



# **MELIADINE WQ-MOP: MONITORING PROGRAM**

**Preliminary Results of Second Monthly Sampling  
Event**

24 August 2020 (with updates)



# WQ-MOP COMMITMENTS (UPDATED)

## MONITORING AND TESTING PROGRAMS



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### Water Quality Monitoring Program

Sampling Media	Effluent	Mixing Zone	Receiving Environment (beyond mixing zone)
<b>Sample Timing</b>	During effluent discharge and during collection of effluent samples for toxicity testing	During effluent discharge <sup>(a)</sup>	During effluent discharge <sup>(a)</sup>
<b>Sampling Locations</b>	MEL-14	3 stations at the edge of the mixing zone (MEL3-01, MEL-13-07 and MEL-13-10) <sup>(b)</sup>	4 stations - 1 mid-field (MEL-02-05), 3 references (MEL-03-02, MEL-04-05, and MEL-05-04)
<b>Number of Samples</b>	Per regulatory and operational requirements	1 sample per station	1 sample per station
<b>Frequency of Sampling</b>	Weekly during discharge	Weekly during discharge or as per NWB's direction	Monthly during discharge or as per NWB's direction
<b>Test Parameters</b>	<ul style="list-style-type: none"> <li>Daily monitoring of effluent flow volumes</li> <li>Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence<sup>(c)</sup></li> </ul>	<ul style="list-style-type: none"> <li>Field physico-chemical water column profile measurements (temperature, specific conductivity, pH, DO)</li> <li>Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence<sup>(c)</sup></li> </ul>	<ul style="list-style-type: none"> <li>Field physico-chemical water column profile measurements (temperature, specific conductivity, pH, DO)</li> <li>Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence</li> </ul>

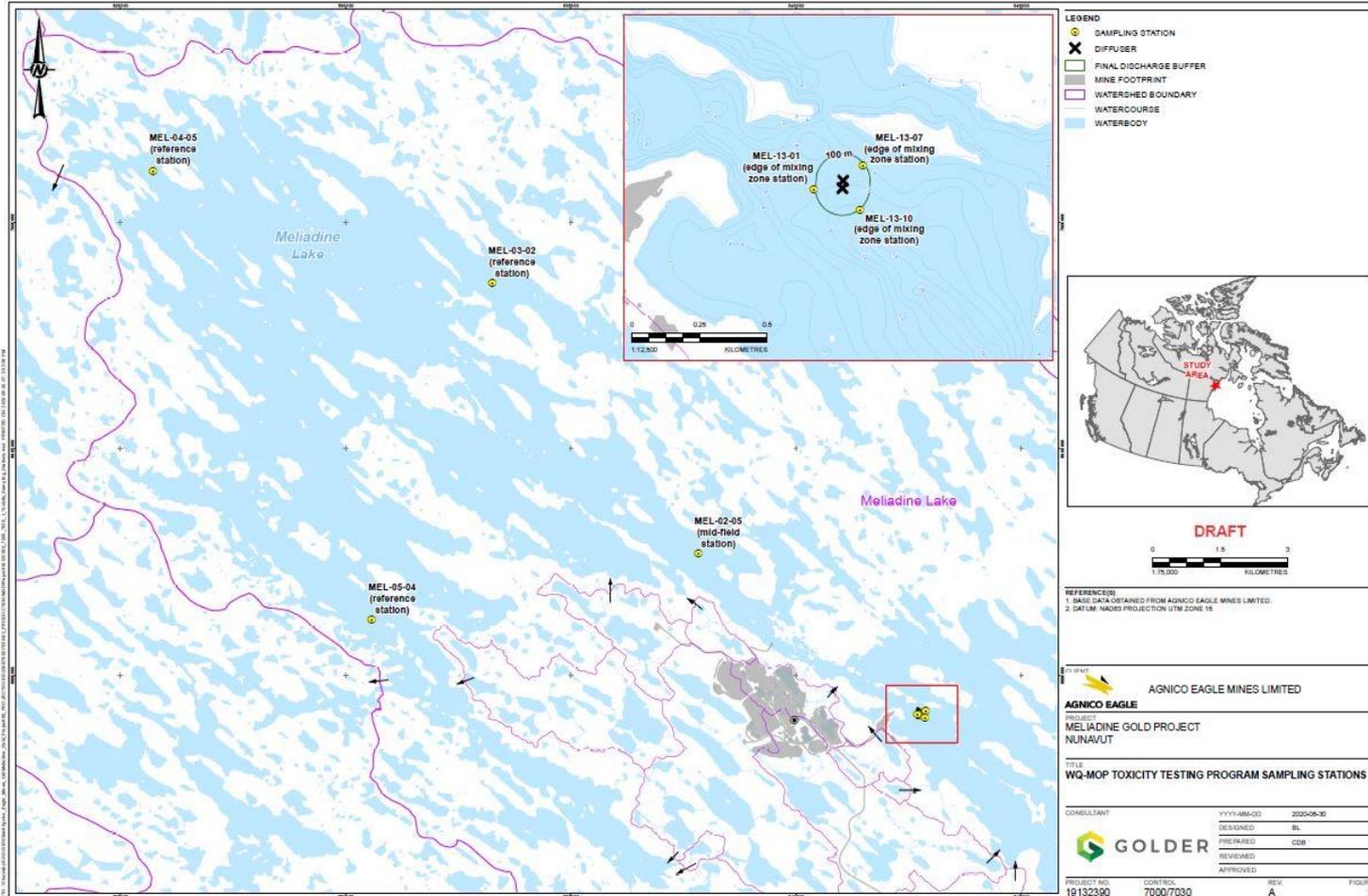
### Plume Delineation Study

Sampling Media	Effluent	Receiving Environment (within mixing zone and beyond)
<b>Sample Timing</b>	During effluent discharge <sup>(e)</sup>	During effluent discharge <sup>(e)</sup>
<b>Sampling Locations</b>	MEL-14	22 survey locations (see Appendix B) at distance intervals of 50 m from the diffuser, 100 m (i.e., edge of mixing zone), 175 m, and 250 m; potentially adjusted to include further afield samples if necessary <sup>(f)</sup>
<b>Frequency of Program</b>	2 events during discharge (early and late summer)	2 events during discharge (early and late summer)
<b>Test Parameters</b>	<ul style="list-style-type: none"> <li>TDS and major ions</li> <li>General parameters<sup>(g)</sup></li> </ul>	<ul style="list-style-type: none"> <li>Field physico-chemical water column profile measurements (temperature and specific conductivity)</li> <li>Water quality samples collected at a subset (a maximum of 10 stations) stations alongside profile measurements and analyzed for TDS, major ions, and general parameters<sup>(f)</sup></li> </ul>

