THE REGIONAL DISTRICT OF EAST KOOTENAY

MOSQUITO CONTROL PROGRAM
WASA/TA TA CREEK/SKOOKUMCHUCK MOSQUITO CONTROL EXTENDED SERVICE AREA

SEASON END REPORT
DECEMBER 2013

PROGRAM STAFF:

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Kendra Lewis	Program Coordinator/Mosquito Control Technician

CONTAINING:

Summary of 2013 Season Activities

Morrow BioScience Ltd.

SUMMARY OF ACTIVITIES

As with the previous two seasons, 2013 was an extremely busy one for mosquito control and the Wasa, Tata Creek and Skookumchuck area. While the snow levels in the basins feeding this floodplain were relatively low (approximately 91% of normal to start), weather factored in to considerably higher than expected river levels.

An unseasonably warm spell in early May caused significant proportions of the snow pack to melt and the river levels to rise. This presented the first opportunities for ground crews to find and treat larval mosquitoes. The first treatment took place on May 15. Ground treatments continued through the end of June.

In late June precipitation events caused the river to increase dramatically. On June 21 the river peaked at 4.957m (as measured at station 08NG065 – Kootenay River at Fort Steele). This high water resulted in an increase in larval activity of a very large area. At this point ground crews could no longer access many of the areas requiring treatment and a helicopter was brought in to conduct a large-scale treatment.

Due to budget constraints, formal treatments were curtailed, at the request of the RDEK, as of July 2. Unfortunately the budget constraints limited the overall effectiveness of the aerial program as resources were allocated only to the highest priority areas. Fortunately, a significant and steady decrease in river levels meant that continued control was not required to maintain mosquito nuisance at tolerable levels.

This season a total of 1,239 hectares were treated, well above the 700 hectares included in the base contract.

Given the extent of the flooding this season and early curtailment of treatments due to RDEK budgets, adult mosquito populations were maintained at tolerable levels for most of the season. Morrow BioScience Ltd (MBL) employees received no complaint calls concerning adult mosquito annoyance in this program this season.

SNOW AND RIVER LEVELS

Snow accumulations throughout the East Kootenay region (fig. 1-3) began this season below average (91% for the Kootenay Basin as of April 1). Unseasonable warm weather in May brought out much of the snow early and rapidly. By May 15 the snow level had been reduced to 62% for the Kootenay basin. Most of the low and mid-elevation snow came out during May, reducing the risk of a freshet induced flood event.

By June 1 the snow levels were still at 63% of normal and the risk of flooding as a result of the freshet was nearly zero. Overall the snow melt was 1-2 weeks ahead of normal for the Province, contrasted with 2-3 weeks behind normal for the previous 2 years.

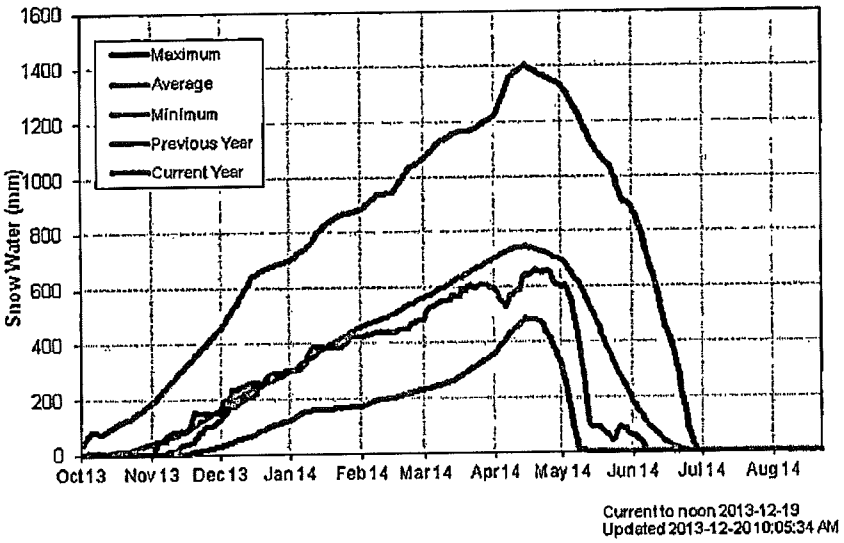

Figure 1 Snow pillow for Morrissey Ridge (2C09Q). The green line represents the accumulated snow levels for the 2013 season. Note that this chart shows average to below average snow levels with a very rapid drop in mid-May.

