Environmental Technical Review Committee (ETRC) - Agency Meeting

November 9, 2023

Agenda Items:

1. Mine Site and Receivership Status - QCC

2. Overview and Status of Activities - QCC

3. Water Management Systems - QCC

A. Groundwater Quality- QCC

B. Receiving Environment Water Quality - QCC

C. Biota Monitoring in Lakes - QCC

4. Update on Projects - QCC

- Site Wide Water Balance and Source Terms Update - QCC

5. Question Session

Mine Site and Receivership Status

On September 26, 2019, The MNP Ltd. formerly The Bowra Group Inc., was appointed Receiver of Quinsam Coal Corporation.

The mine has been operating in care and maintenance to maintain the health and safety of employees and the environment

Mandate to fulfill environmental terms and conditions outlined in amended permit's PE:7008, issued under the Environmental Management Act and amendments of the C-172 Mines Act Permit

Overview and Status of Activities

Mine Site Management

Continuous Care and Maintenance

- Administration
- 24-hour security
- Daily pump checks for underground and surface
- Underground mine stability inspections
- Tailings and Water Dam inspections, monitoring and compliance reporting
- Electrical inspections and maintenance
- Road maintenance and vegetation control

Environmental Monitoring Program

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- **Compliance Monitoring**

  Weekly - 7 sites

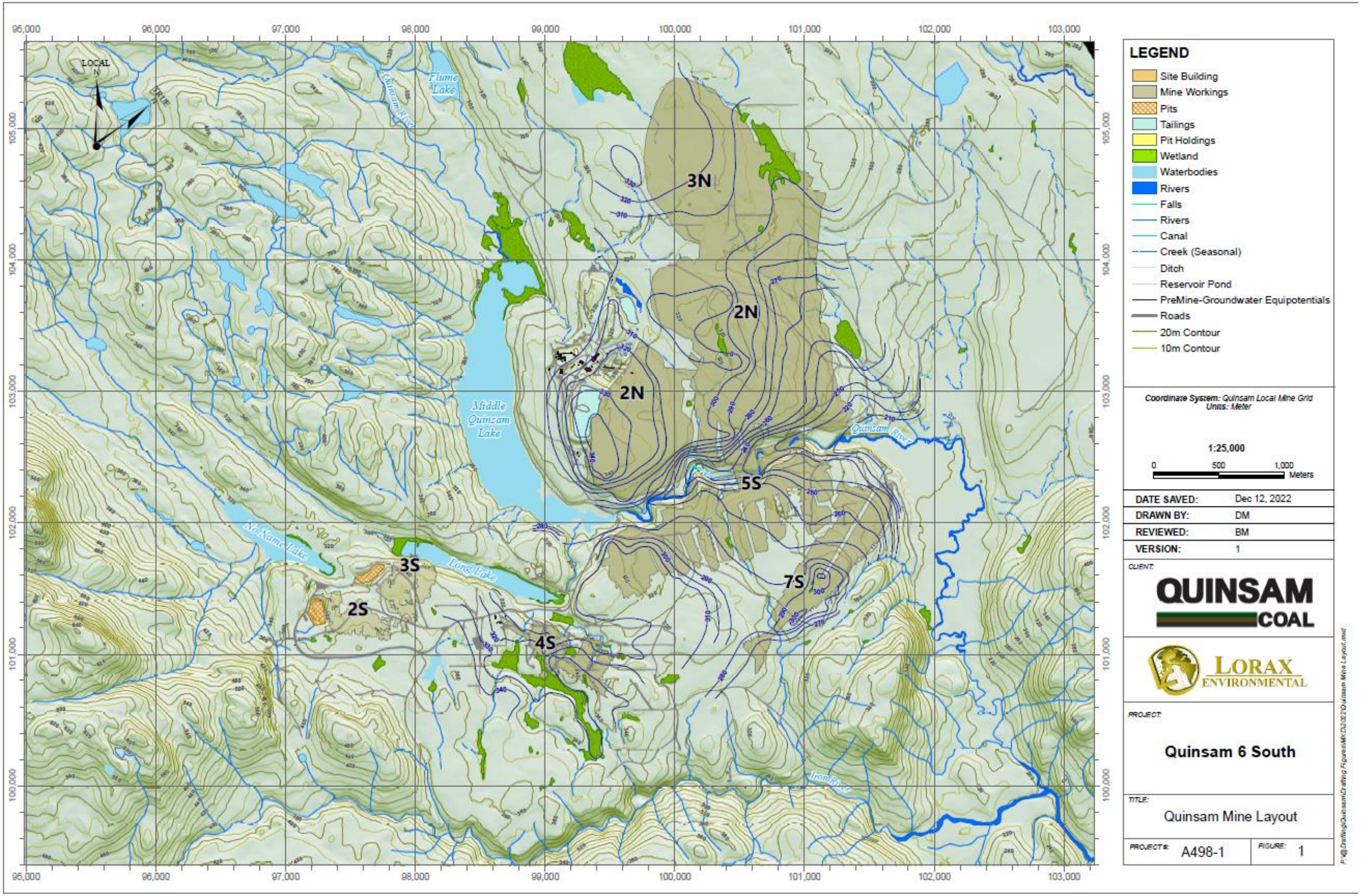
  Monthly - 27 sites

- **Receiving Environment** - 5 weekly samples collected over 30 days (5 in 30)

  - Rivers (Quinsam and Iron) - (9) locations

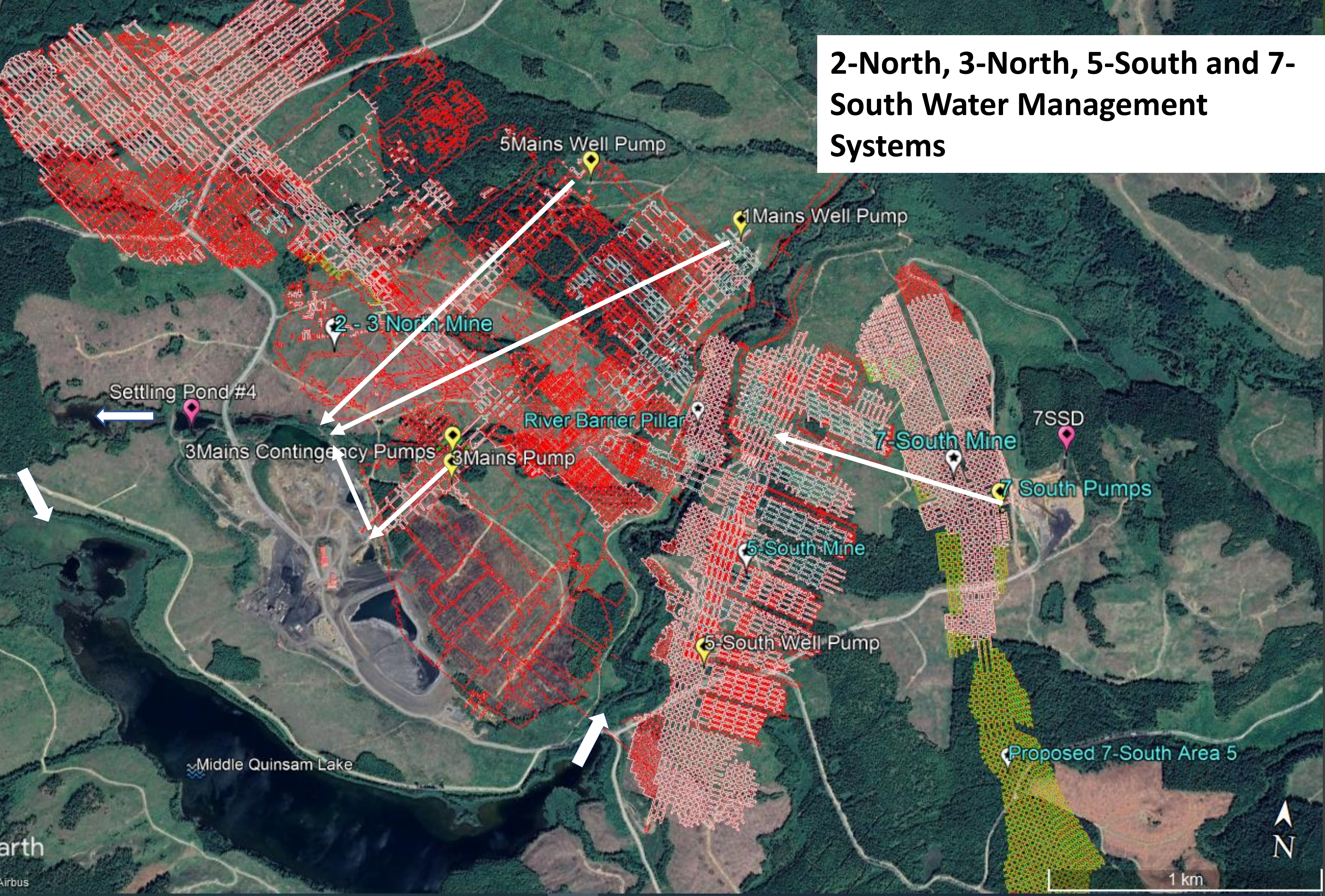
  - Lakes (No Name, Long, Middle Quinsam and Lower Quinsam) - (4 depths) water chemistry and depth profiling.

- **Groundwater Monitoring** - quarterly (15 wells) and semi-annual (28 wells)
- **Continuous Flow Monitoring** - 21 locations
- **Pressure Transducer Loggers** - 9 locations
- **Compliance Reporting -** (4 Quarterly and 1 Annual Report)