### Toxicity Testing Program

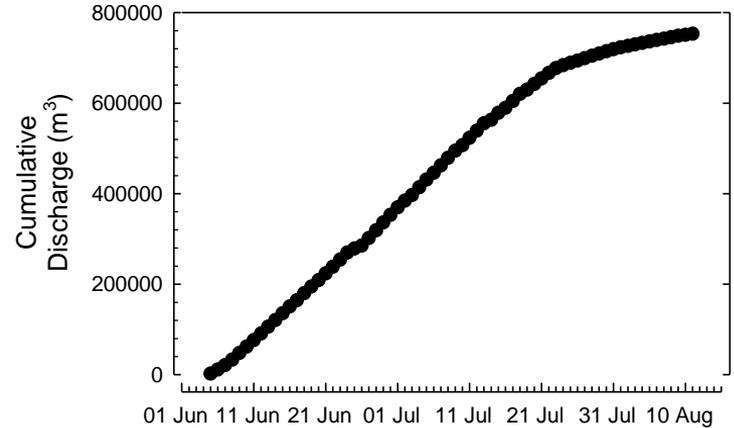
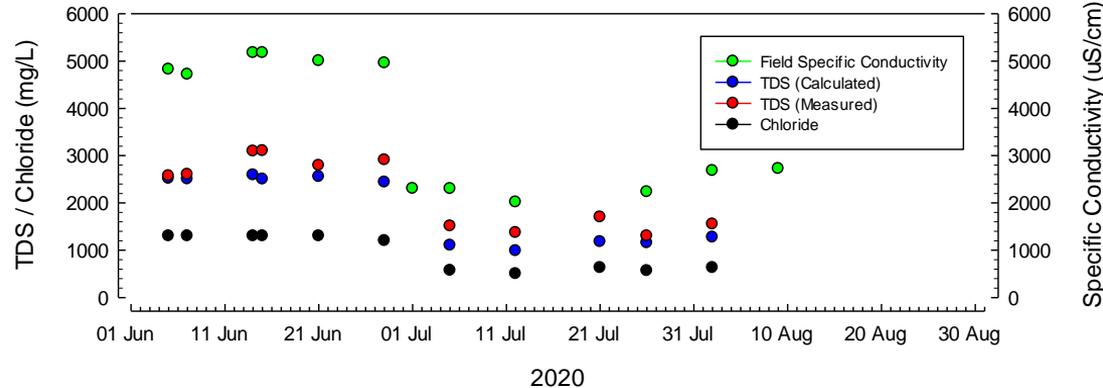
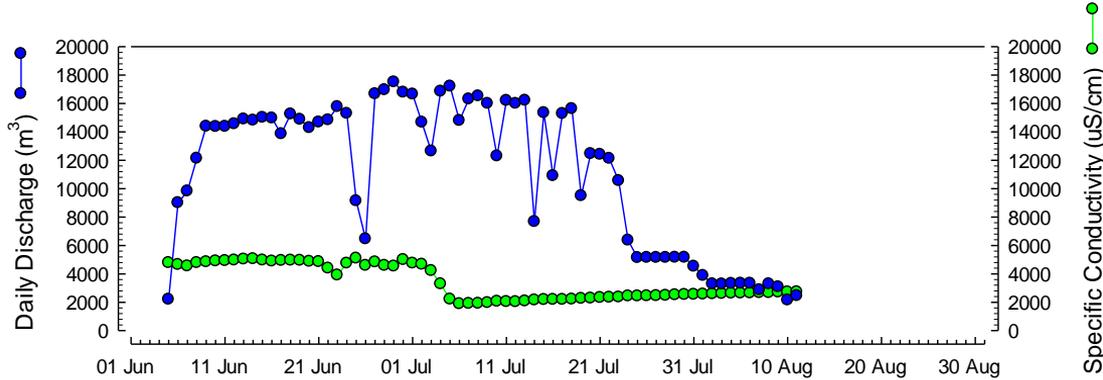
Sampling Media	Effluent	Mixing Zone	Receiving Environment (beyond mixing zone)
<b>Sample Timing</b>	During effluent discharge	During effluent discharge <sup>(a)</sup>	During effluent discharge <sup>(a)</sup>
<b>Sampling Locations</b>	MEL-14	3 stations at the edge of the mixing zone (MEL-13-01, MEL-13-07 and MEL-13-10) <sup>(b)</sup>	4 stations - 1 mid-field (MEL-02-05), 3 references (MEL-03-02, MEL-04-05, and MEL-05-04)
<b>Number of Samples</b>	Per regulatory and operational requirements	1 composite sample per station	1 composite sample per station
<b>Frequency of Sampling</b>	Weekly acute tests during discharge; monthly chronic toxicity tests beginning during the second monthly event <sup>(c)</sup>	Monthly during discharge	Monthly during discharge or as per NWB direction
<b>Test Parameters</b>	<p>Acute toxicity tests with:</p> <ul style="list-style-type: none"> <li>Rainbow Trout</li> <li><i>Daphnia magna</i></li> </ul> <p>Chronic toxicity tests<sup>(d)</sup> with:</p> <ul style="list-style-type: none"> <li>Pelagic crustacean (<i>Daphnia magna</i>)</li> <li>Epibenthic Invertebrate (<i>Hyalella azteca</i>)</li> <li>Macrophyte (duckweed)</li> <li>ELS fish (Fathead Minnow)</li> </ul>	<p>Chronic toxicity tests with:</p> <ul style="list-style-type: none"> <li>Pelagic crustacean (<i>Daphnia magna</i>)</li> <li>Epibenthic Invertebrate (<i>Hyalella azteca</i>)</li> <li>Macrophyte (duckweed)</li> <li>ELS fish (Fathead Minnow)</li> </ul>	<p>Chronic toxicity tests with:</p> <ul style="list-style-type: none"> <li>Pelagic crustacean (<i>Daphnia magna</i>)</li> <li>Epibenthic Invertebrate (<i>Hyalella azteca</i>)</li> <li>Macrophyte (duckweed)</li> <li>ELS fish (Fathead Minnow)</li> </ul>