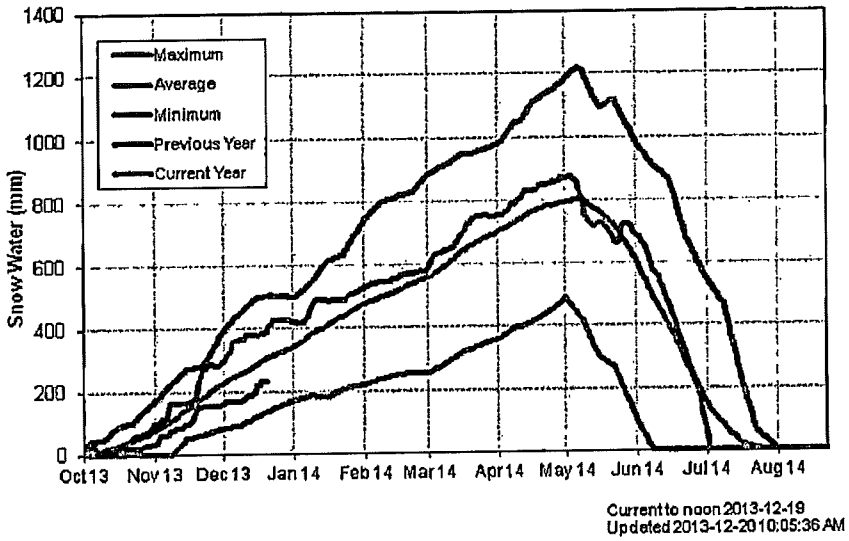

Figure 2 Snow pillow for Floe Lake (2C14P). The green line represents the accumulated snow levels for the 2013 season. Note that this chart shows a slightly higher than average snow level.

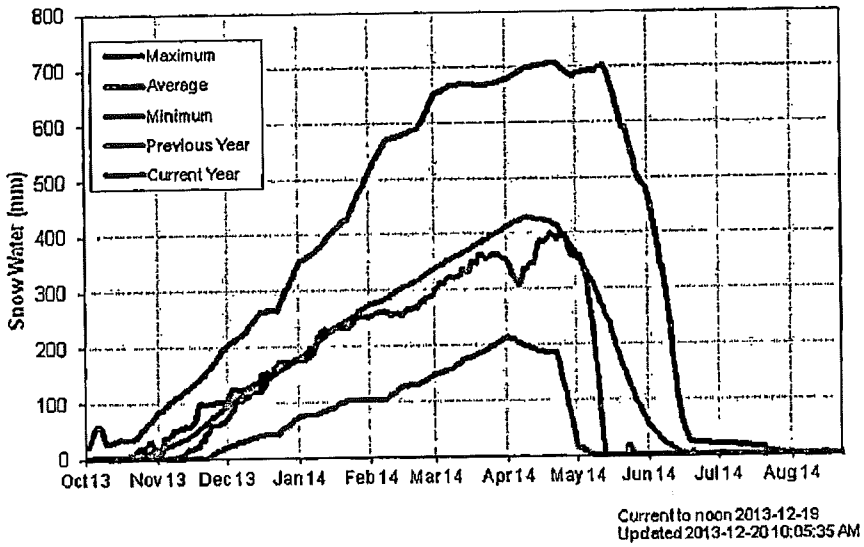

Figure 3 Snow pillow for Moyie Mountain (2C10P). The Green line represents the accumulated snow levels for the 2013 season. Note that this chart shows an average snow level with an extraordinarily quick drop in mid-May.

