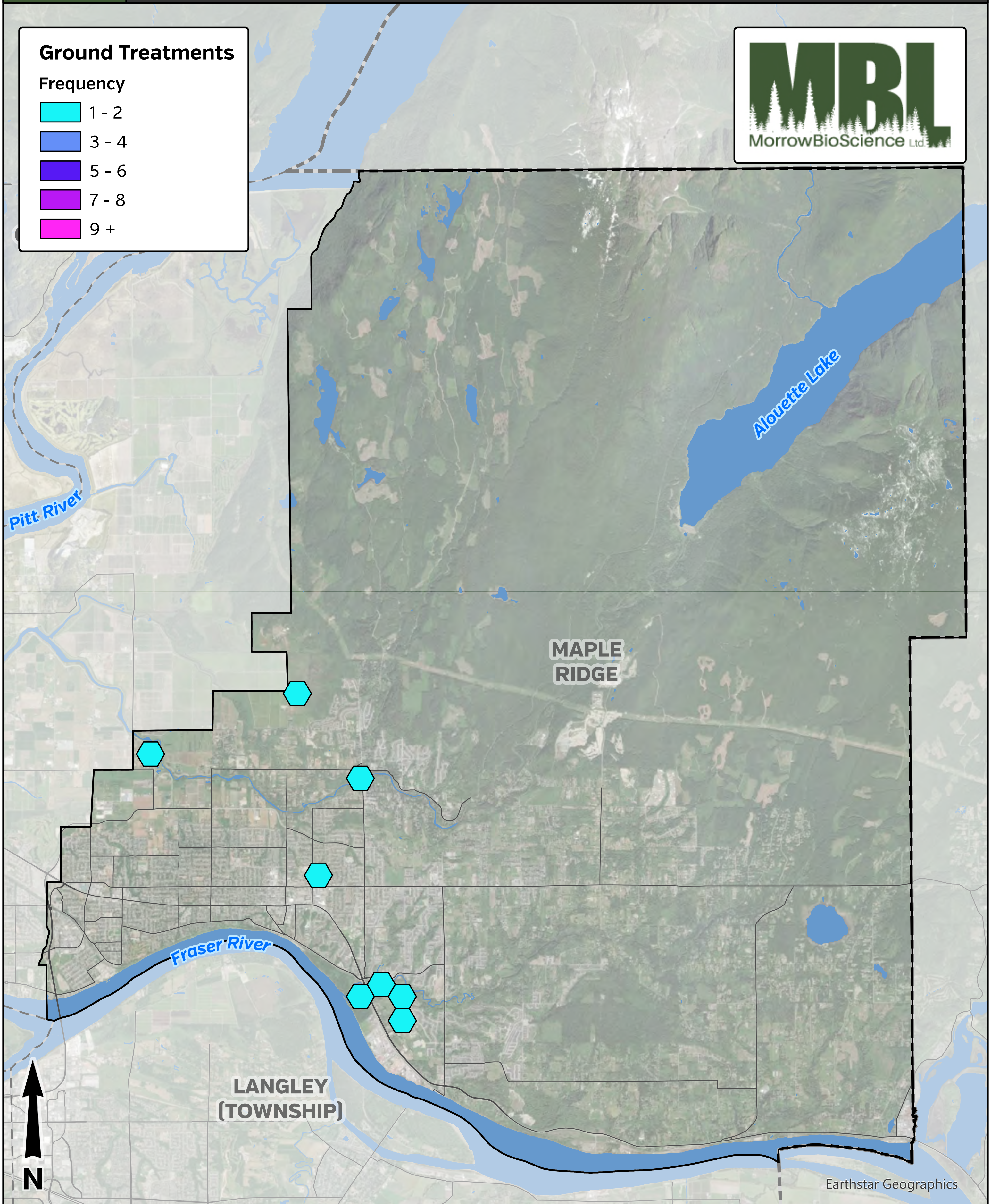