# SAMPLING STATIONS



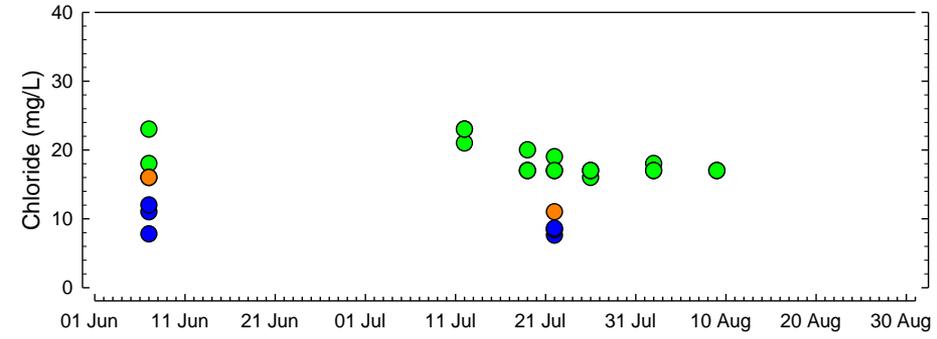
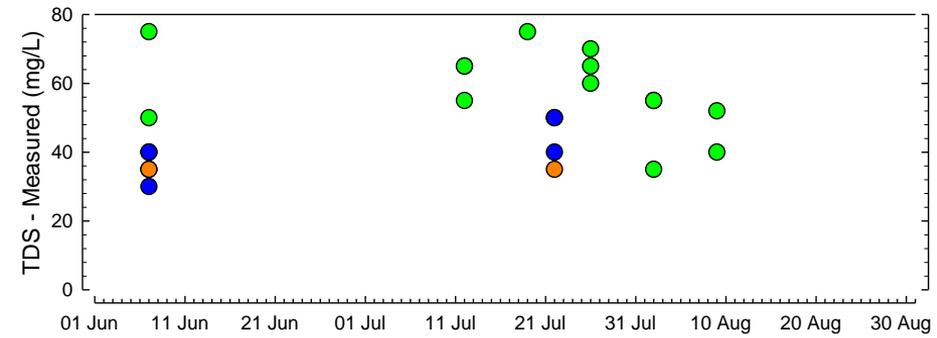
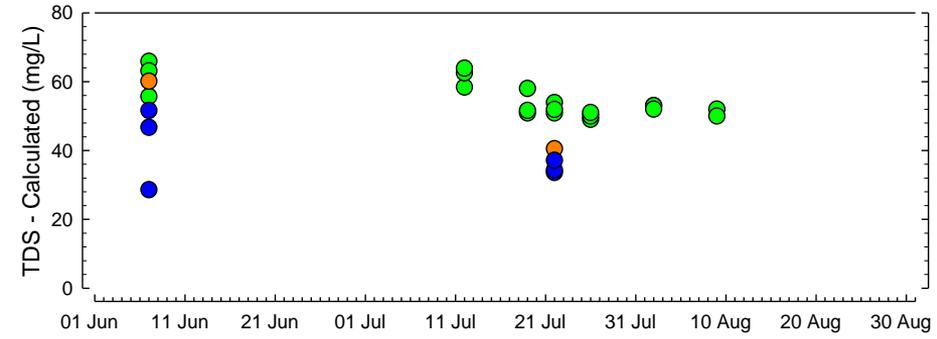
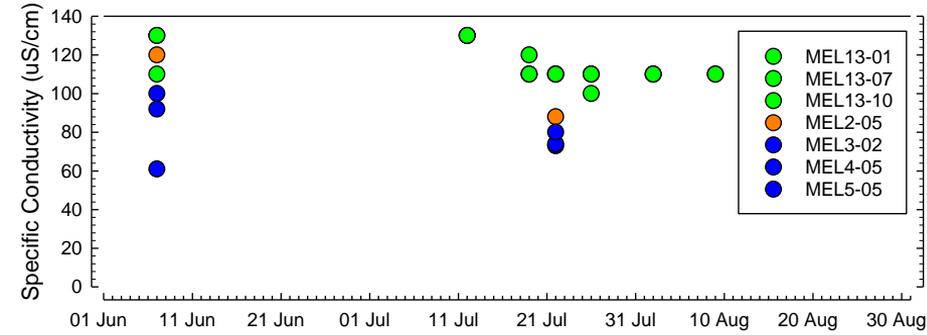
# DISCHARGE AND WATER CHEMISTRY

## DISCHARGE QUALITY – KEY INDICATORS



# WATER CHEMISTRY (UPDATED)

## RECEIVING ENVIRONMENT – KEY INDICATORS



2020

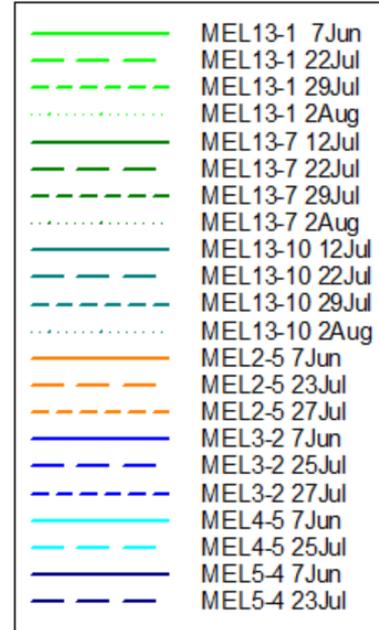
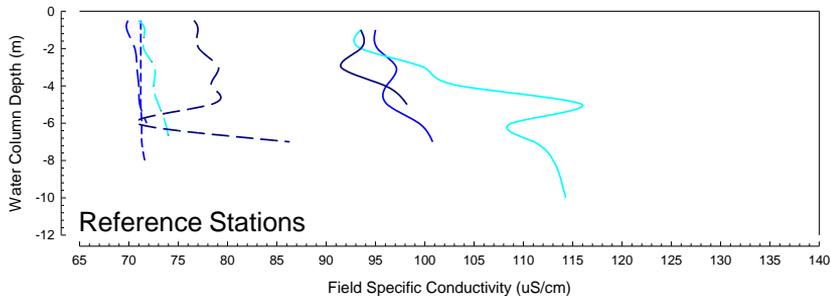
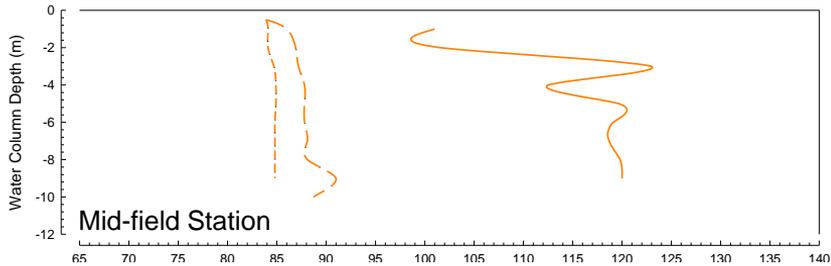
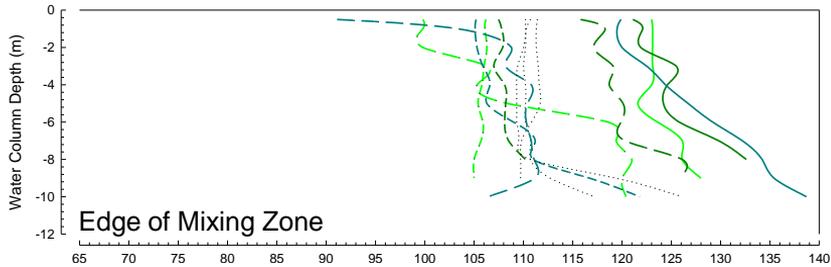