WEATHER (PRECIPITATION AND TEMPERATURE)

The weather for the 2013 mosquito season saw two trends that affected the mosquito control program. The first was the unseasonably warm weather in May. This brought the snow down rapidly causing the first significant rise in river levels and hence the first significant larval activity and subsequent treatment. (fig. 4)

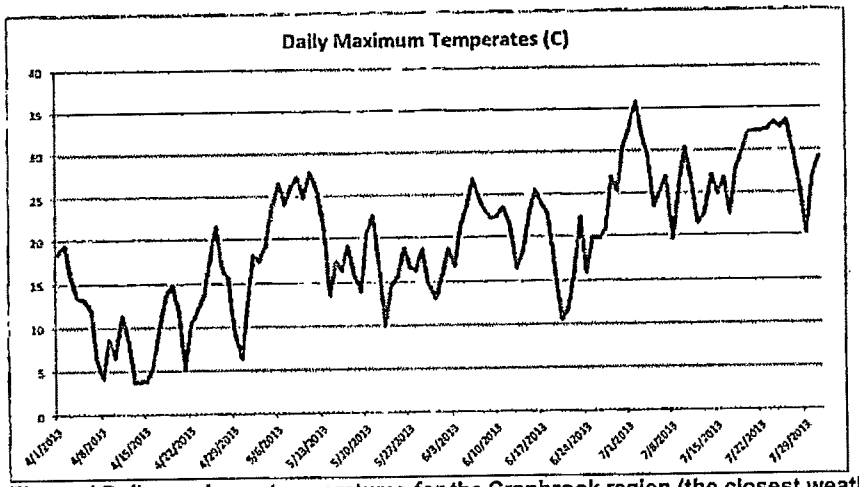

Figure 4 Daily maximum temperatures for the Cranbrook region (the closest weather recording station for the Wasa area). Note the significant heat wave in early May.

The second trend of the season affecting the mosquito control program was higher than average precipitation in June. This precipitation exacerbated river levels and had an additive effect on the already saturated ground. This caused a spike in river levels in the third week of June.

RIVER LEVELS

The river levels reflect the early snowmelt and the mid-season precipitation very well. The result of the unseasonal weather patterns was higher than average water levels for the third year in a row with a late season peak in the river causing higher than expected requirements for larval mosquito control (fig. 5).