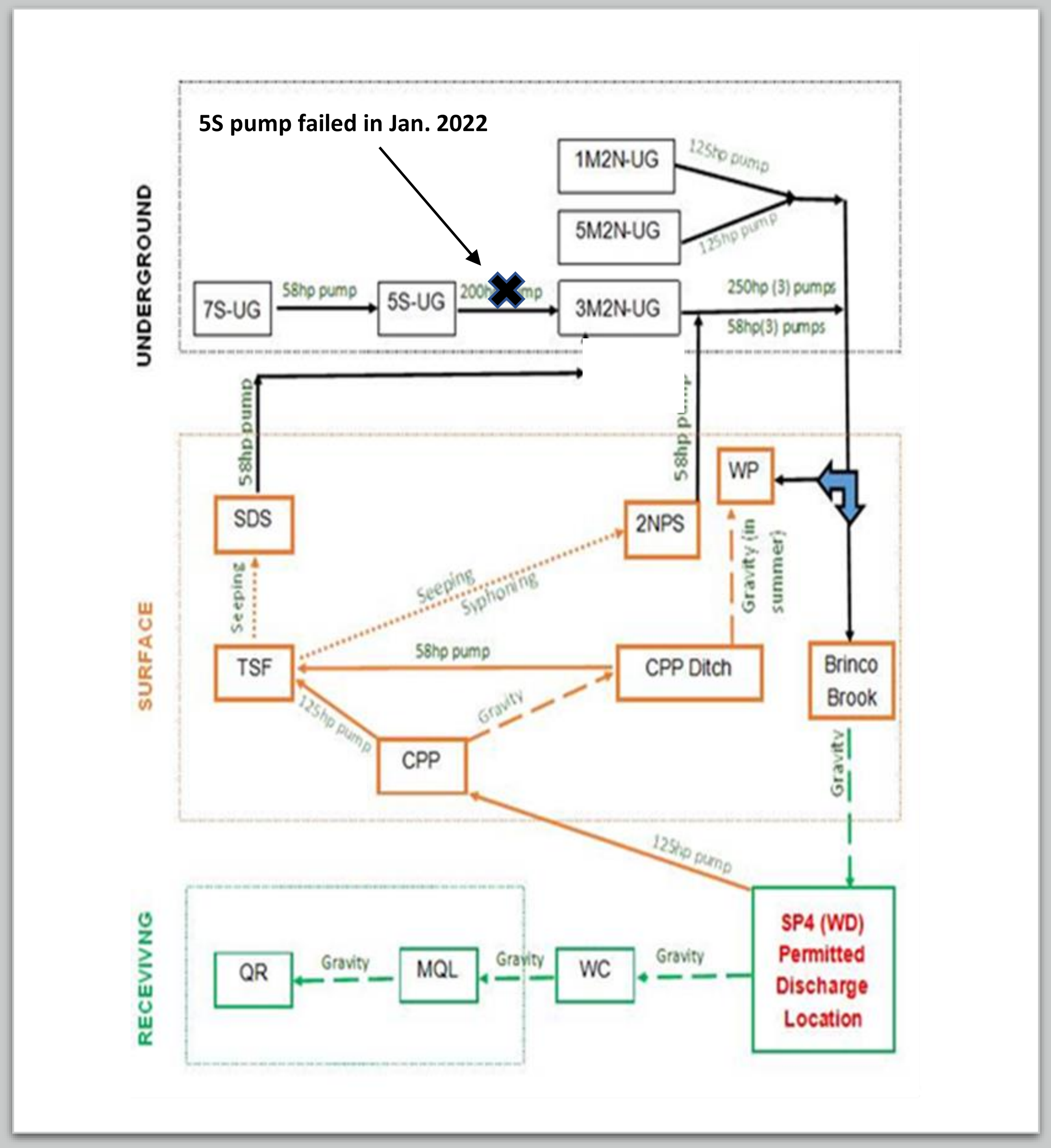


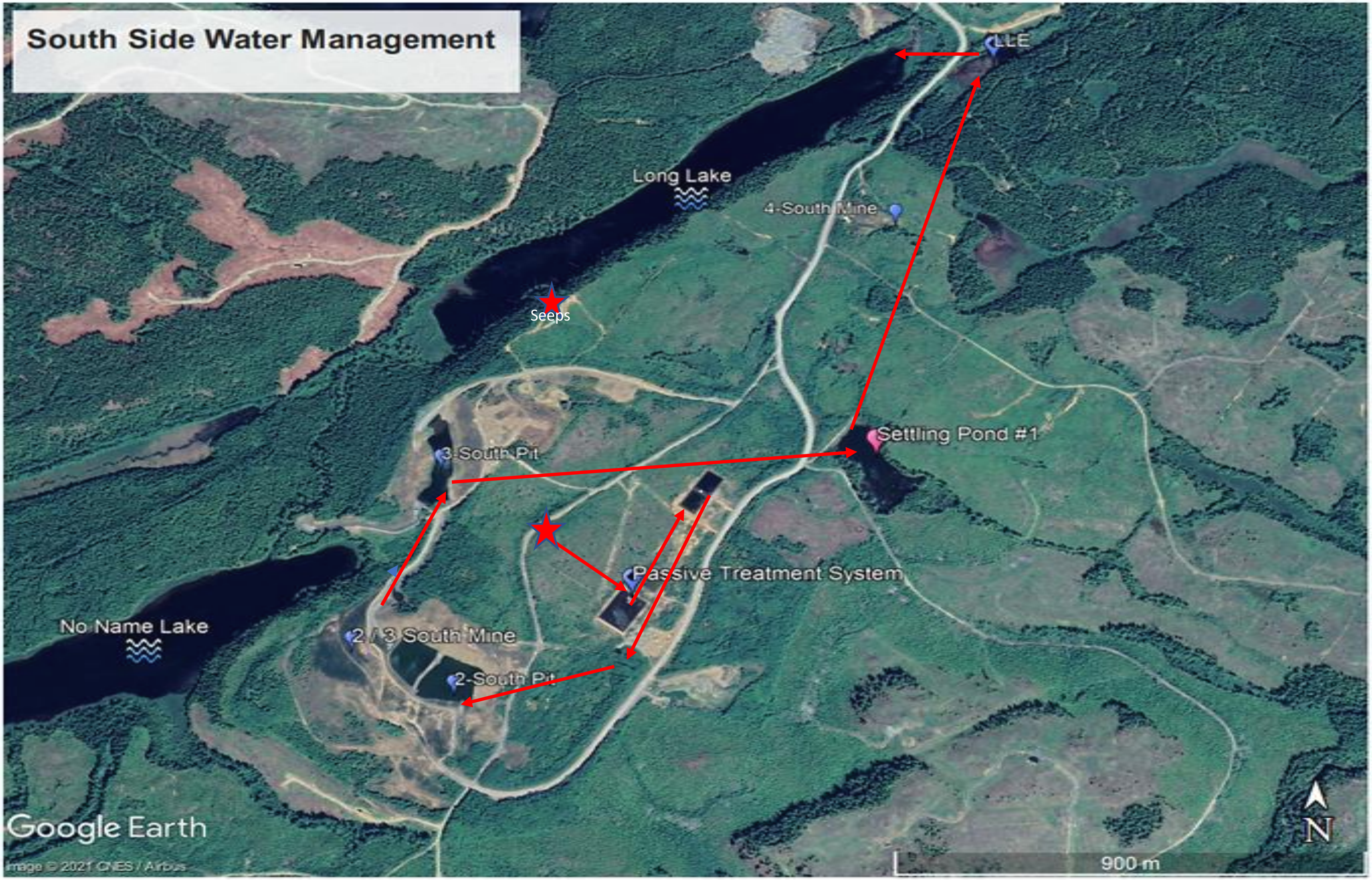
Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

2-North, 3-North, 5-South and 7-South Water Management Systems



7-South, 5-South and 2-North – Water Management Systems



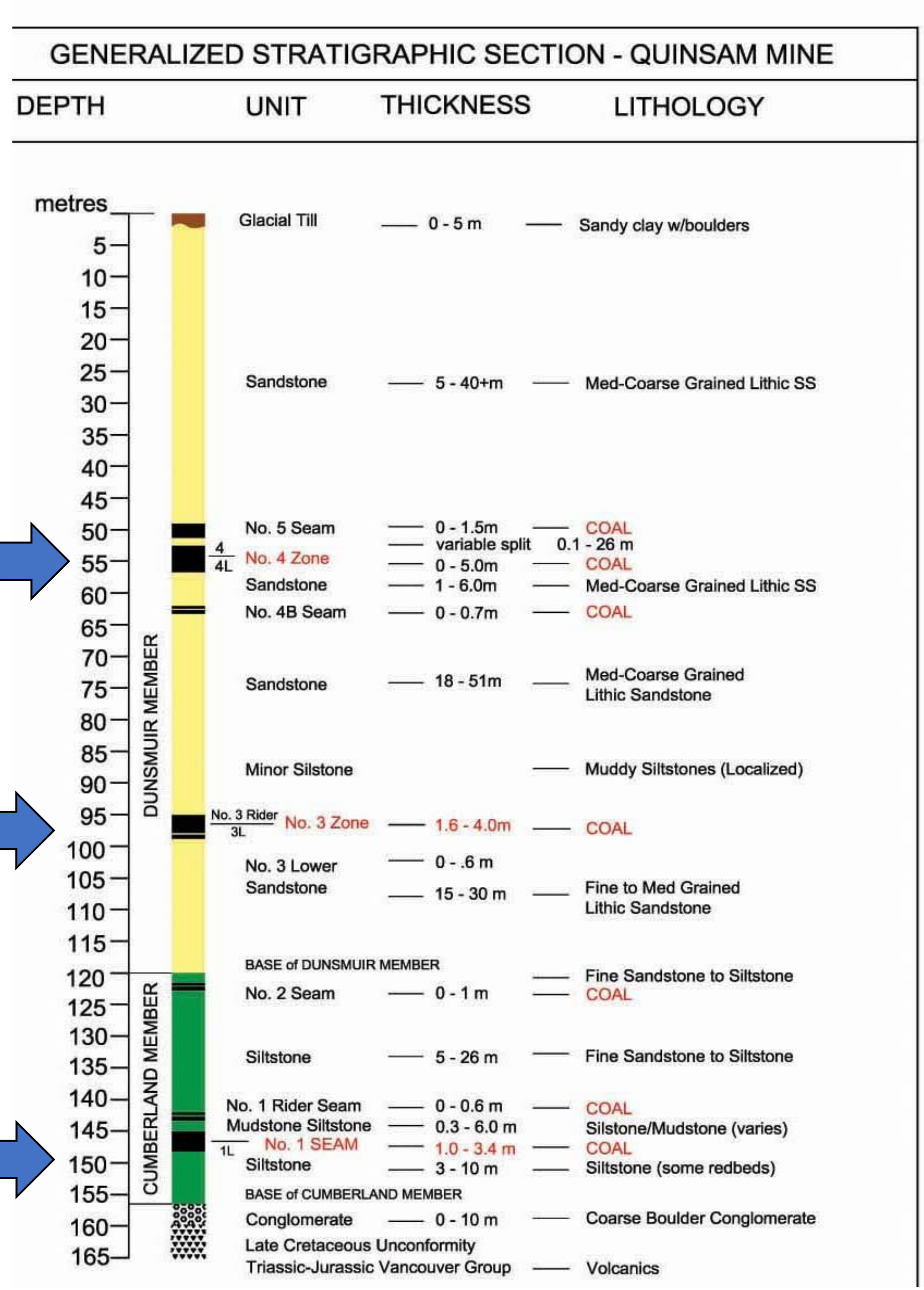

South Side Water Management
LLE
Long Lake
4-South Mine
Seeps
Settling Pond #1
3-South Pit
Passive Treatment System
No Name Lake
2 / 3 South Mine
2-South Pit
Google Earth
Image © 2021 CNES / Airbus
900 m
N

Stratigraphic Position of Mines

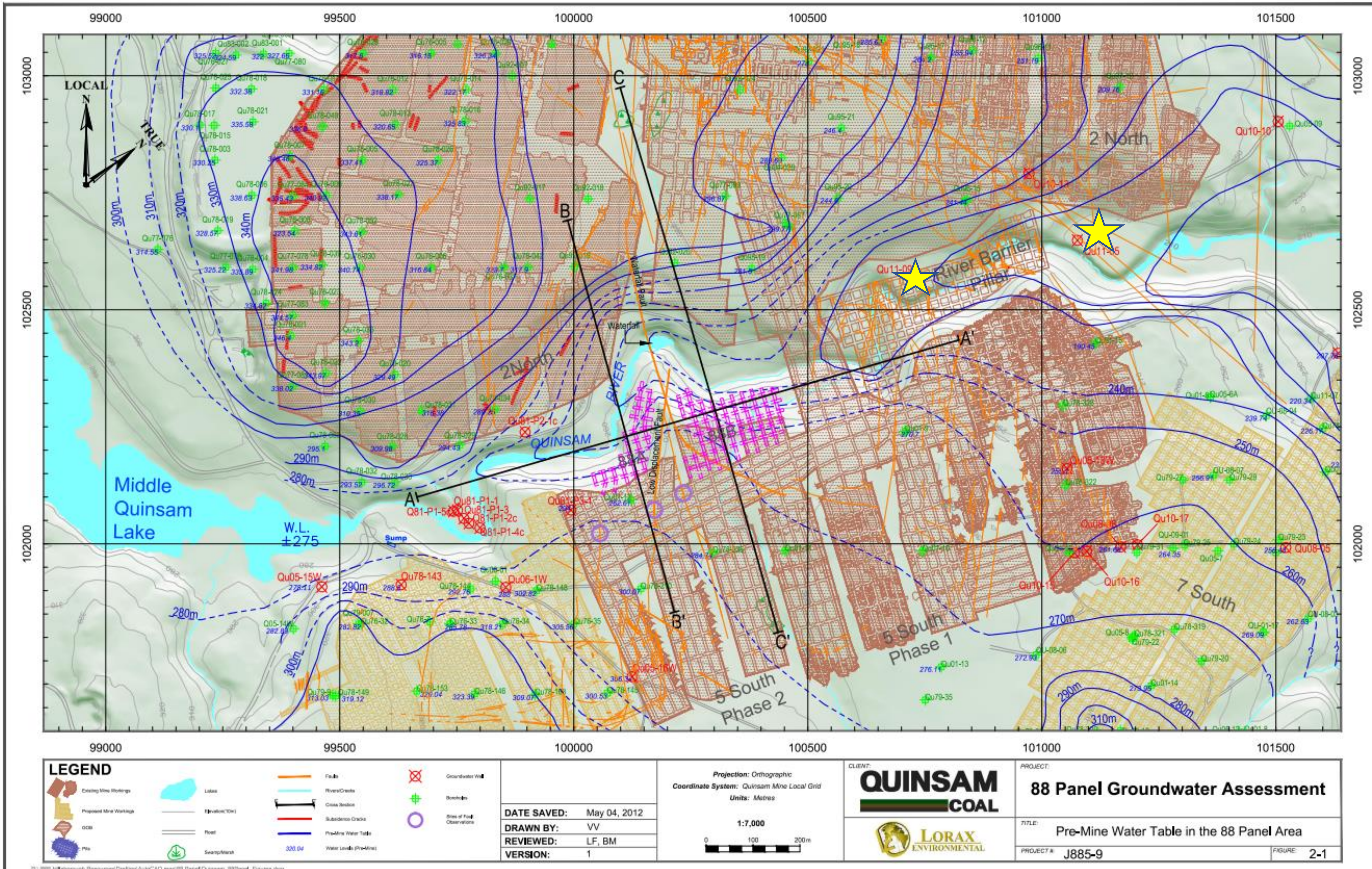
7 South Mine – No. 4 Seam

4 South Mine – No. 3 Seam

2 North Mine
3 North Mine - No. 1 Seam
5 South Mine



2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011



Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

Water Quality Predictions

Hydrogeology Summary

Mine	Seepage Flux (m^3/d)	Shortest Travel Time (years)	Reflooding Time (years)	Receiving Water
7-South	50	6	15	Quinsam River
2-North – 3-North	220	1.4	4	Quinsam River[1]
5-South - RBP	48	1.5	2.5	Quinsam River
4-South	1.4	18[2]	1[3]	Middle Quinsam Lake[4]

Notes:

1. Small component of flow to Middle Quinsam Lake
2. Travel time to Long Lake 3 years
3. Estimate only
4. 10% of flow (0.14 m^3/d) reports to Long Lake

Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

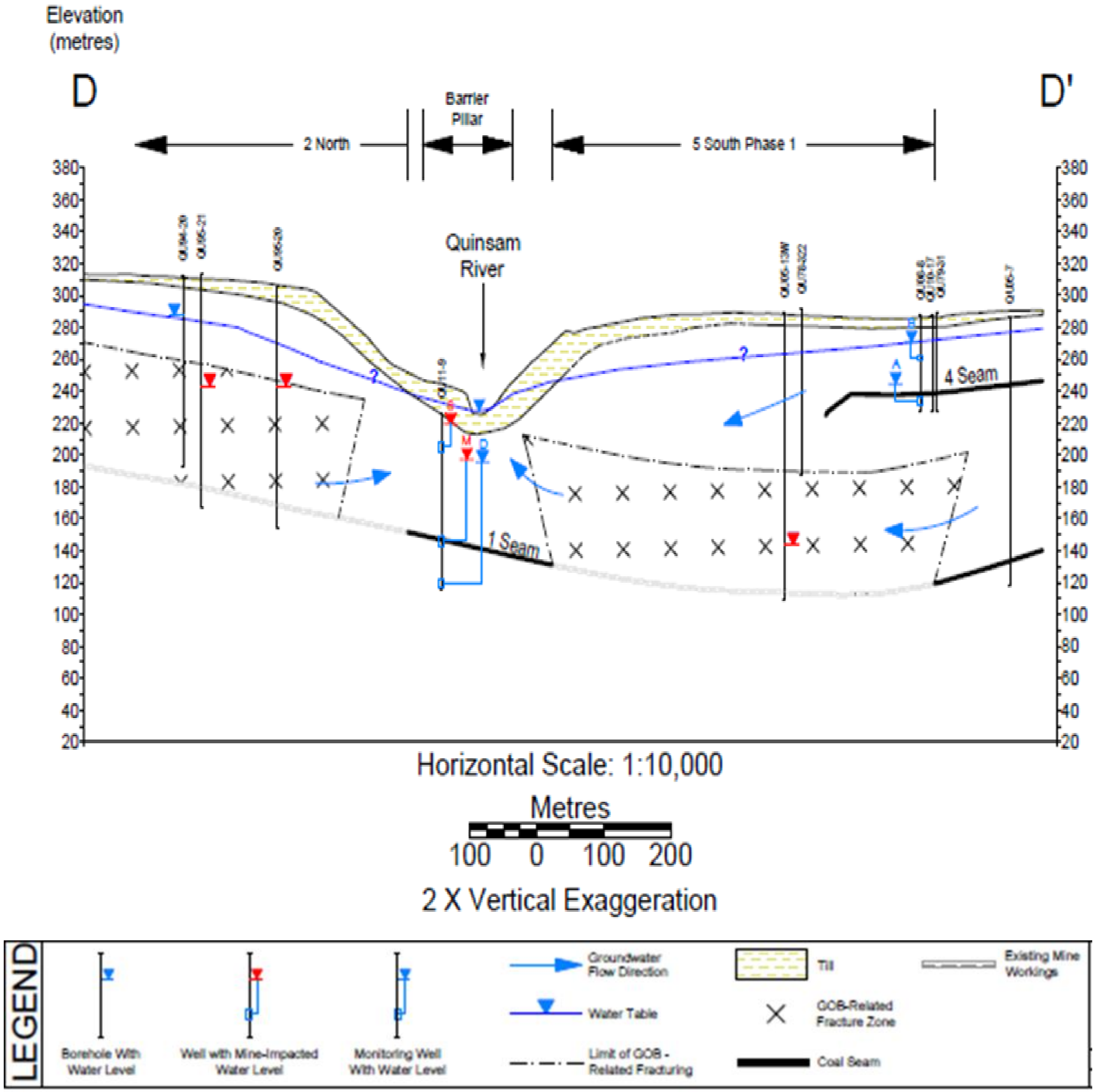
5 South and River Barrier Pillar Hydrogeology

Potential Mine Related Seepage

Cross section displays QU11-09 borehole located in the River Barrier Pillar (RBP). Groundwater has an upward vertical seepage toward the river. 5-South is primarily lateral through the mine perimeter.

Groundwater wells QU11-09 and QU11-05 are at similar elevations:

QU11-09 (226.3 mASL)
QU11-05 (228.4 mASL) (downstream)



2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011

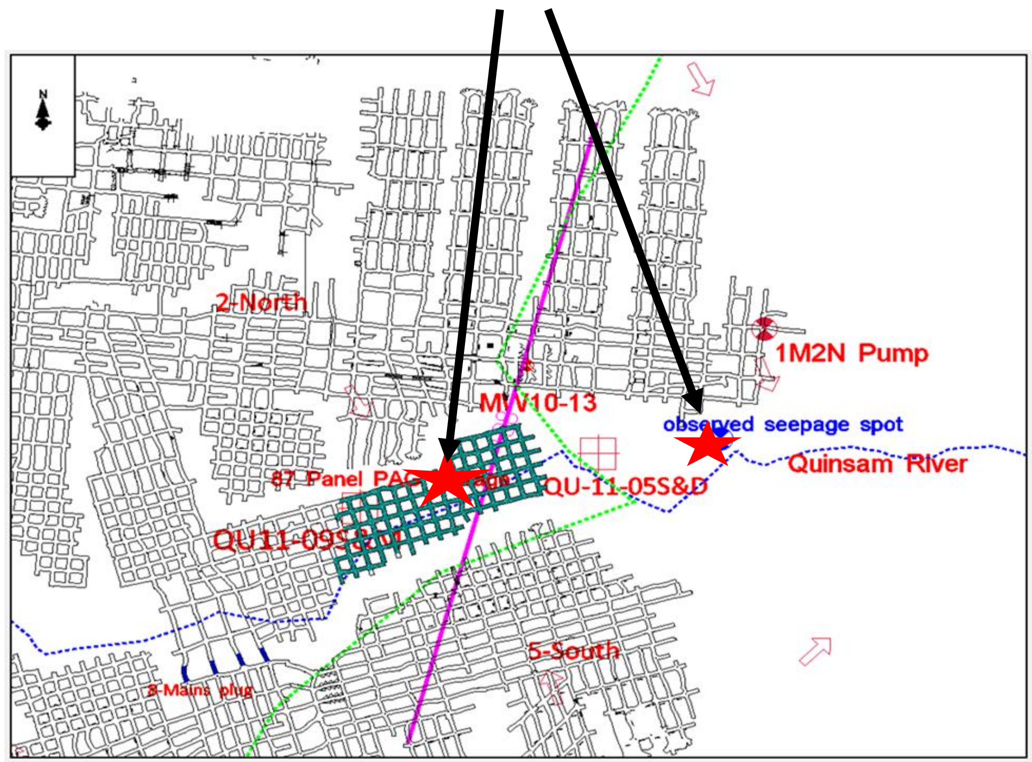
Potential Mine Related Seepage Locations

Mechanisms for groundwater flow is predominant though bedrock fractures and geological faults.

River Barrier Pillar and 2-North dominant lithology is siltstone/mudstone.

Seepage waters display similar trends as mine waters and shallow groundwater.

Potential Mine Related Seepage

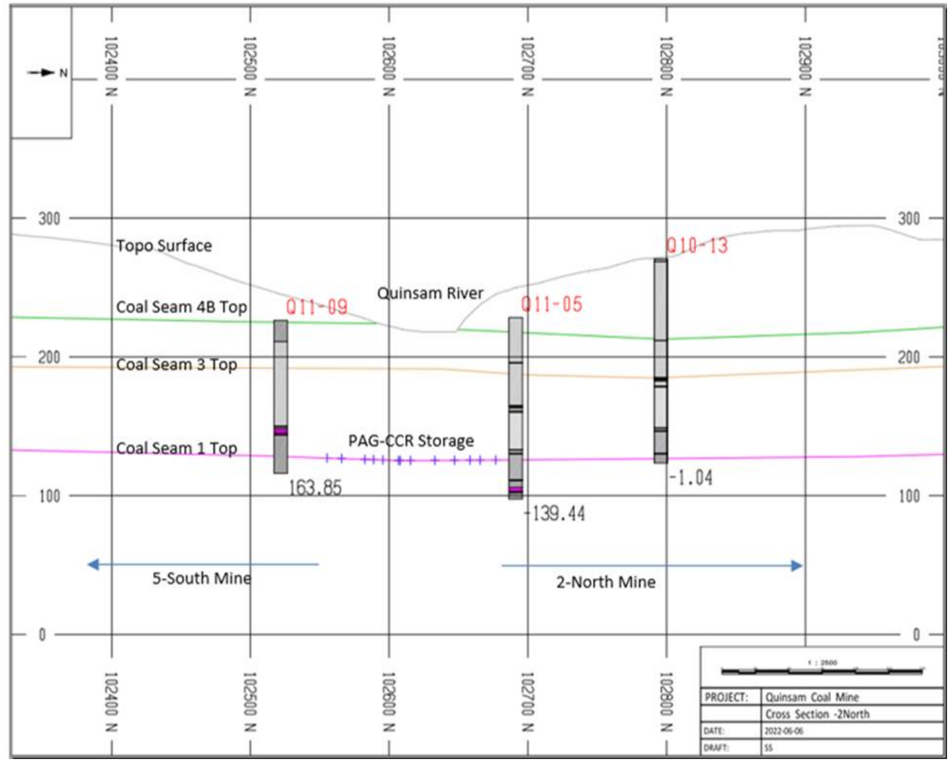


Plan view where seepage is observed near wells QU11-09 and QU11-05 with cross section line (pink solid polyline), seam 4B sub-crops (green dotted polyline), and groundwater flow (pink arrow).

Potential Mine Related Seepage Locations

Cross section in North-South direction near the seepage areas QU11-09 and QU11-05 at locations S and S2.

Groundwater in these areas interacts with the No. 3 coal seam and No. 4 coal seam that sub-crops at the river.



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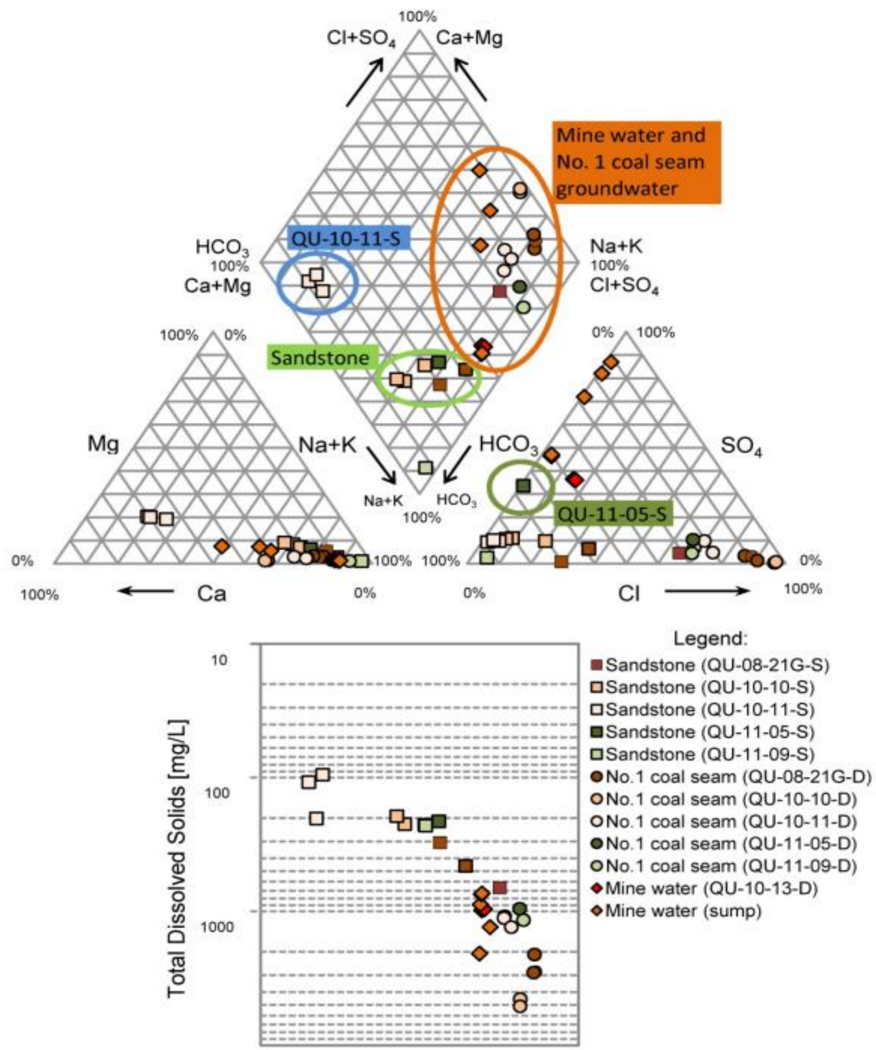

Figure 5-5: **Piper plot of 2 North groundwaters showing three distinct water types; mine water, Dunsmuir sandstone and No. 1 coal seam. The ion contents are plotted as percentages of total equivalents per litre.**

2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011

2-North Mine waters - distinct sulphate signature, classified as a sodium-sulphate calcium bicarbonate type water

No. 1 seam from 2-North Area – deeper waters are sodium-chloride
Shallower waters are sodium bicarbonate type waters.
Plot distinctly from mine waters indicating not strongly mine influenced. Chloride signature indicates these waters are older than sodium and calcium bicarbonate formation waters.

Dunsmuir sandstone waters are predominantly sodium bicarbonate and those influenced by fractured flow from mine water have a sulphate signature.