# WATER CHEMISTRY



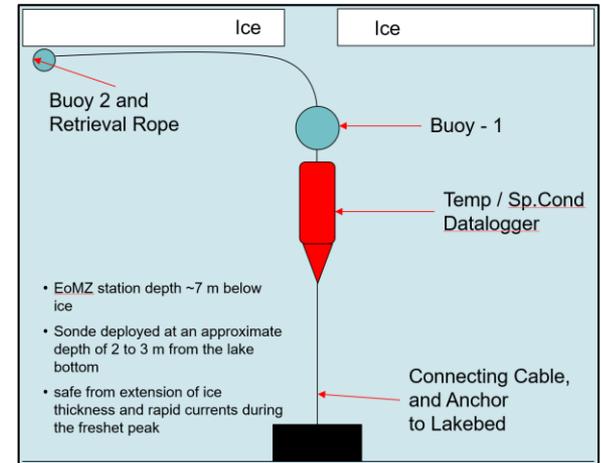
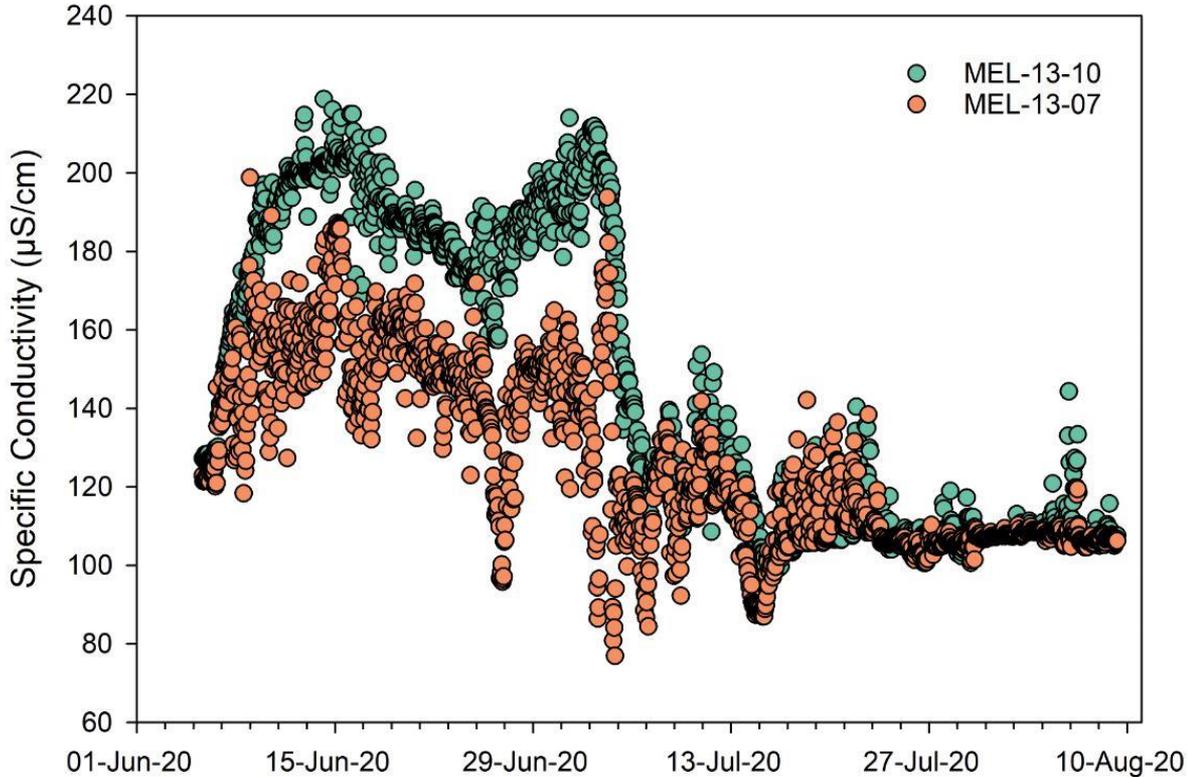
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## WATER COLUMN PROFILES – SPECIFIC CONDUCTIVITY



# WATER CHEMISTRY

## EDGE OF MIXING ZONE – REMOTE LOGGING DATA



# WATER CHEMISTRY

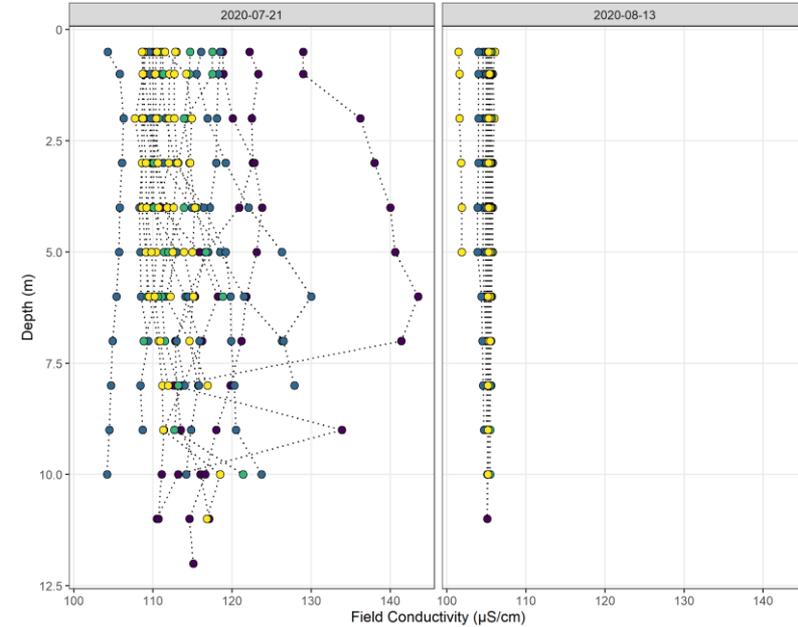
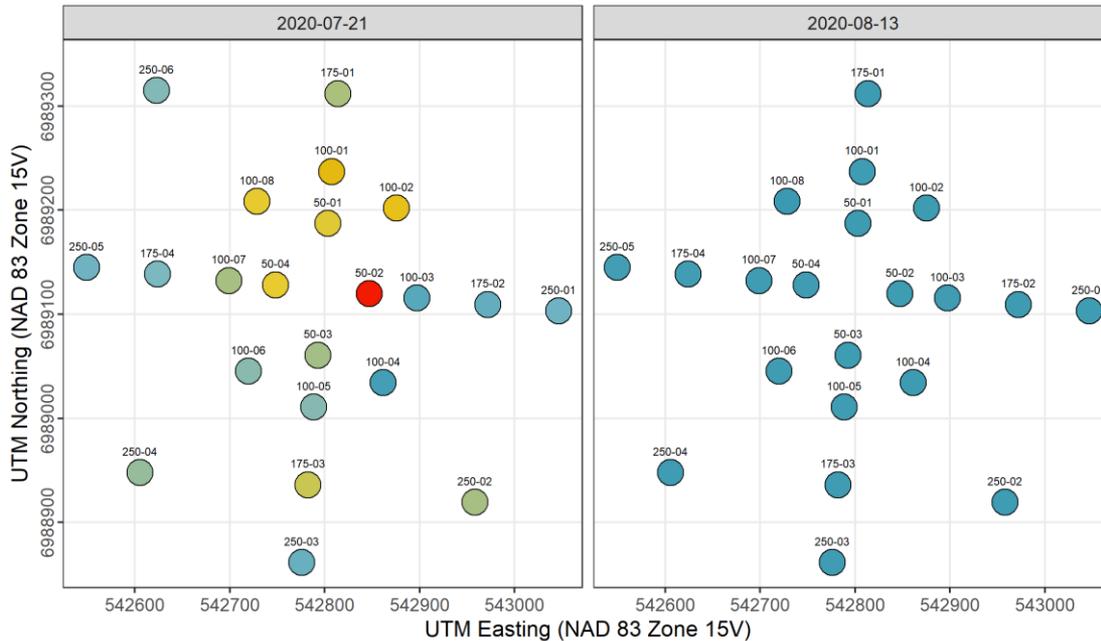
## PLUME DELINEATION STUDIES