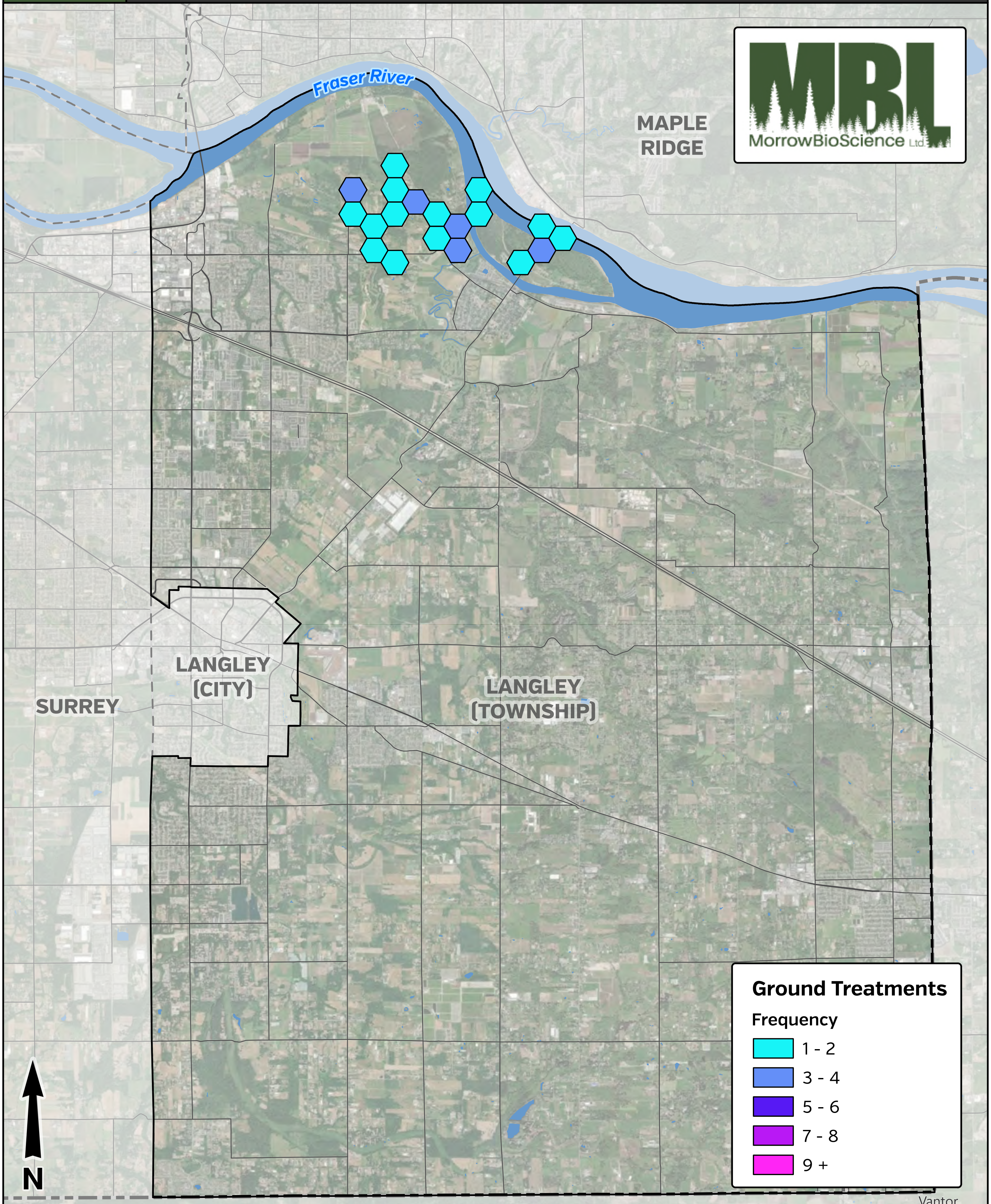
Appendix II-D