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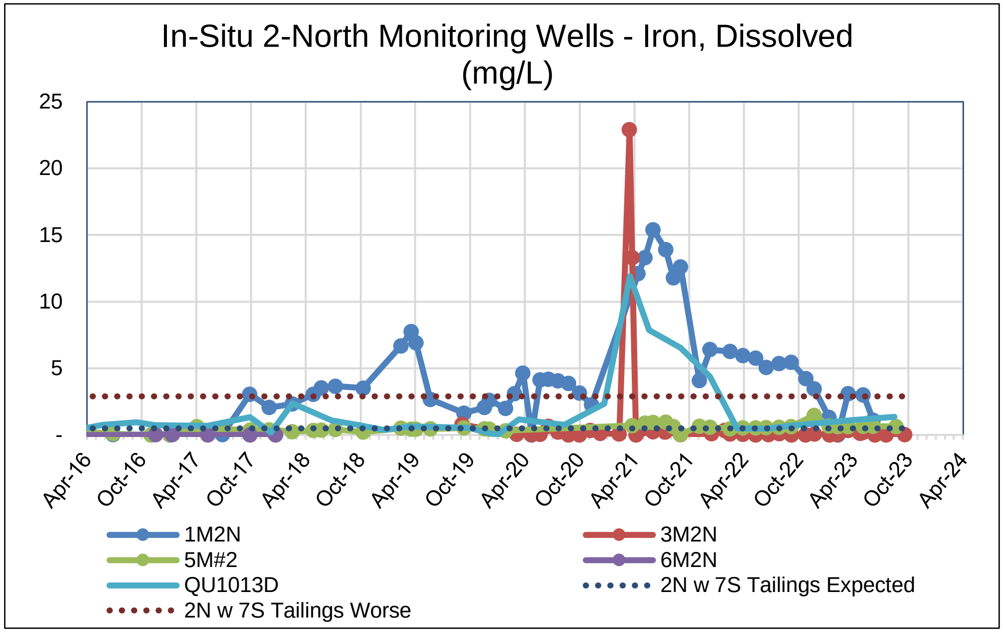

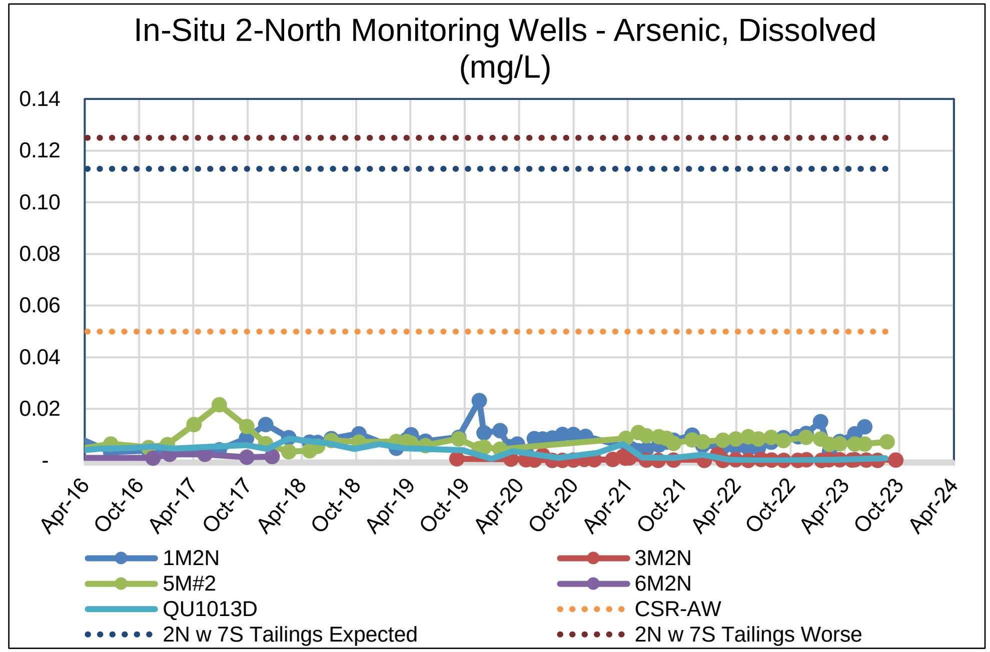

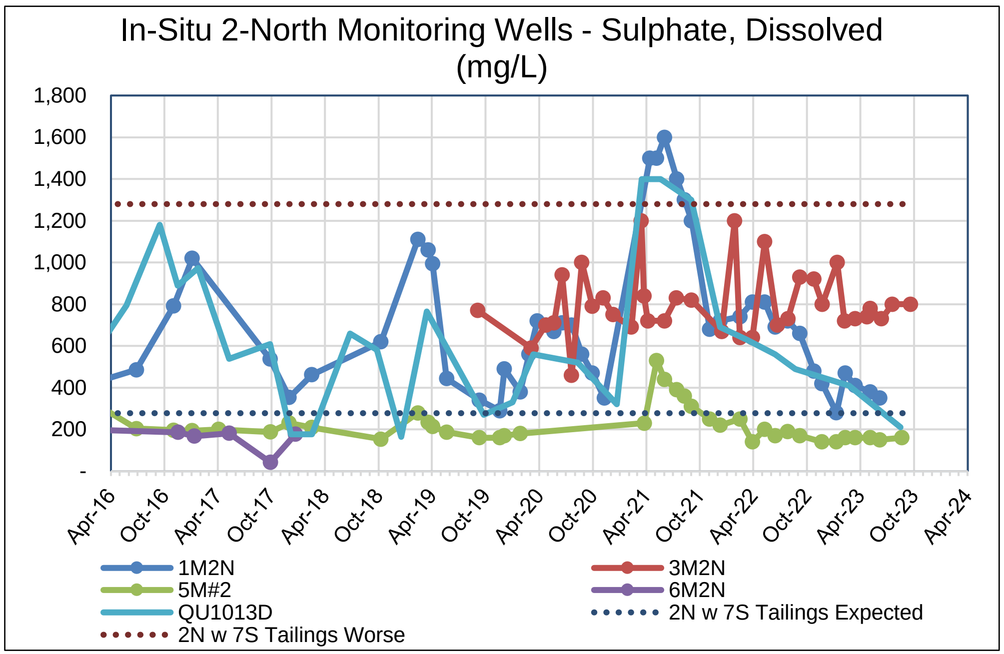

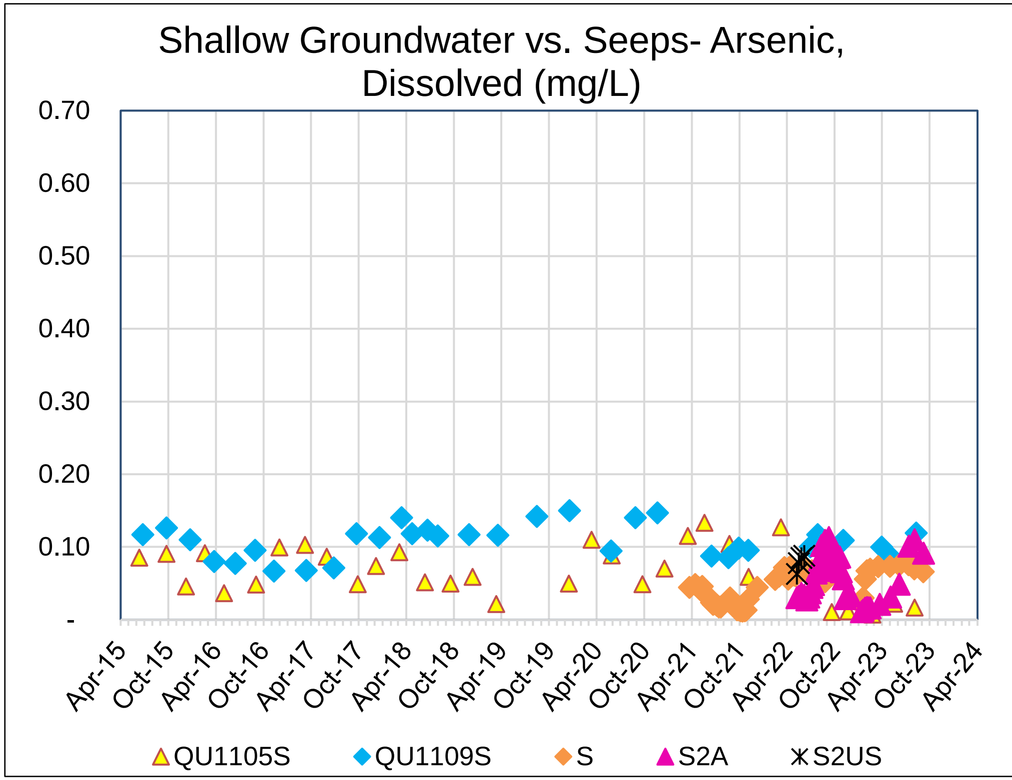

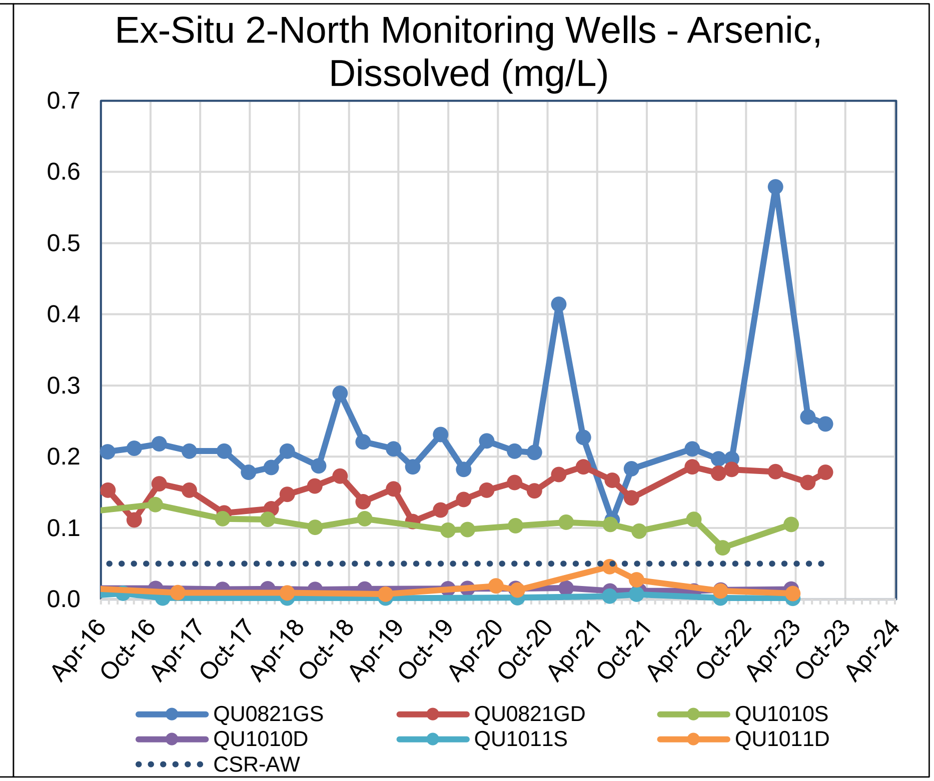

Arsenic was elevated in the Dunsmuir sandstone relative to levels observed in the No. 1 Seam, this is consistent with the realgar mineralization previously observed in the sandstone formation (Lorax, 2011b).