- Plume delineation studies completed in Meliadine Lake on July 21 and August 13, 2020
- Data currently in review; however, preliminary results suggest that the plume is rapidly assimilated within the receiving environment

# WATER CHEMISTRY

## PRELIMINARY RESULTS OF THE PLUME DELINEATION STUDIES



Group ● 50m ● 100m ● 175m ● 250m

# SELECTED TESTS

## TOXICITY TESTING PROGRAM



- Acute toxicity tests (weekly)
  - 96-h Rainbow Trout survival test
  - 48-h *Daphnia magna* survival test
- Chronic toxicity tests (monthly)
  - 21-day *Daphnia magna* (freshwater crustacean) survival and reproduction test
  - 14-day *Hyalella azteca* (benthic invertebrate) survival and growth test
  - 72-hour *Lemna minor* (duckweed; aquatic macrophyte) survival and growth test
  - 7-day Fathead Minnow (freshwater fish) survival and growth test

# ACUTE TOXICITY TEST RESULTS

## SURVIVAL



Sample Date	Rainbow Trout		<i>Daphnia magna</i>	
	LC50	Mortalities	LC50	Mortalities
7 June 2020	>100	0	>100	0
14 June 2020	>100	0	>100	0
21 June 2020	>100	0	>100	0
28 June 2020	>100	0	>100	0
5 July 2020	>100	0	>100	0
12 July 2020	>100	0	>100	0
19 July 2020	>100	0	>100	0
26 July 2020	>100	0	>100	0
2 Aug 2020	>100	-	>100	-

# CHRONIC TOXICITY TESTING

## REMINDERS

### Site-specific Test Design:

1. Control for the low hardness conditions in Meliadine Lake by testing multiple laboratory controls with varying TDS
2. Select relevant references to compare organism responses in mid-field and edge of mixing zone stations
3. Set-up the test design so that the health and validity of the tests can be properly assessed, while accounting for the non-standard (low hardness) exposure conditions expected during the test



# CHRONIC TOXICITY TESTING

## EVALUATION CRITERIA



### Staged Approach:

1. Compare results of the undiluted samples to the range in response observed at the reference stations
2. Evaluate the dose response relationship observed along the dilution series for edge of mixing zone stations
3. Assess the response in the laboratory controls to determine if an effect could be related to an artifact of the test design

# CHRONIC TOXICITY TESTING

## ROUND 1 FINAL FATHEAD RESULTS



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Sample: MEL-13-01

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
Fathead minnow: Survival	-	>100 (N/A, N/A)
Biomass	>100 (N/A, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
Fathead minnow: Survival	No	No	No	No
Biomass	No	No	No	No

N/A = Not available  
95% confidence limits in parentheses

Sample: MEL-13-07

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
Fathead minnow: Survival	-	>100 (N/A, N/A)
Biomass	>100 (N/A, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
Fathead minnow: Survival	No	No	No	No
Biomass	No	No	No	No

1. Compare results of the undiluted samples to the range in response observed at the reference stations
2. Evaluate the dose response relationship observed along the dilution series for edge of mixing zone stations

Sample: MEL-02-05

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
Fathead minnow: Survival	No	No	No	No
Biomass	No	No	No	No

N/A = Not available  
95% confidence limits in parentheses

# CHRONIC TOXICITY TESTING

## ROUND 1 FINAL DAPHNIA RESULTS



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Sample: MEL-13-01

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
<i>Daphnia magna</i> : Survival	-	>100 (N/A, N/A)
Reproduction	>100 (N/A, N/A)	-
Growth	>100 (N/A, N/A)	-

Significant Effect	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Daphnia magna</i> : Survival	No	No	No	No
Reproduction	No	No	No	No
Growth	Yes	Yes	Yes	Yes

N/A = Not available  
95% confidence limits in parentheses

Sample: MEL-13-07

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)	Significant Effect
<i>Daphnia magna</i> : Survival	-	N/C	No
Reproduction	>100 (N/A, N/A)	-	-
Growth	>100 (N/A, N/A)	-	-

Significant Effect	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Daphnia magna</i> : Survival	No	No	No	No
Reproduction	No	No	No	No
Growth	Yes	Yes	Yes	Yes

N/A = Not available  
N/C = Not Calculable – The LC50 for survival was not able to be calculated due to an interrupted dose response. Comparison testing was conducted between the 100% v/v concentration vs the Site Control (Synthetic Control) to determine the effect of the sample.  
95% confidence limits in parentheses

Sample: MEL-02-05

Significant Effect	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Daphnia magna</i> : Survival	No	No	No	No
Reproduction	No	No	No	No
Growth	No	Yes	No	No

1. Compare results of the undiluted samples to the range in response observed at the reference stations
2. Evaluate the dose response relationship observed along the dilution series for edge of mixing zone stations

# CHRONIC TOXICITY TESTING

## ROUND 1 FINAL DUCKWEED RESULTS



Sample: MEL-13-01

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
<i>Lemna Minor</i> : Frond Increase	-	>97 (N/A, N/A)
Dry weight	>97 (N/A, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Lemna Minor</i> : Frond Increase	No	No	No	No
Dry weight	No	No	No	No

N/A = Not available  
95% confidence limits in parentheses

Sample: MEL-13-07

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
<i>Lemna Minor</i> : Frond Increase	-	>97 (N/A, N/A)
Dry weight	>97 (N/A, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Lemna Minor</i> : Frond Increase	Yes (I)	Yes (I)	Yes (I)	Yes (I)
Dry weight	No	Yes (I)	Yes (I)	Yes (I)

N/A = Not available  
(I) = Sample Inhibition  
95% confidence limits in parentheses

Sample: MEL-02-05

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Lemna Minor</i> : Frond Increase	No	No	No	No
Dry weight	No	No	No	No

**1. Compare results of the undiluted samples to the range in response observed at the reference stations**

**2. Evaluate the dose response relationship observed along the dilution series for edge of mixing zone stations**

# CHRONIC TOXICITY TESTING

## ROUND 1 FINAL HYALELLA RESULTS



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Sample: MEL-13-01

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
<i>Hyalella azteca</i> : Survival	-	>100 (N/A, N/A)
Mean dry weight	2.3 (<1.6, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Hyalella azteca</i> : Survival	No	No	No	No
Mean dry weight	No	No	Yes	No

N/A = Not available  
95% confidence limits in parentheses

Sample: MEL-13-07

Test	IC25 or LC25 (%v/v)	IC50 or LC50 (%v/v)
<i>Hyalella azteca</i> : Survival	-	>100 (N/A, N/A)
Mean dry weight	>100 (N/A, N/A)	-

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Hyalella azteca</i> : Survival	No	No	No	No
Mean dry weight	No	No	No	No

1. Compare results of the undiluted samples to the range in response observed at the reference stations
2. Evaluate the dose response relationship observed along the dilution series for edge of mixing zone stations