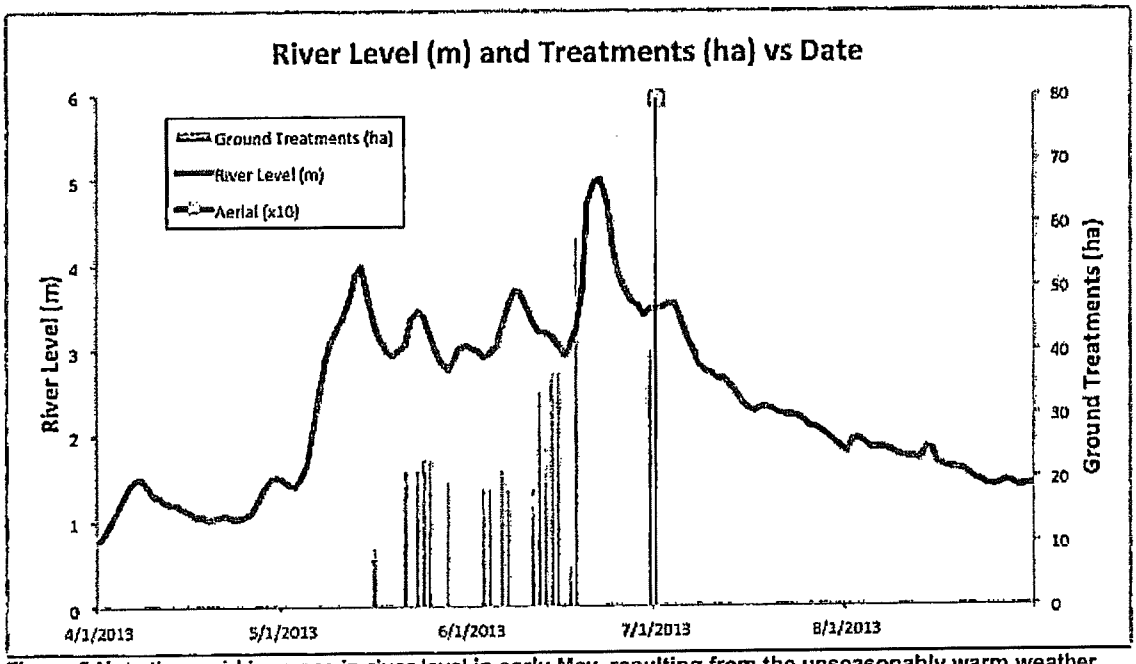

Figure 5 Note the rapid increase in river level in early May, resulting from the unseasonably warm weather and a second spike in river levels in late June, resulting from higher than normal precipitation. The red lines represent ground treatments and the green square represents the one aerial (x10 to determine hectares treated).

MONITORING METHODOLOGY

The RDEK mosquito control program involves monitoring historically recognized mosquito development sites within the floodplain surrounding Wasa Lake, Tata Creek, and Skookumchuck. Although the monitoring area is relatively small, new sites are continually detected especially in high water years. High water means that the potential for seepage site development is also high. As there are numerous low-lying farms and benches throughout the floodplain, these areas are at a greater risk for the development of seepage from the Kootenay River. When new sites are found they are entered into a GIS database and monitored on the same schedule as are the historical sites.

This year the majority of the mosquito development sites in the program area were mapped with GPS. A map of the sites will be made available before the start of the 2014 season. In April and early May, the sites are visited at least once a week with the exception of the snowmelt-influenced sites, which are visited twice because they typically become active early. From mid-May through mid-August, each site is visited at least twice a week.

Aedes mosquitoes are the most common nuisance mosquitoes within the program. As opposed to other mosquitoes (i.e., *Culex, Culisetta, Anopholes*), *Aedes* lay their eggs on damp substrate in areas with a high flooding potential; they are often called 'floodwater' mosquitoes for this very reason. If the water flooding the eggs is sufficiently warm, contains a low enough dissolved oxygen (DO) content, and is organically rich (which contributes to a decreased DO content), hatching will commence (Gjullin et al. 1950).

The mosquito eggs hatch into larvae, which then go through 5 stages on their way to adulthood. The stages include 4 larval instars (or stages) and one pupal stage. These mosquitoes can hatch with densities recorded at levels up to 80 million per hectare, feeding many vertebrates and invertebrates for a few weeks each year before leaving the aquatic system.

Larval counts are made upon each visit and counts are distinguished between early instar (1st and 2nd) and late (3rd and 4th). Also at each visit, notes are made regarding pupae counts, which aid in distinguishing whether or not a treatment has been missed at a particular site. MBL treatment protocol dictates that field technicians target the late 3rd instar and early 4th instar stages in order to leave more biomass in the water for predators who depend on larvae as a food source.

LARVAL TREATMENT

Larval mosquitoes are treated with Aquabac®. Aquabac® is considered a microbial larvicide, meaning that the active ingredient is a soil-borne bacteria. In this case, the bacteria is *Bacillus thuringiensis* var. *israelensis* (Bti). The mode of action for Bti is relatively simple and with a rather high degree of species specificity. Receptors within the midgut region of the mosquito larvae are specific to the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval midgut cells occurs as a result of cleavage of the protoxins by midgut proteases. An osmotic imbalance across the midgut epithelial cell membranes occurs due to this binding, which causes considerable damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert, 2000). Bti has four specific endotoxins (Beaty and Marquardt, 1996).

Due to the specificity of the mosquito larval midgut receptors to the Bti endotoxins, Bti is a relatively safe treatment option. Besides mosquitoes, Bti also has an effect on black fly larvae. A commonly voiced concern is whether or not Bti has effects on salmonids. There is a large body of evidence that suggests Bti does not directly affect salmonids. Numerous studies have demonstrated the general safety of exposing fish to Bti (Brown et al. 1998, Brown et al. 2002, Brown et al. 2004). Hurst et al. (2007) subjected the crimson-spotted rainbowfish (*Melanotaenia duboulayi)* to 10 times the effective field concentration of Bs, Bti, and s-methoprene and reported no effects on their swimming performance. Sternberg et al. (2012) subjected juvenile coho salmon (*Oncorhynchus kisutch*) to the maximum recommended amount of a Bti product in two separate standard static toxicity tests (USEPA, 1996). No overt effects were observed on

behavior or detected in fish weight. Therefore, amounts of Bti applied in field treatments are highly unlikely to cause direct hazard to juvenile salmonids.