2025 Larvicide Treatments - Maple Ridge



Scale = 1:100,000 | NAD 1983 UTM Zone 10N | Contains information licensed under the Open Government Act - Canada | Printed: 2025-11-27

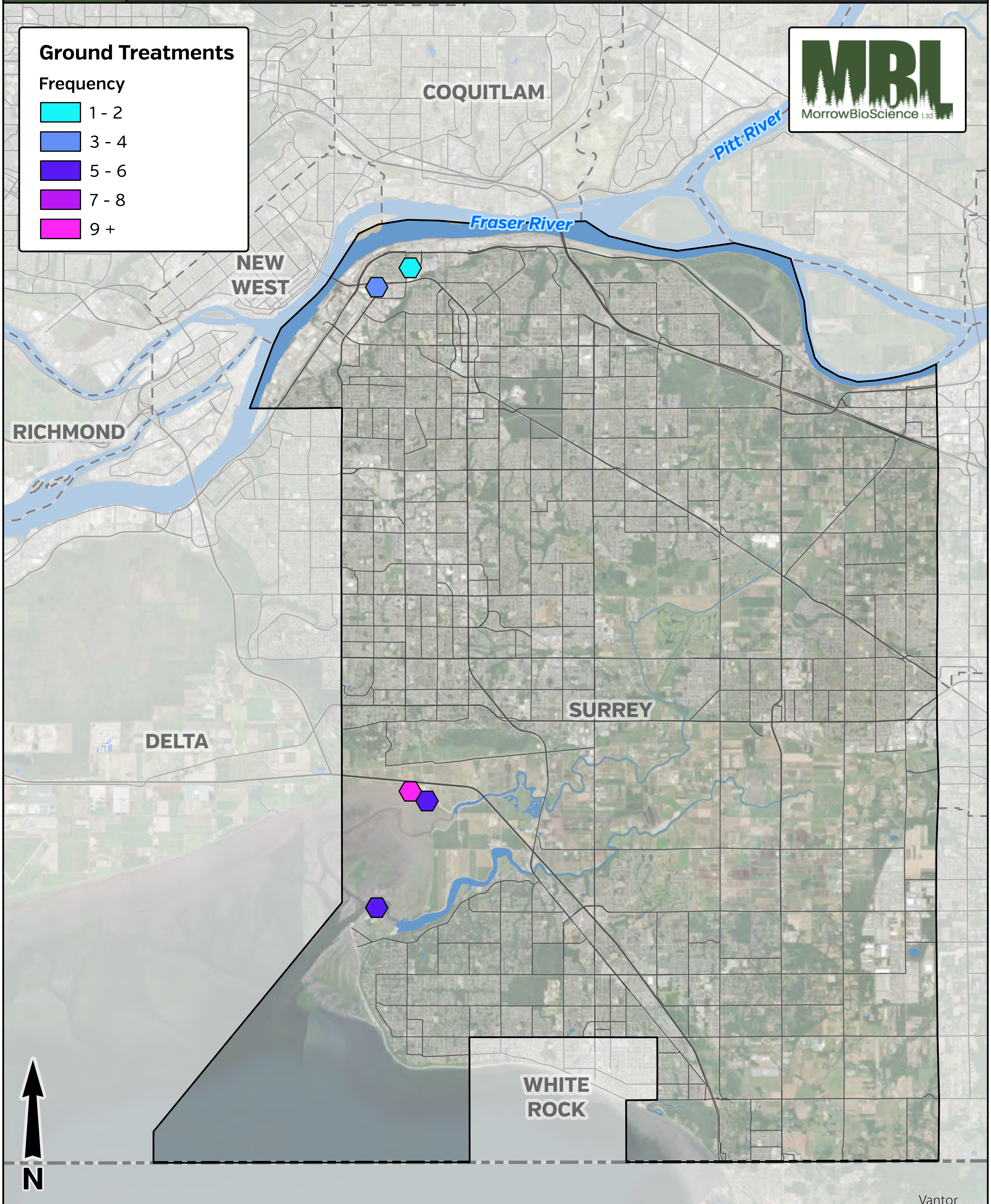
2025 Larvicide Treatments - Langley



Scale = 1:100,000 | NAD 1983 UTM Zone 10N | Contains information licensed under the Open Government Act - Canada | Printed: 2025-11-27