Sample: MEL-02-05

Significant Effect vs	MEL-03-02	MEL-04-05	MEL-05-04	Pooled references
<i>Hyalella azteca</i> : Survival	No	No	No	No
Mean dry weight	No	No	No	No

N/A = Not available  
95% confidence limits in parentheses

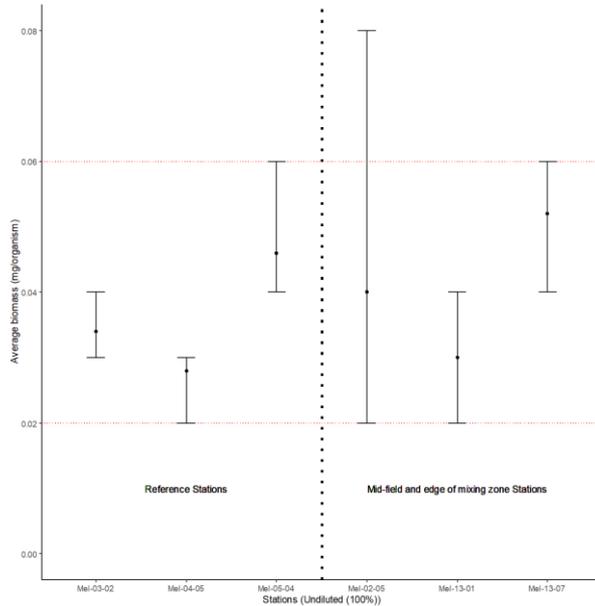
\*Survival in controls met the recommended test criteria; however, growth was less than the recommended criteria of 0.1 mg/organism in each of the tests.

# CHRONIC TOXICITY TESTING

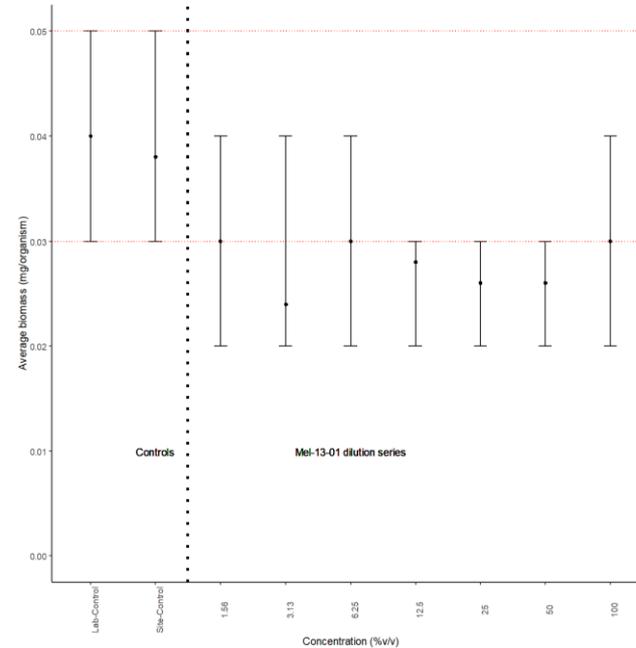
## HYALELLA – ROUND 1 – MEL-13-01 INTERPRETATION