MONITORING AND TREATMENT SUMMARY

Table 1 Each entry in the table indicates a monitoring and/or treatment event. In the event that there is no treatment indicated in column 5, then the event is considered a "monitoring only event".

Site ID Number	Treat / Sample Date	Larvae Per Dip	Predominant Instar	Treatment Method (Hand, Blower, Aerial)	Area (ha)
RDEK006	28-Mar	0			0.0
RDEK001	28-Mar	0			0.0
RDEK014	17-Apr	0			0.0
RDEK015	17-Apr	0			0.0
RDEK053	17-Apr	0			0.0
RDEK020	24-Apr	0			0.0
RDEK001	30-Apr	0			0.0
RDEK002	30-Apr	0			0.0
RDEK006	30-Apr	0			0.0
RDEK015	30-Apr	0			0.0
RDEK020	30-Apr	0			0.0
RDEK028	30-Apr	0			0.0
RDEK042	30-Apr	0			0.0
RDEK047	30-Apr	0			0.0
RDEK001	8-May	0			0.0
RDEK002	8-May	0			0.0
RDEK003	8-May	0			0.0
RDEK005	8-May	0			0.0
RDEK006	8-May	0			0.0
RDEK015	8-May	0			0.0
RDEK020	9-May	0			0.0
RDEK028	9-May	0			0.0
RDEK018	9-May	0			0.0
RDEK023	9-May	0			0.0
RDEK030	9-May	0			0.0
RDEK035	9-May	0			0.0
RDEK042	10-May	0			0.0
RDEK047	10-May	100	1		0.0

RDEK048	15-May	200	2	Blower	9.1
RDEK050	15-May	200	1		0.0
RDEK042	15-May	0			0.0
RDEK043	15-May	0			0.0
RDEK045	15-May	0			0.0
RDEK028	15-May	0			0.0
RDEK001	15-May	0			0.0
RDEK020	15-May	0			0.0
RDEK006	20-May	100	1		0.0
RDEK015	20-May	50	1		0.0
RDEK050	20-May	200	2		0.0
RDEK001	20-May	5	1		0.0
RDEK050	21-May	200	2	Blower	21.2
RDEK045	21-May	0			0.0
RDEK007	22-May	100	2		0.0
RDEK008	22-May	100	2		0.0
RDEK001	22-May	0			0.0
RDEK002	22-May	0			0.0
RDEK003	22-May	0			0.0
RDEK004	22-May	0			0.0
RDEK005	22-May	0			0.0
RDEK006	22-May	0			0.0
RDEK007	22-May	0			0.0
RDEK008	22-May	0			0.0
RDEK009	22-May	0			0.0
RDEK010	22-May	0			0.0
RDEK011	22-May	0			0.0
RDEK012	22-May	0			0.0
RDEK013	22-May	0			0.0
RDEK014	22-May	0			0.0
RDEK015	22-May	0			0.0
RDEK016	22-May	0			0.0
RDEK017	22-May	0			0.0
RDEK018	22-May	0			0.0
RDEK019	22-May	0			0.0
RDEK020	22-May	0			0.0
RDEK021	22-May	0			0.0
RDEK022	22-May	0			0.0
RDEK023	22-May	0			0.0