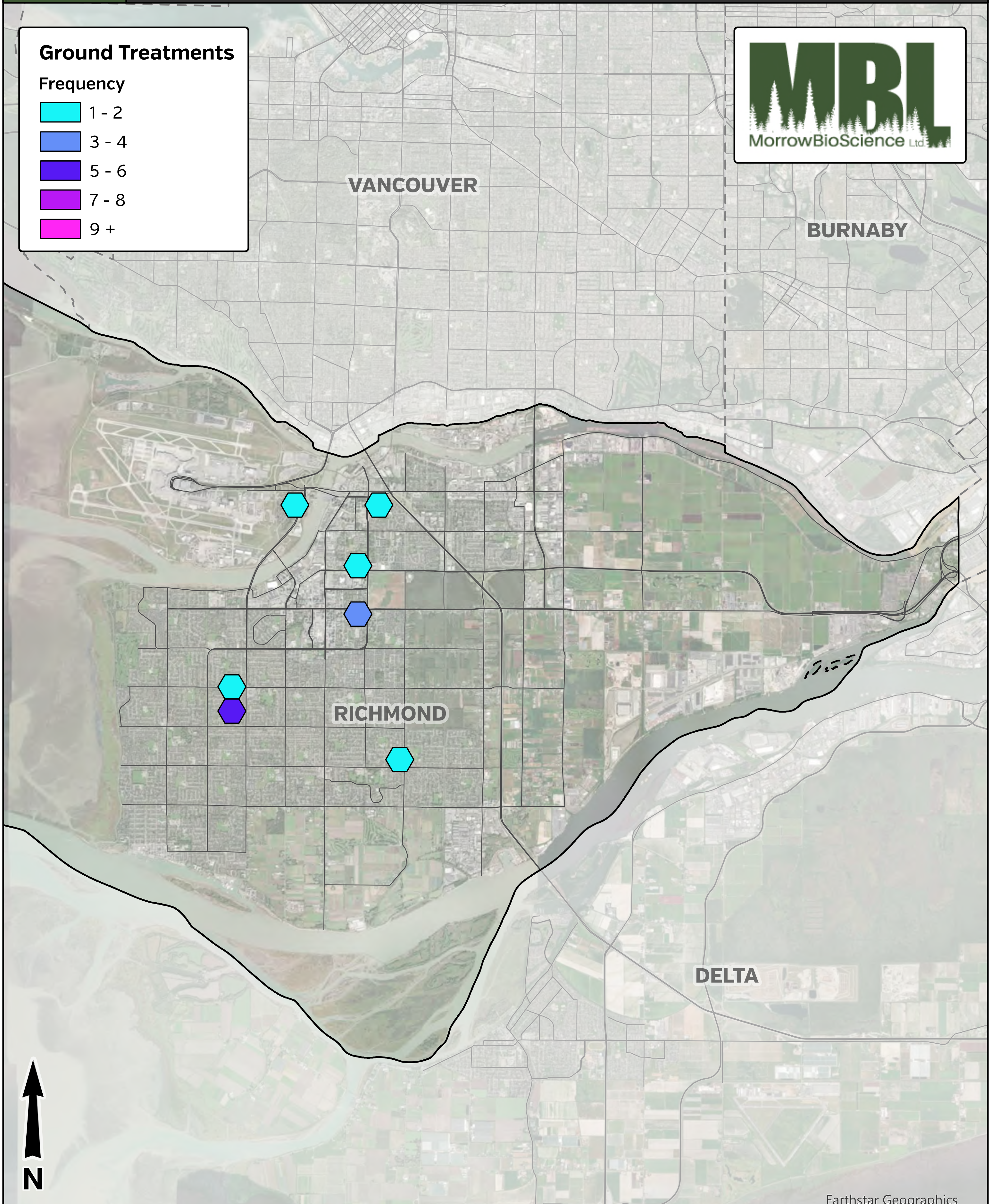
Appendix II-F

2025 Larvicide Treatments - Surrey



2025 Larvicide Treatments - Richmond

Appendix II-G



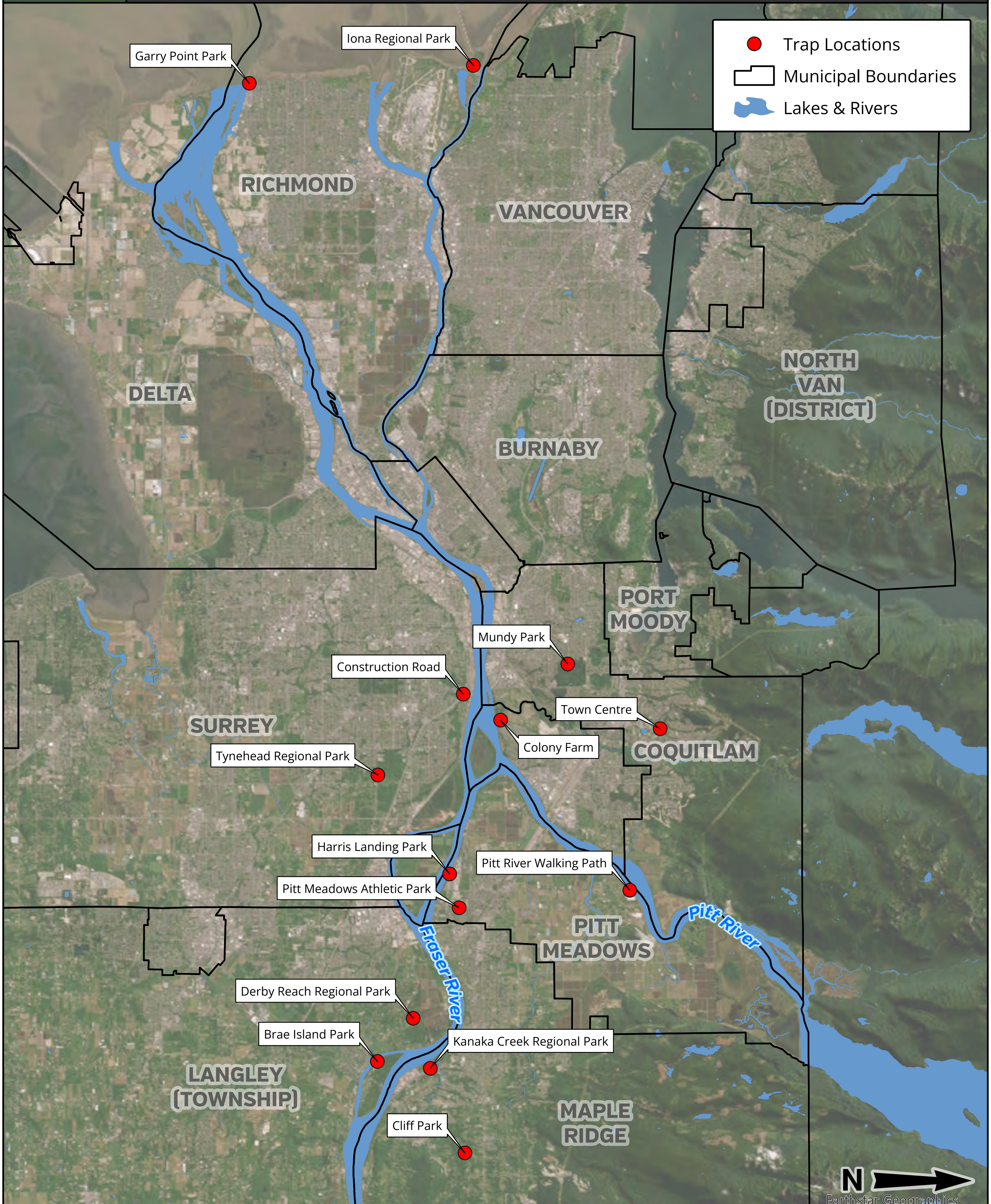
Appendix III – treatment amounts by location, 2025

	Sum of treatment_amount_kg
MVRD - Coquitlam	
COQ-001	0.8
COQ-041	0.5
MVRD - Langley	
(blank)	48
MA-008	0.25
TOL-008	0.1
TOL-011	0.1
TOL-013	0.07
TOL-016	2
TOL-1012	4
TOL-236	0.17
TOL-341	0.15
MVRD - Maple Ridge	
(blank)	0.35
MR-095	1
MR-191	2
MR-503	0.2
MVRD - Parks (Blaney Bog Regional Park Reserve)	
MR-513	2.5
MVRD - Parks (Boundary Bay Regional Park)	
SR-046	3.7
SR-630	2.75
MVRD - Parks (Brae Island Regional Park)	
(blank)	25
TOL-240	10
MVRD - Parks (Derby Reach Regional Park)	
(blank)	1
MVRD - Parks (Kanaka Creek Regional Park)	
(blank)	6
MR-158	4
MVRD - Pitt Meadows	
(blank)	0.3
PM-060	0.2
MVRD - Richmond	
(blank)	2.5
RICH-A2	5.5
RICH-B5	3.7
RICH-B6	1

MVRD - Surrey	
SR-103	0.15
SR-104	0.3
SR-606	0.08
SR-624	1.65
SR-626	0.6
Grand Total	**130.62**

Appendix IV

2025 MVRD Mosquito Trap Locations



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