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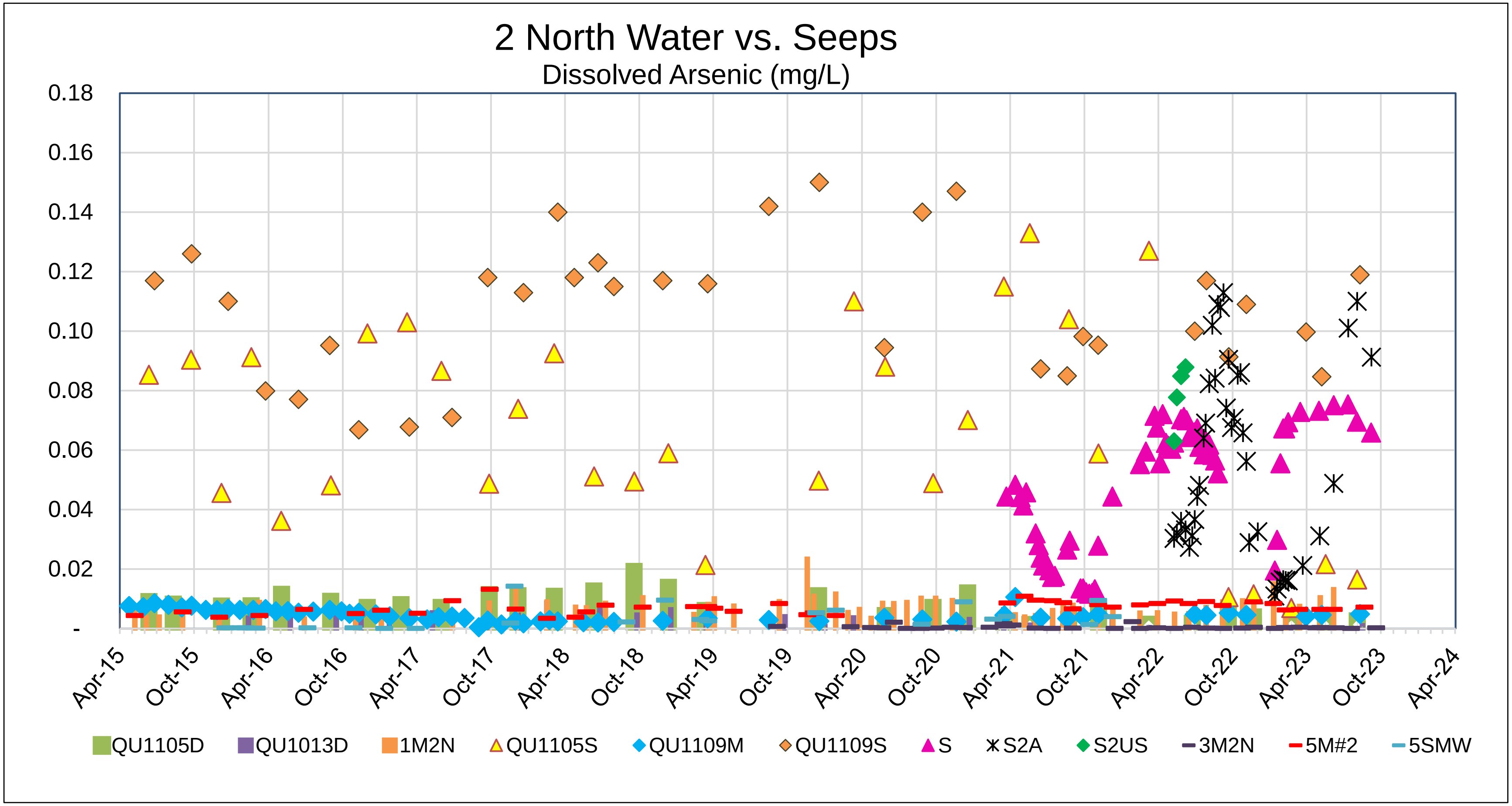
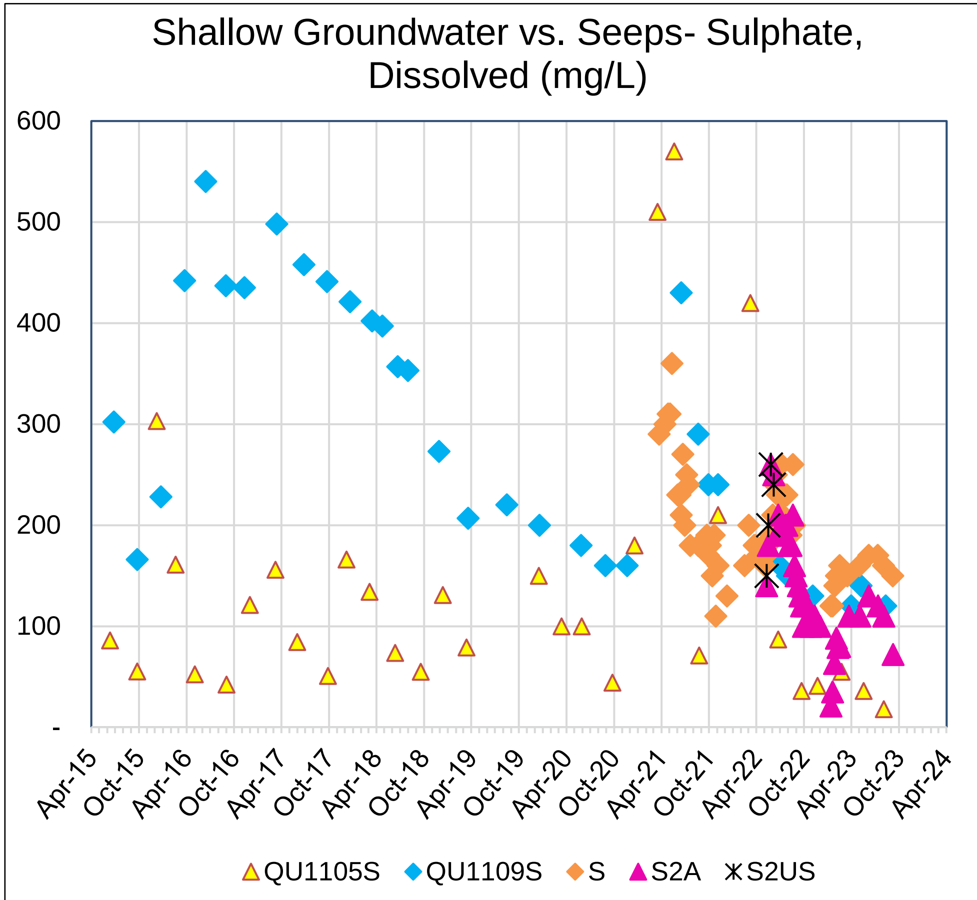
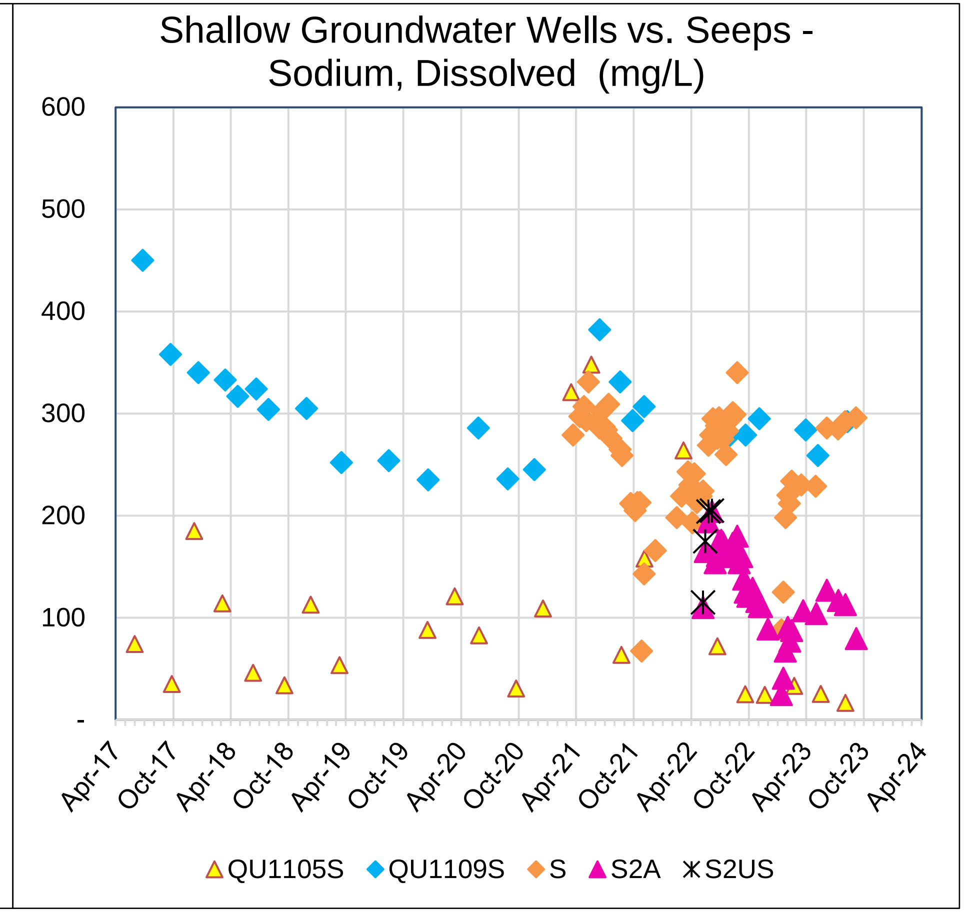
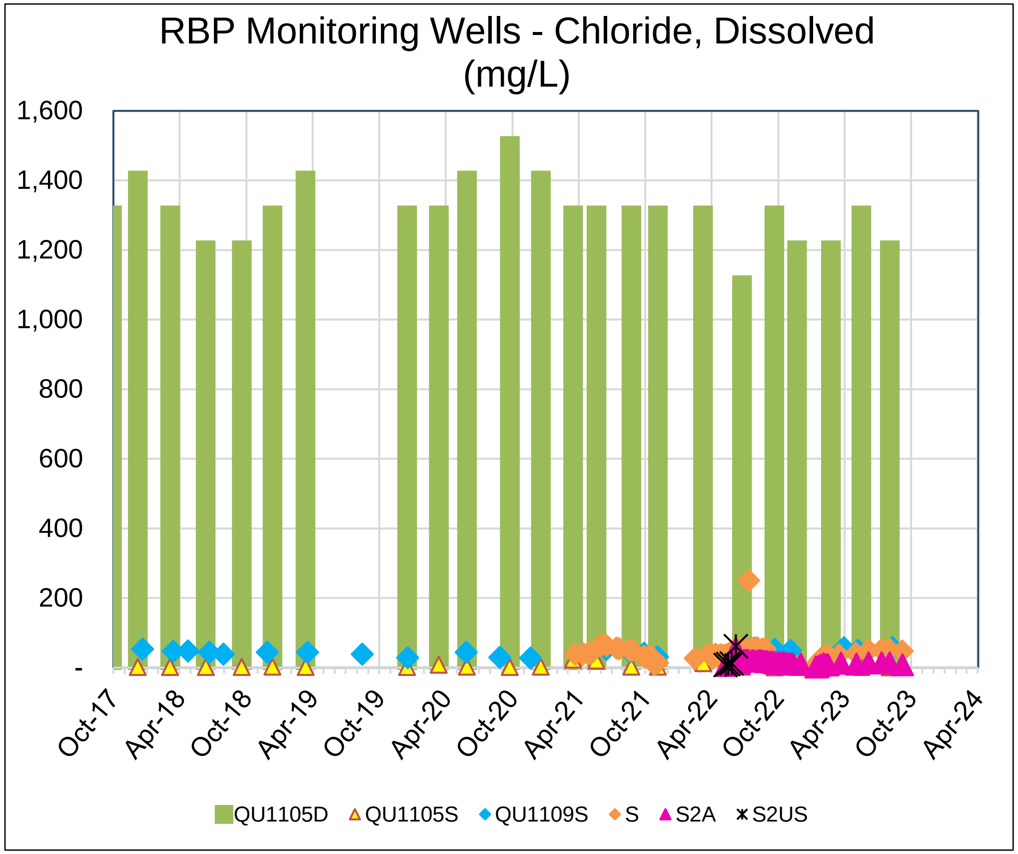


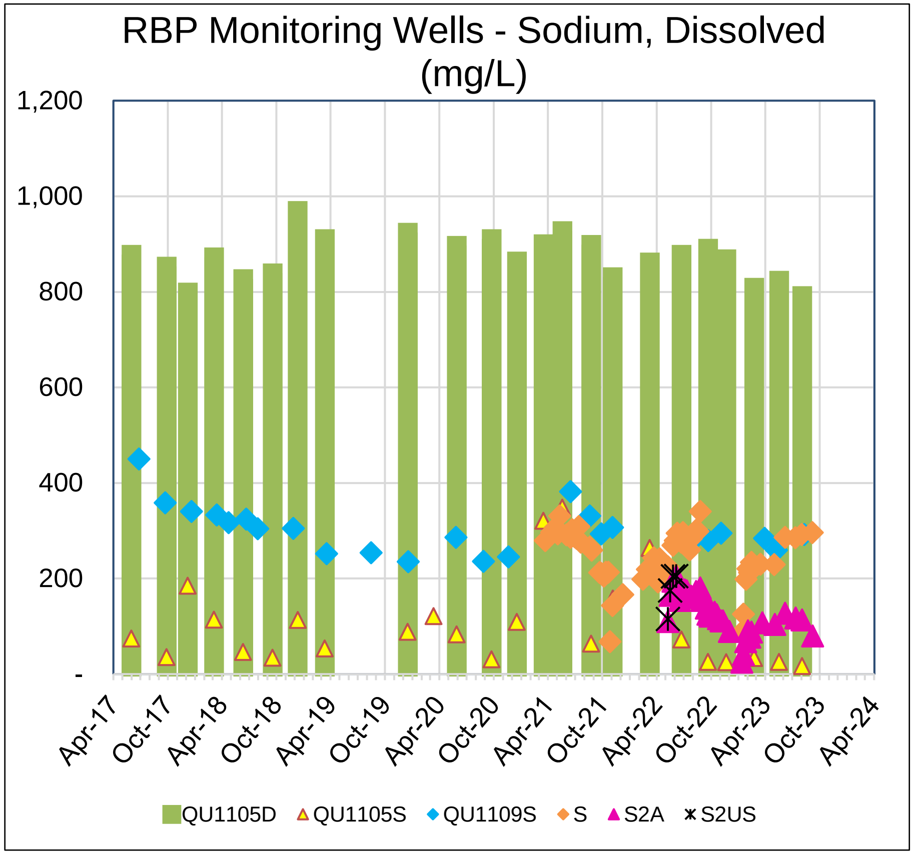
This chart provides a graphical representation of the 2-North and 5-South Mine Water (QU1013D, 1M2N, 3M2N, 5M#2, QU1109M and 5SMW) compared to shallow (QU1109S and QU1105S) and Deep (QU1105D) groundwater and Potential Seeps (S, S2A and S2US). As-D concentrations for shallow groundwater and seeps display similar trends, falling within the same range (0.01 mg/L to 0.15 mg/L).





The possible influence of sulphate rich mine water is observed in the shallow groundwaters and seepage waters having a sodium bicarbonate, sulphate signature. Fractured flow is suspected at these locations as indicated by the high hydraulic conductivity and very rapid recharge rates observed in the shallow groundwater wells.