RDEK024	22-May	0			0.0
RDEK025	22-May	0			0.0
RDEK026	22-May	0			0.0
RDEK027	22-May	0			0.0
RDEK028	22-May	0			0.0
RDEK029	22-May	0			0.0
RDEK030	22-May	0			0.0
RDEK031	22-May	0			0.0
RDEK032	22-May	0			0.0
RDEK033	22-May	0			0.0
RDEK034	22-May	0			0.0
RDEK035	22-May	0			0.0
RDEK036	22-May	0			0.0
RDEK037	22-May	0			0.0
RDEK038	22-May	0			0.0
RDEK039	22-May	0			0.0
RDEK040	22-May	0			0.0
RDEK041	22-May	0			0.0
RDEK042	22-May	0			0.0
RDEK043	22-May	0			0.0
RDEK044	22-May	0			0.0
RDEK045	22-May	0			0.0
RDEK046	22-May	0			0.0
RDEK047	22-May	0			0.0
RDEK048	22-May	0			0.0
RDEK049	22-May	0			0.0
RDEK050	22-May	0			0.0
RDEK051	22-May	0			0.0
RDEK052	22-May	0			0.0
RDEK053	22-May	0			0.0
RDEK054	22-May	0			0.0
RDEK018	23-May	30	2		0.0
RDEK007	23-May	40	3		0.0
RDEK050	23-May	200	2	Blower	21.2
RDEK015	23-May	30	2		0.0
RDEK006	24-May	100	3	Blower	21.2
RDEK018	24-May	30	2	Blower	1.5
RDEK001	25-May	100	2	Blower	15.2
RDEK015	25-May	30	2	Blower	6.1

RDEK007	25-May	100	2	Blower	1.5
RDEK028	28-May	50	2	Blower	9.1
RDEK001	28-May	100	2	Blower	3.0
RDEK003	28-May	25	3	Blower	1.5
RDEK005	28-May	30	2	Blower	6.1
RDEK028	3-Jun	50	2	Blower	15.2
RDEK056	3-Jun	3	2	Blower	3.0
RDEK028	4-Jun	50	2	Blower	9.1
RDEK015	4-Jun	20	2	Blower	3.0
RDEK018	4-Jun	30	2	Blower	1.5
RDEK025	4-Jun	30	2	Blower	1.5
RDEK027	4-Jun	50	2	Blower	1.5
RDEK023	4-Jun	50	2	Blower	1.5
RDEK005	6-Jun	20	2	Blower	6.1
RDEK001	6-Jun	20	2	Blower	12.1
RDEK008	6-Jun	20	2	Blower	3.0
RDEK007	7-Jun	50	2	Blower	18.2
RDEK045	11-Jun	50	2	Blower	6.1
RDEK042	11-Jun	30	2	Blower	6.1
RDEK044	11-Jun	30	2	Blower	6.1
RDEK028	12-Jun	50	2	Blower	15.2
RDEK029	12-Jun	50	2	Blower	6.1
RDEK023	12-Jun	50	2	Blower	1.5
RDEK027	12-Jun	50	2	Blower	9.1
RDEK025	12-Jun	50	2	Blower	1.5
RDEK028	13-Jun	50	2	Blower	12.1
RDEK007	13-Jun	50	2	Blower	3.0
RDEK027	13-Jun	50	2	Blower	9.1
RDEK001	14-Jun	50	2	Blower	6.1
RDEK005	14-Jun	50	2	Blower	6.1
RDEK002	14-Jun	50	2	Blower	4.6
RDEK007	14-Jun	50	2	Blower	6.1
RDEK003	14-Jun	50	2	Blower	3.0
RDEK004	14-Jun	50	2	Blower	10.6
RDEK001	15-Jun	50	2	Blower	24.3
RDEK006	15-Jun	50	2	Blower	9.1
RDEK004	15-Jun	50	2	Blower	3.0
RDEK021	17-Jun	50	3	Blower	1.5
RDEK022	17-Jun	30	3	Blower	1.5