### Reference Comparison



### Dose Response

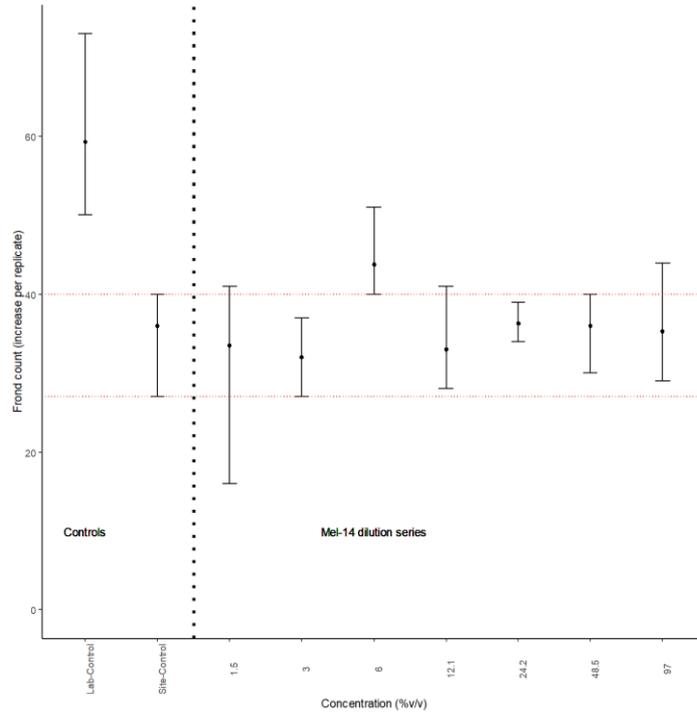


# PRELIMINARY ROUND 2 CHRONIC TOXICITY RESULTS

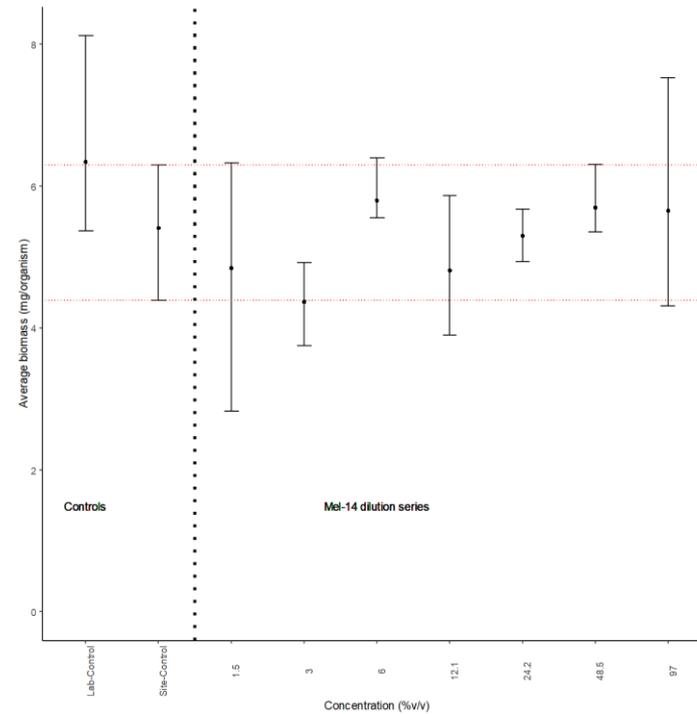


## MEL-14 EFFLUENT DUCKWEED GROWTH RESULTS

### Fronnd Count



### Biomass

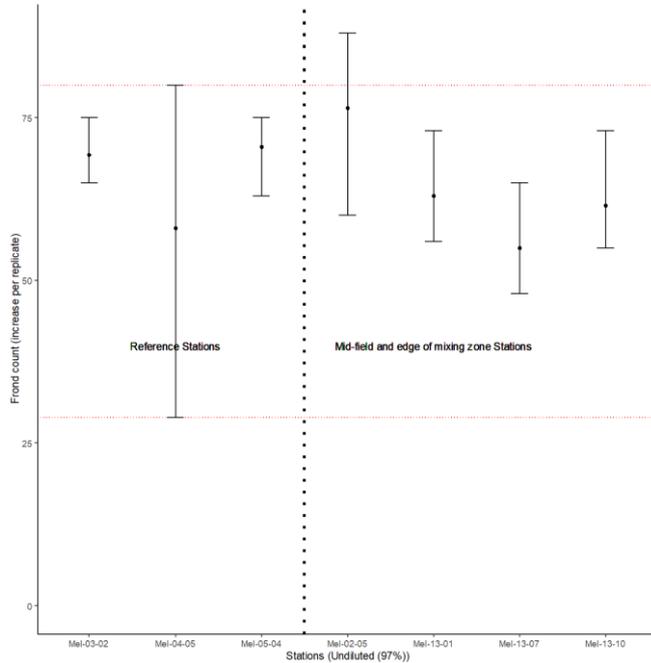


# PRELIMINARY ROUND 2 CHRONIC TOXICITY RESULTS

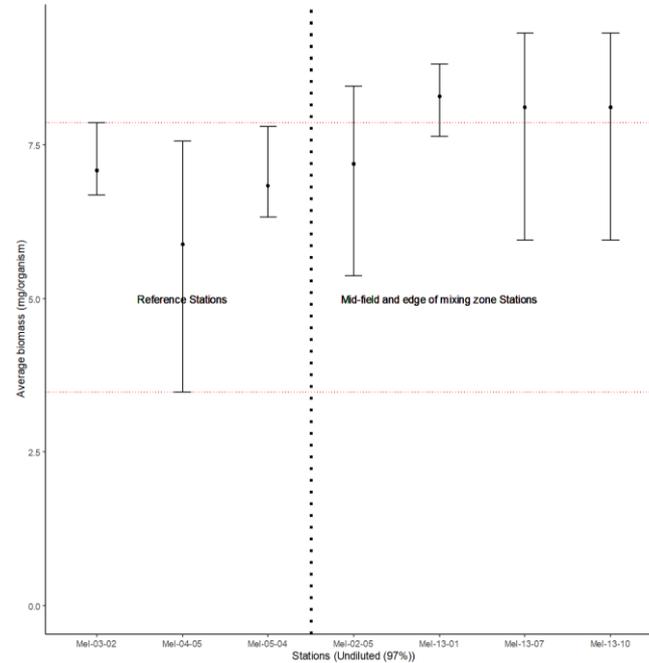
## RECEIVING ENVIRONMENT DUCKWEED GROWTH RESULTS



### Fronnd Count



### Biomass

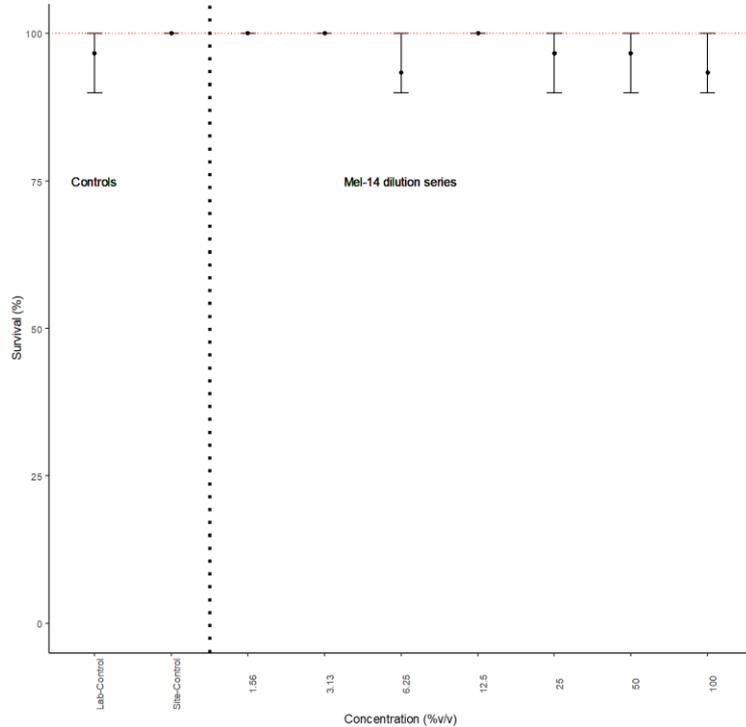


# PRELIMINARY ROUND 2 CHRONIC TOXICITY RESULTS

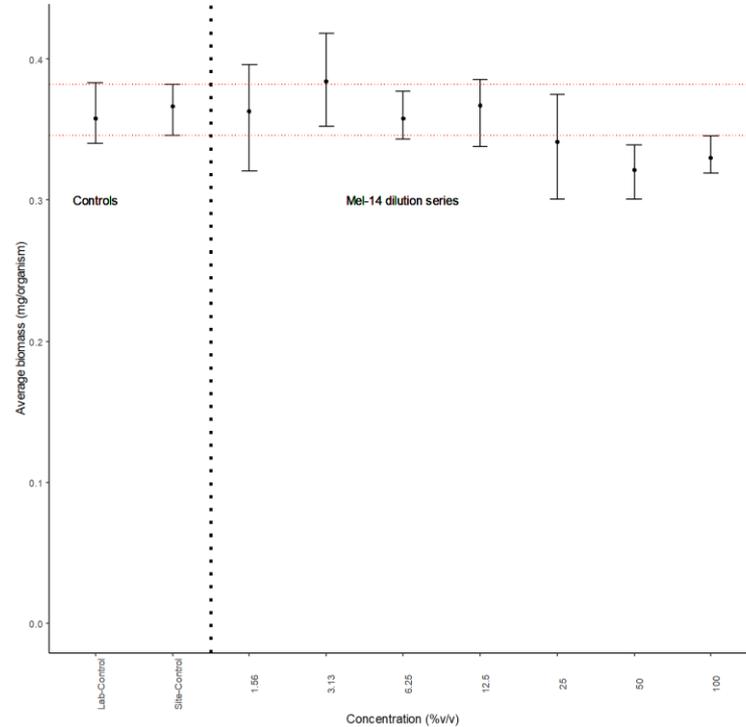
## MEL-14 EFFLUENT FATHEAD MINNOW SURVIVAL AND GROWTH RESULTS



### Survival

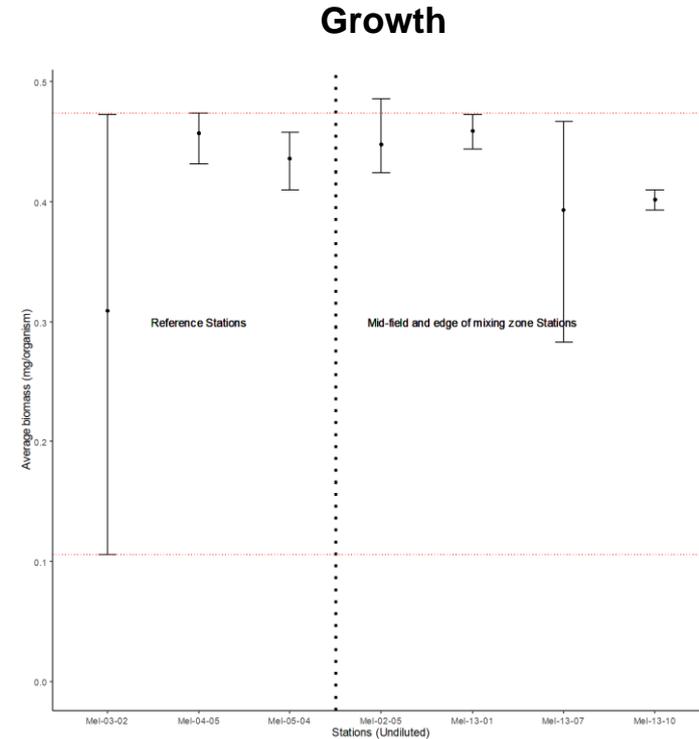
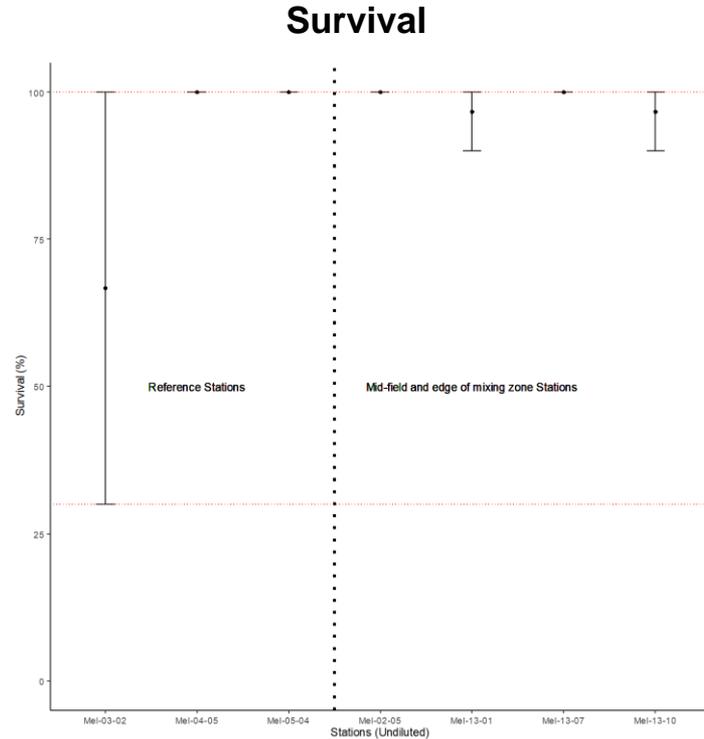


### Growth



# PRELIMINARY ROUND 2 CHRONIC TOXICITY RESULTS

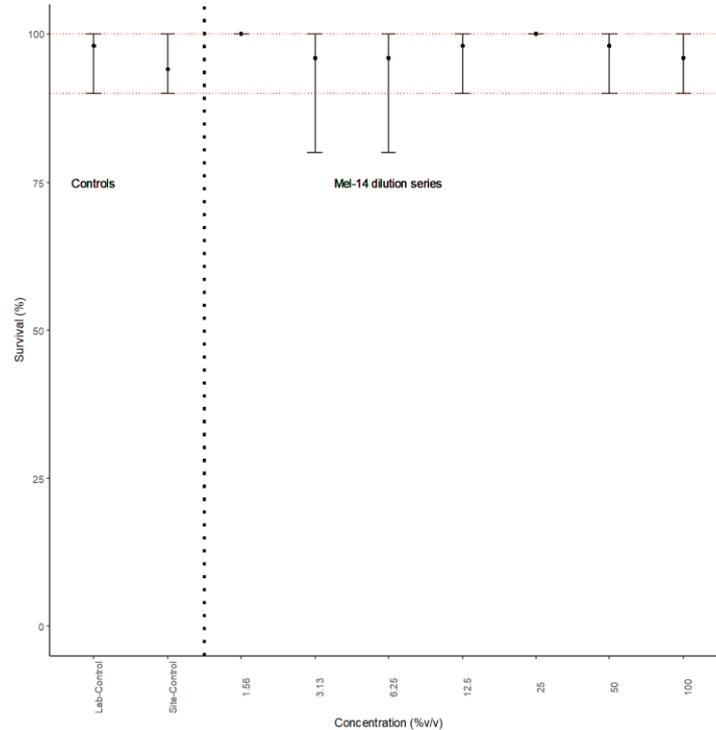
## RECEIVING ENVIRONMENT FATHEAD MINNOW SURVIVAL AND GROWTH



# PRELIMINARY ROUND 2 CHRONIC TOXICITY RESULTS



## MEL-14 EFFLUENT HYALELLA SURVIVAL RESULTS



# CHRONIC TOXICITY TESTING

## SUMMARY FINDINGS



- Preliminary results do not suggest adverse effects in mid-field and edge of mixing zone stations relative to reference locations
- As per Working Group recommendations, the MEL-14 effluent was tested for chronic toxicity during the second round of monthly testing
  - Preliminary results do not suggest significant adverse effects up to the 100% undiluted full-strength sample
- Organism response in these low conductivity waters has high variability, which needs to be considered in the test design and interpretation of results