RDEK024	17-Jun	20	2	Blower	1.5
RDEK015	17-Jun	30	3	Blower	1.5
RDEK006	18-Jun	50	3	Blower	18.2
RDEK010	18-Jun	50	3	Blower	3.0
RDEK052	18-Jun	30	3	Blower	6.1
RDEK043	18-Jun	20	2	Blower	15.2
RDEK042	18-Jun	20	3	Blower	15.2
RDEK019	30-Jun	500	3	Blower	3.6
RDEK020	30-Jun	300	3	Blower	10.9
RDEK021	30-Jun	200	3	Blower	1.8
RDEK022	30-Jun	200	3	Blower	1.8
RDEK025	30-Jun	100	3	Blower	1.8
RDEK027	30-Jun	200	3	Blower	1.8
RDEK043	30-Jun	500	3	Blower	18.2
RDEK018	1-Jul	500	3	Aerial	7.3
RDEK019	1-Jul	500	2	Aerial	14.6
RDEK022	1-Jul	500	2	Aerial	10.9
RDEK023	1-Jul	500	2	Aerial	10.9
RDEK024	1-Jul	500	2	Aerial	10.9
RDEK027	1-Jul	500	2	Aerial	7.3
RDEK001	1-Jul	500	2	Aerial	43.7
RDEK002	1-Jul	500	2	Aerial	18.2
RDEK003	1-Jul	500	2	Aerial	18.2
RDEK004	1-Jul	500	2	Aerial	43.7
RDEK005	1-Jul	500	2	Aerial	14.6
RDEK006	1-Jul	500	2	Aerial	43.7
RDEK007	1-Jul	500	2	Aerial	18.2
RDEK008	1-Jul	500	2	Aerial	43.7
RDEK009	1-Jul	500	2	Aerial	43.7
RDEK010	1-Jul	500	2	Aerial	43.7
RDEK011	1-Jul	500	2	Aerial	43.7
RDEK013	1-Jul	500	2	Aerial	18.2
RDEK014	1-Jul	500	2	Aerial	18.2
RDEK015	1-Jul	500	2	Aerial	43.7
RDEK016	1-Jul	300	3	Aerial	40.0
RDEK017	1-Jul	300	3	Aerial	40.0
RDEK029	1-Jul	300	3	Aerial	40.0
RDEK030	1-Jul	300	3	Aerial	43.7
RDEK034	1-Jul	300	3	Aerial	43.7

RDEK051	1-Jul	300	3	Aerial	14.6
RDEK053	1-Jul	300	3	Aerial	18.2
RDEK054	1-Jul	300	3	Aerial	18.2
RDEK055	1-Jul	300	3	Aerial	18.2

SEASON TOTALS

	QUANTITY APPLIED (kg)	AREA (ha)	APPLICATION MODE
	3,967.6	793.5	Aerial
	2,629.9	445	Blower/Hand
Grand Total	6,597.5	1,238.5	

Summary of Helicopter Applications
Helicopter Service: Range Helicopters Inc.
Helicopter Used: Bell 206B
July 1: 5.1 hrs

BUMMERS FLATS

Dialogue has continued during the off-season with major stakeholders in the Bummers Flats area.

DISCUSSION

In an effort to assist all areas in broadcasting a uniform message regarding mosquito control and WNV, Morrow BioScience Ltd. operates a comprehensive website. This site can be found at www.morrowbioscience.com. MBL would encourage people to utilize this resource to help answer any questions they may have. MBL would also encourage the RDEK to provide a link to this website from their municipal site for easy access to local residents. It is planned to revamp/update the website prior to the 2014 season in order to further improve its content and presentation.

A summary of costs for this season is as follows:

MB13-104 RDEK		
Base Contract (excludes larvicide)	$	47,500.00
Larvicide	$	36,267.00
Aerial over 700 ha	$	24,233.00
HST	$	3,603.60
GST	$	3,898.48
PST	$	436.59
TOTAL	**$**	**115,938.67**

A total of 6,597.5kg of larvicide or approximately 326.5 bags (18.2kg/bag) were applied to 1,238.5ha during the season.

Plans for Mosquito Control Program Improvements – Future Seasons

- Continue to monitor and liaise with the landowner of Thunderhoof Ranch to determine the future of the water control structure located there.
- Ensure proper functioning of culverts in the service area to allow for enhanced drainage and reduced stagnant (thus reduced mosquito development habitat)
- Continue to dialogue with Ducks Unlimited Canada, The Nature Trust of BC, and the BC Ministry of Forest, Lands, and Natural Resource Operations on mitigating the mosquito issue with "Bummers Flats"
- Contact BC Parks or Wasa Land Improvement District for trail upkeep around the lake
- Ensure that the ongoing beaver dam problems are actively pursued

If you have any questions regarding this summary report, please do not hesitate to give me a call at 604-986-1168.

Mark Vaandering, P.Eng.
President
MORROW BIOSCIENCE LTD.