- Testing with *Daphnia magna* and *Hyalella azteca* were successful during the first monthly testing; however, sub-lethal results for growth and reproduction in these invertebrate tests appear to be lower in low conductivity receiving environment waters relative to standard test conditions. This needs to be considered when evaluating test results. The testing program has been designed to control for this; however, the non-standard conditions can create some uncertainty with respect to organism response.
  - The addition of the MEL-14 effluent should provide additional support for this interpretation, as the higher conductivity of the sample allows for more standard test conditions relative to the receiving environment testing.

# KEY MESSAGES (UPDATED)

## SUMMARY

- Constituents in the effluent are not being released at levels which are harmful in Meliadine Lake
- The monitoring data confirms that the diffuser is working as planned and that the water being released is not harmful to Meliadine Lake
- The release of the water is going as planned and testing and continuous monitoring shows that harmful effects on the environment, fish, and other aquatic life are not occurring
- Discharge volumes are lower than planned, as precipitation has been lower than average this year
- Agnico Eagle is working on alternative strategies for discharging CP1 water into Meliadine Lake, one of which consists of recirculating CP1 water into the Process Plant
- Meliadine Lake is the source of freshwater for the camp and we have not observed changes in the drinking water quality at the camp



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	<b>Discharge</b>	<b>Edge of mixing zone</b>	<b>Mid-field</b>	<b>Reference</b>
TDS Threshold (mg/L)	3,500	1,000	n/a	n/a
Maximum Measured Concentration of TDS (mg/L)	3,100	115	35	50
Survival Test	Pass	n/a	n/a	n/a
Growth and Reproduction Test	n/a	Pass	Pass	Pass

**Notes:** n/a = not applicable; TDS = total dissolved solids; mg/L = milligrams per litre.



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## Questions and Discussion



THANK YOU