Groundwater tends to evolve to sodium chloride type water as it ages in the formation flow path (Freeze, 1979) indicating the down-dip 2 North, No.1 coal seam groundwater is older groundwater with chloride concentrations increasing with formation contact time. *Low levels of chloride indicate these waters are younger groundwaters with limited formation contact time.*

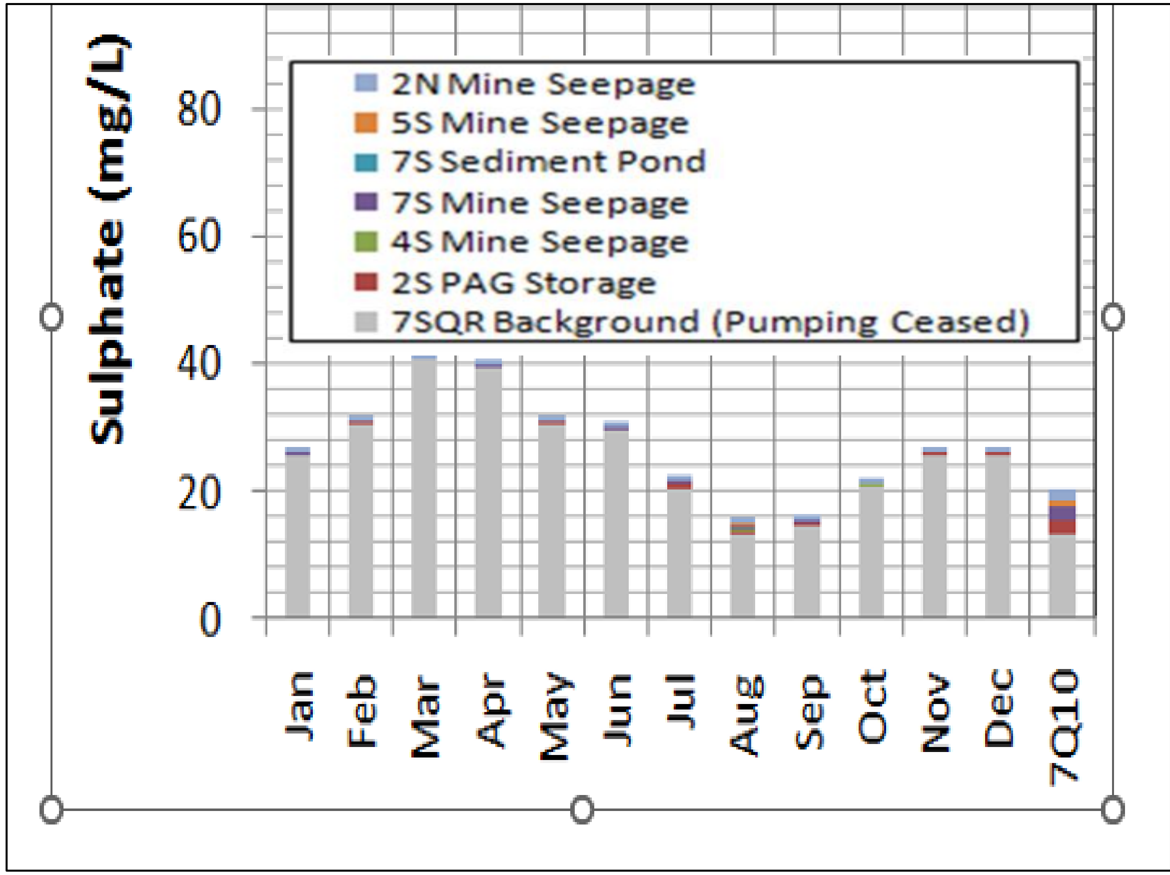
Receiving Environment Water Quality Guidelines and Objectives

- Receiving environment (lakes and rivers) at Quinsam Mine are compared to British Columbia (B.C.) **Approved Water Quality Guidelines (WQGs)** for Freshwater Aquatic Life (FWAL). Both chronic (30-day exposure) and acute (immediate exposure).
- **Water Quality Objectives (WQOs)** Middle Quinsam and Long Lake and Quinsam River are also compared to relevant for Middle Quinsam Sub-basin developed in 1986.
- In most cases WQG's are more current and stringent than WQO's.

- **WQGs:**
- Exceeding a WQG's does not imply that unacceptable risks exists, but rather that the potential for adverse effects may be increased and additional investigation may be required.

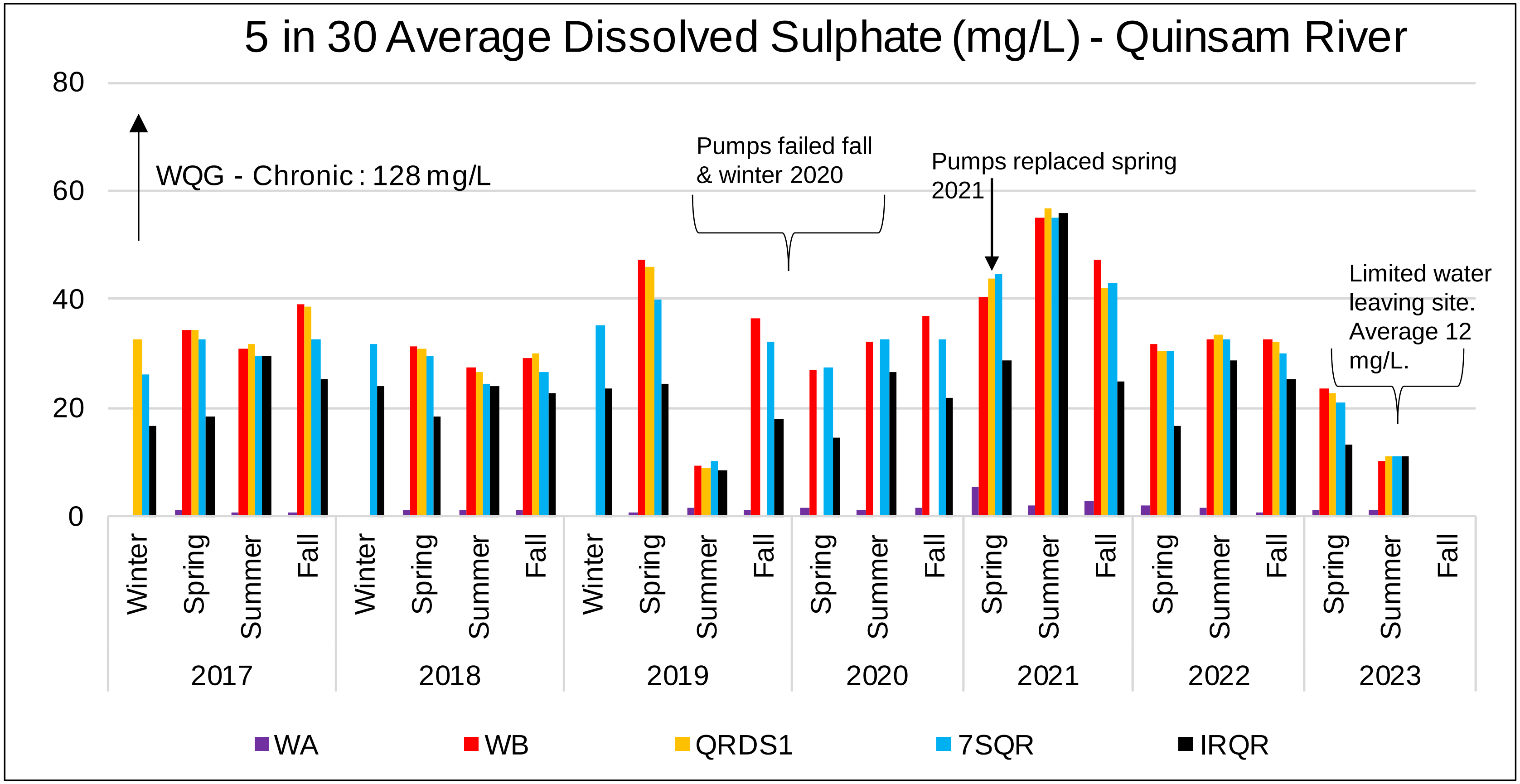
Predicted Post-Closure Cumulative Effects on the Quinsam River

- Expected concentrations for Quinsam River - Water quality remains below both chronic and acute WQG's
- Worst case - Highest predicted concentrations for mine influenced parameters (*e.g., SO*$_4$, As, Co and Fe) 7Q10 (7-day lowest flow event)

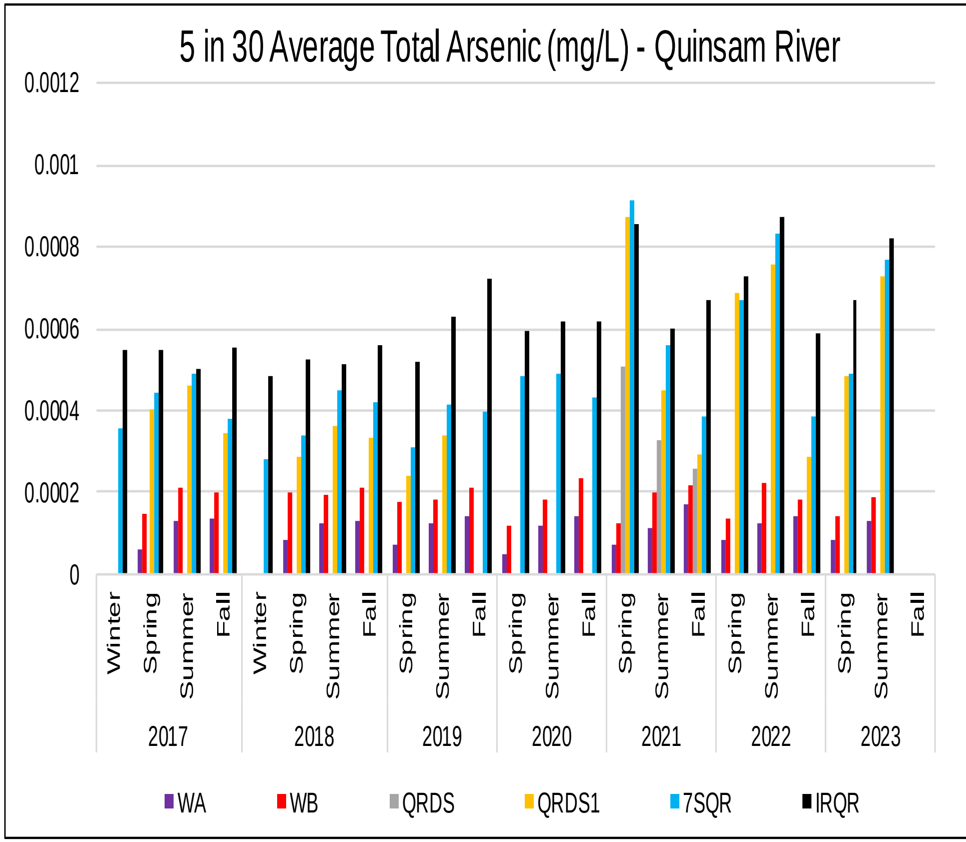


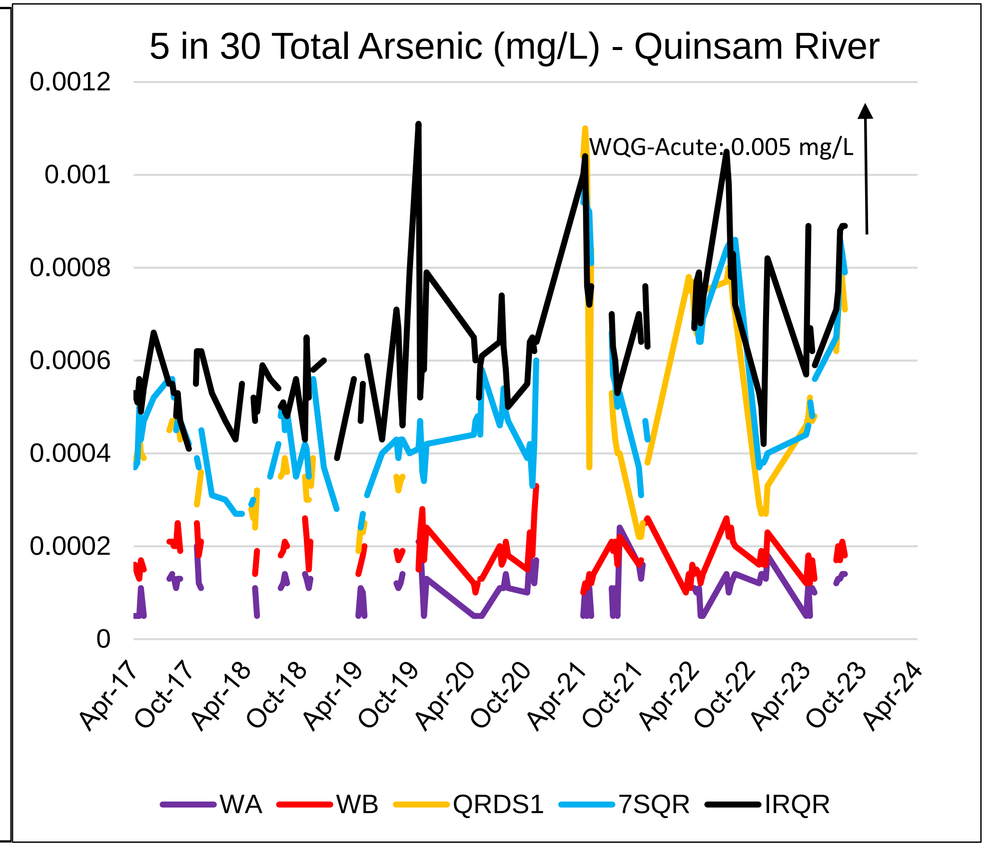
Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS



UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS





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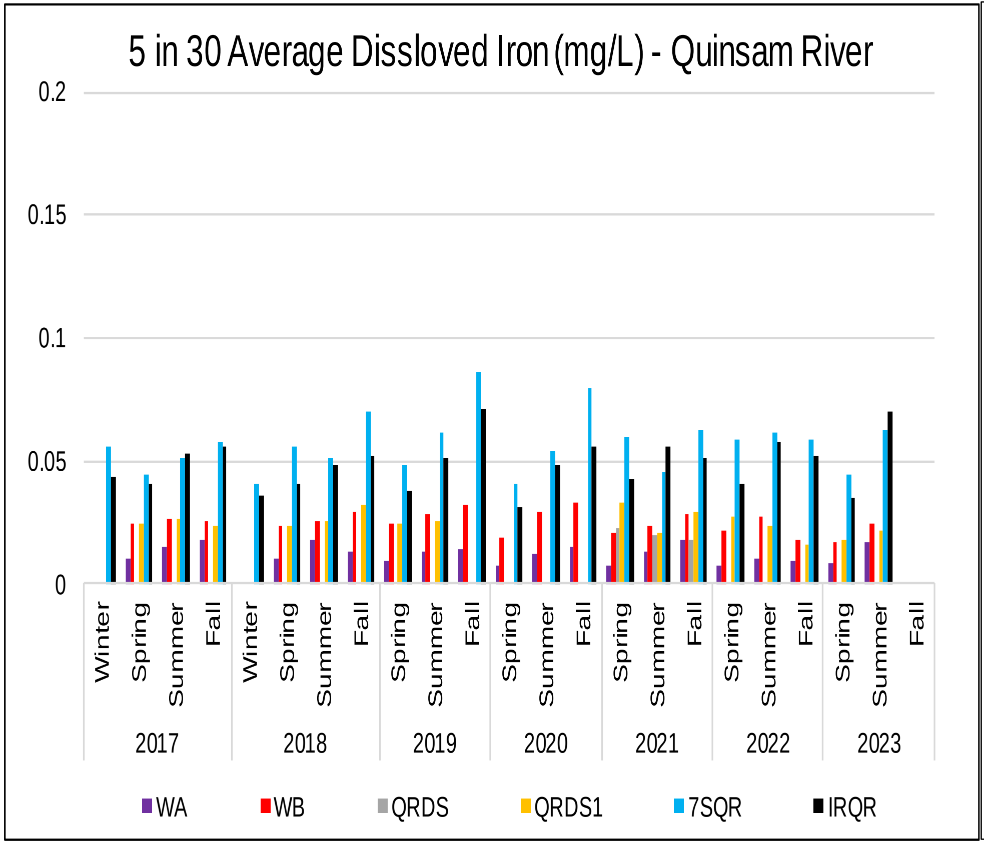
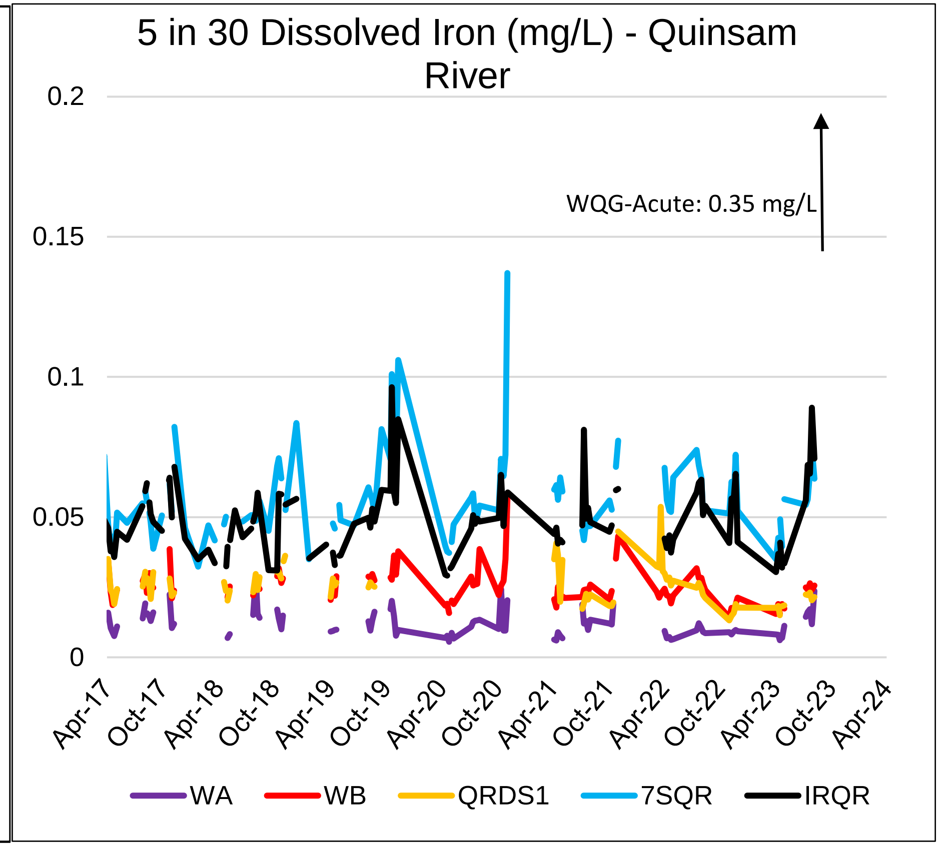
UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS





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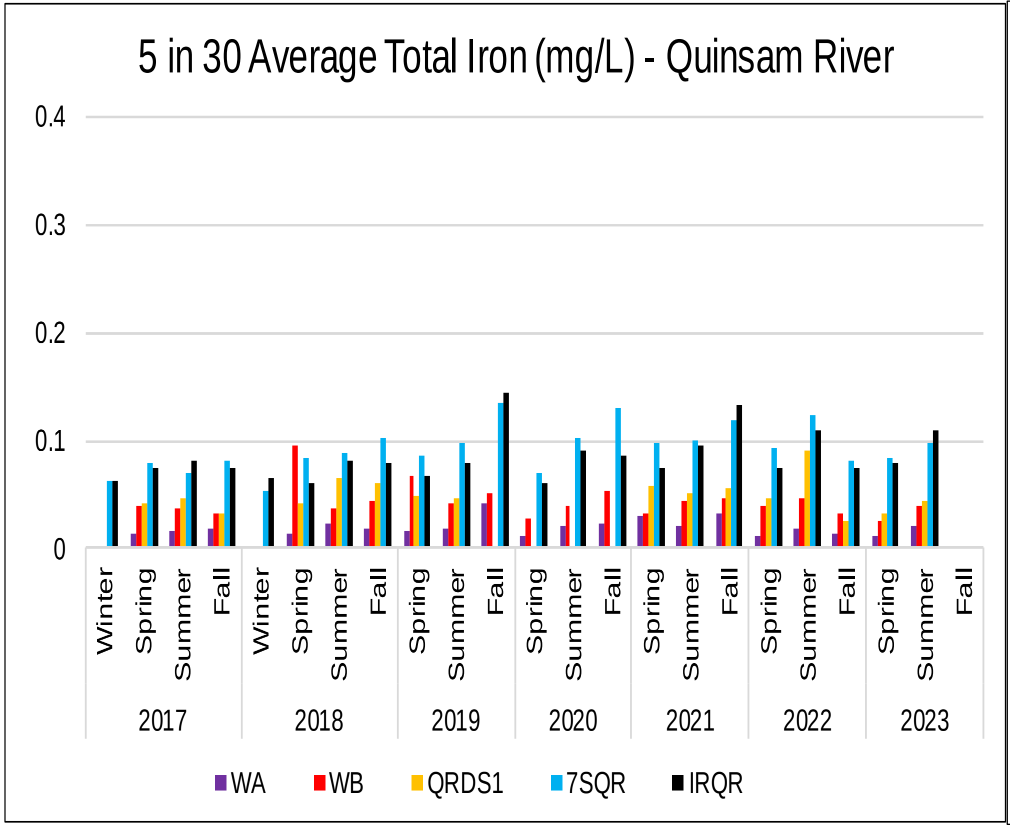
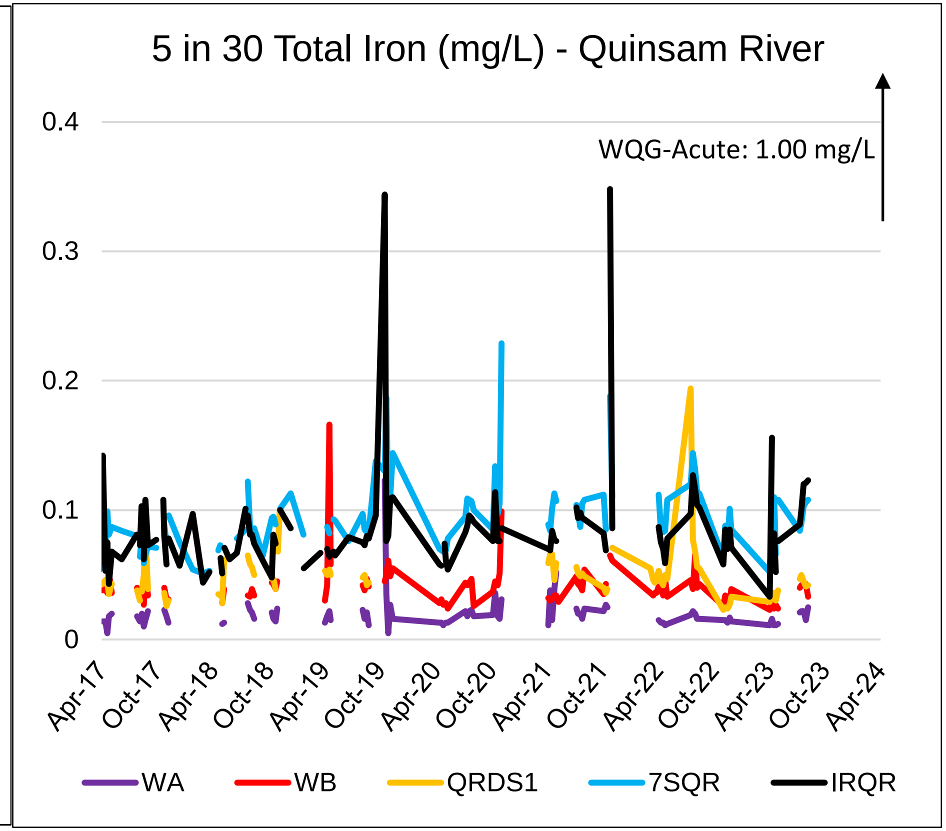
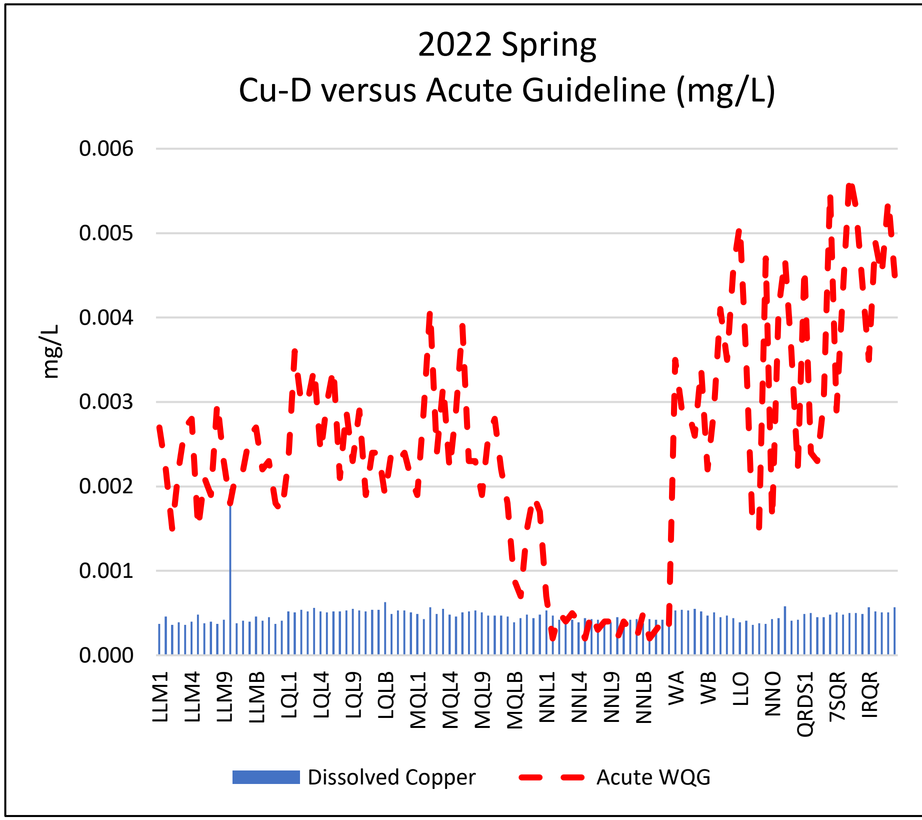
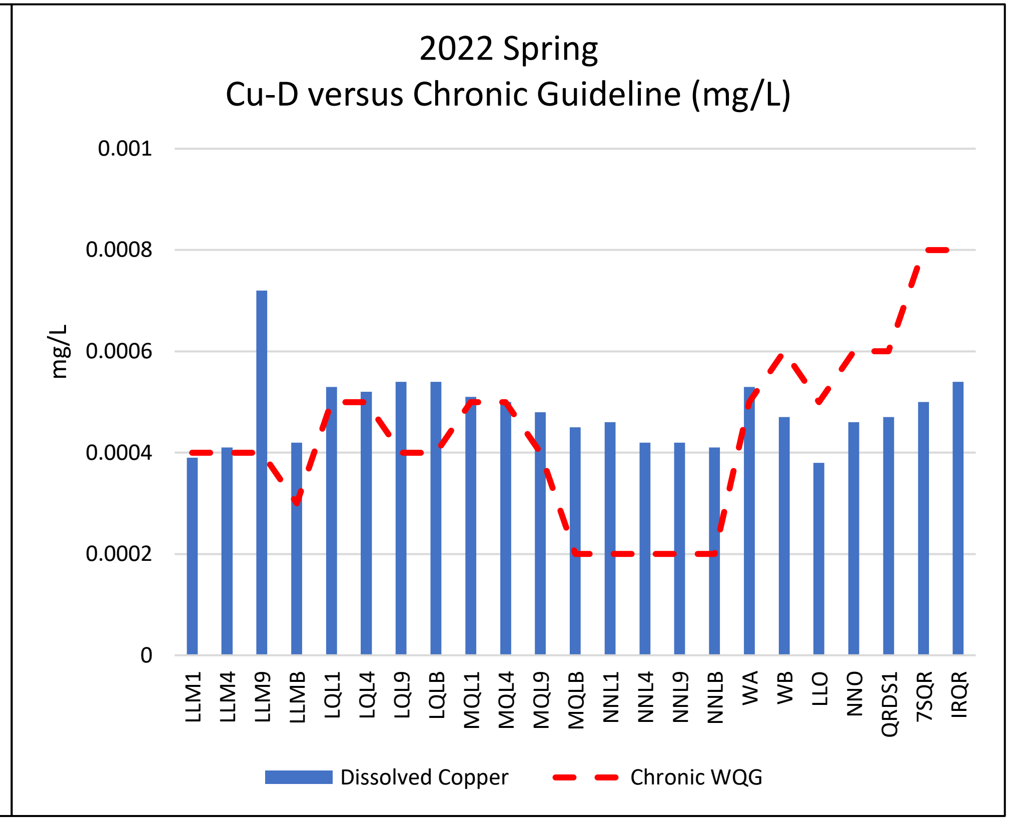
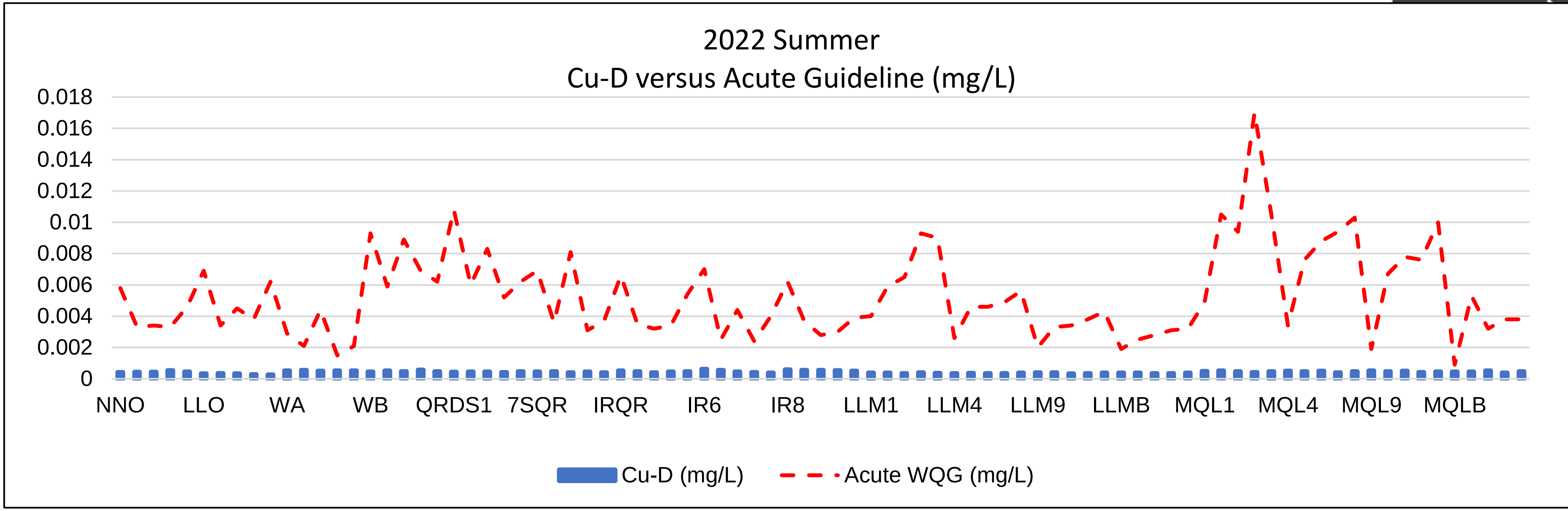
UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS

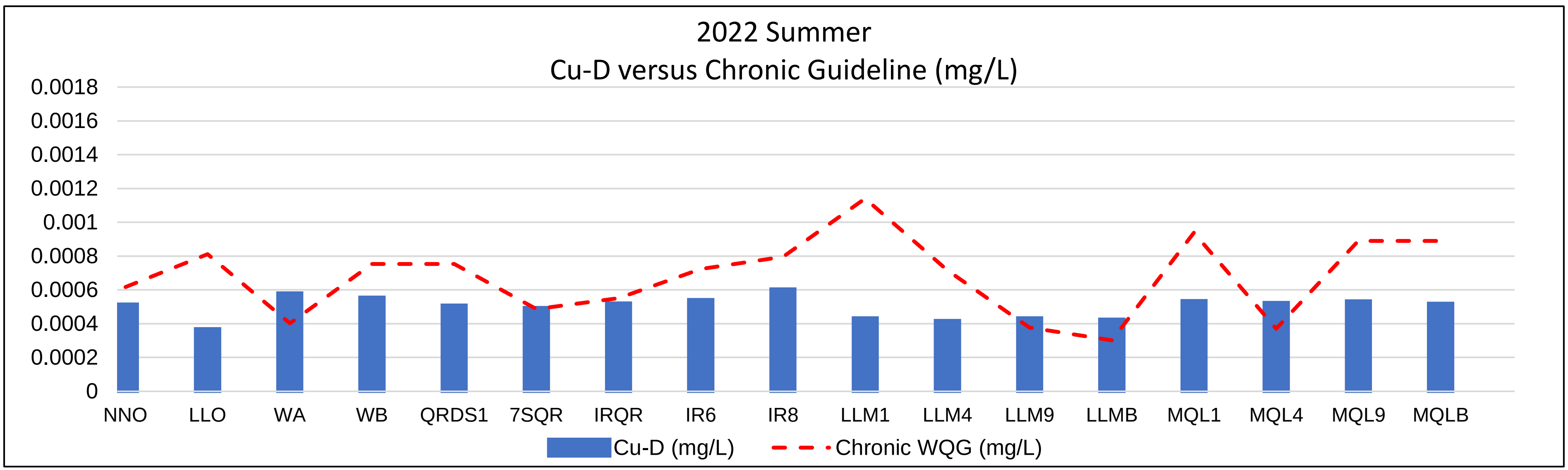


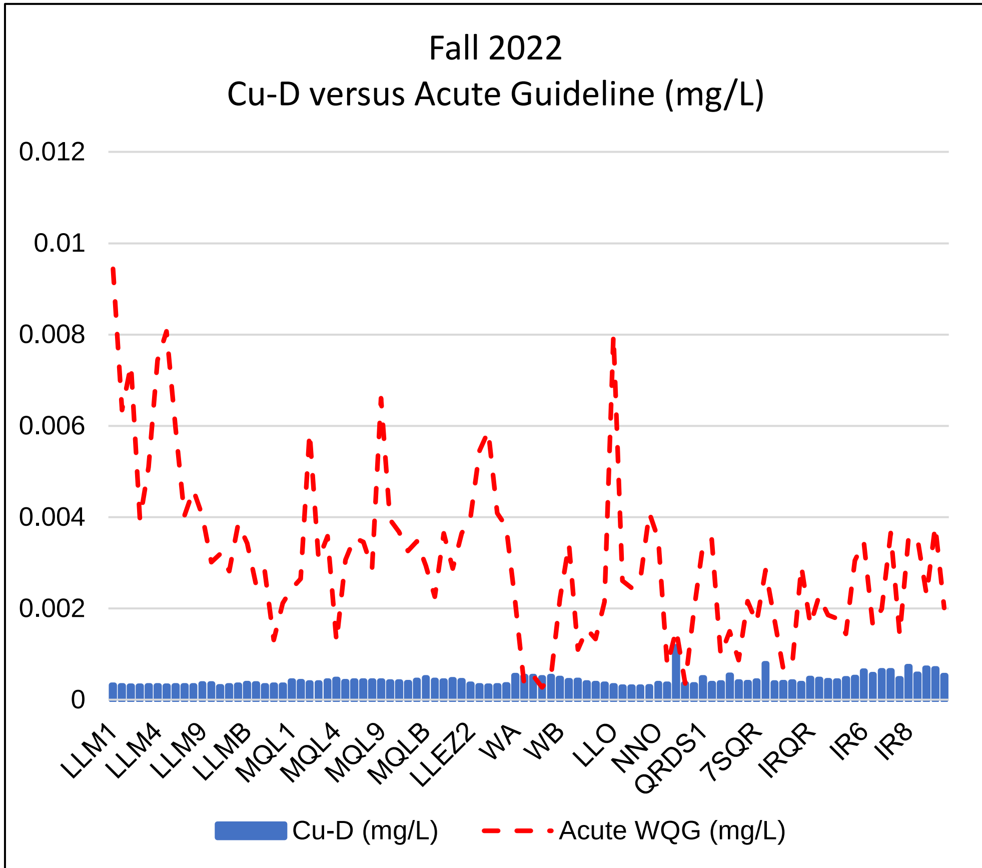



2022 Spring
Cu-D versus Acute Guideline (mg/L)
mg/L
0.006
0.005
0.004
0.003
0.002
0.001
0.000
LLM1
LLM4
LLM9
LLMB
LQL1
LQL4
LQL9
LQLB
MQL1
MQL4
MQL9
MQLB
NNL1
NNL4
NNL9
NNLB
WA
WB
LLO
NNO
QRDS1
7SQR
IRQR
Dissolved Copper
Acute WQG

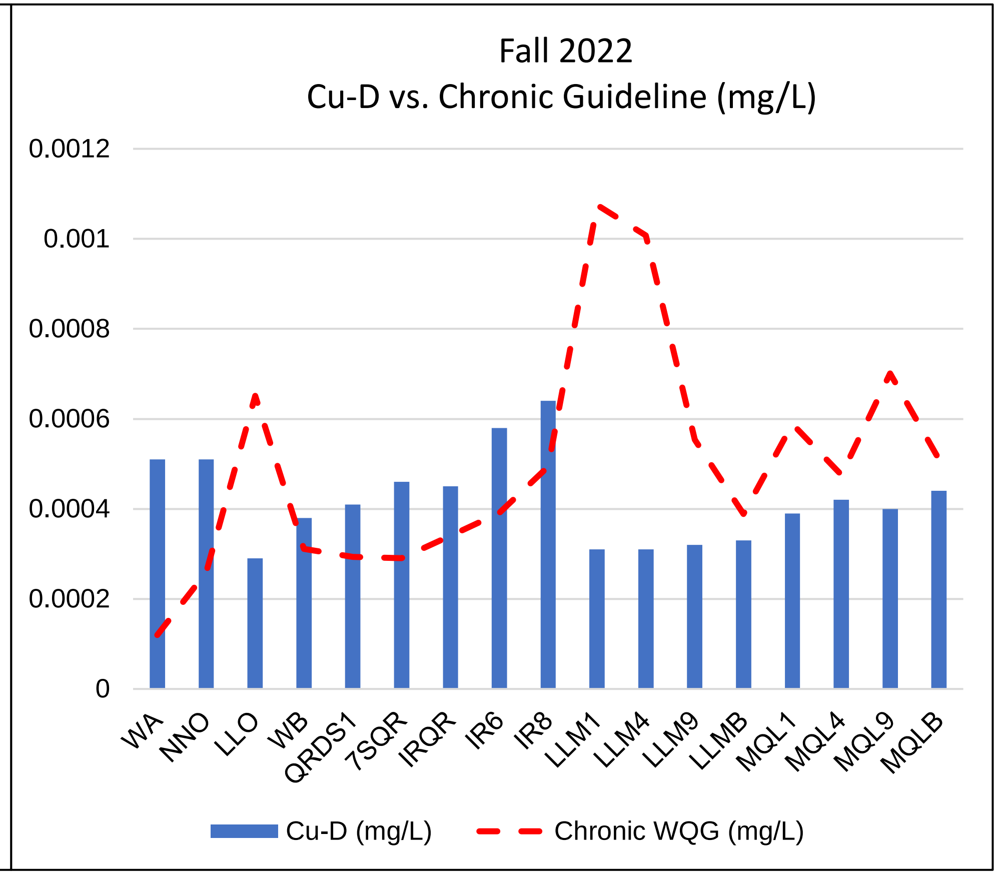

2022 Spring
Cu-D versus Chronic Guideline (mg/L)
mg/L
0.001
0.0008
0.0006
0.0004
0.0002
0
LLM1
LLM4
LLM9
LLMB
LQL1
LQL4
LQL9
LQLB
MQL1
MQL4
MQL9
MQLB
NNL1
NNL4
NNL9
NNLB
WA
WB
LLO
NNO
QRDS1
7SQR
IRQR
Dissolved Copper
Chronic WQG


2022 Summer
Cu-D versus Acute Guideline (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
NNO
LLO
WA
WB
QRDS1
7SQR
IRQR
IR6
IR8
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
Cu-D (mg/L)
Acute WQG (mg/L)

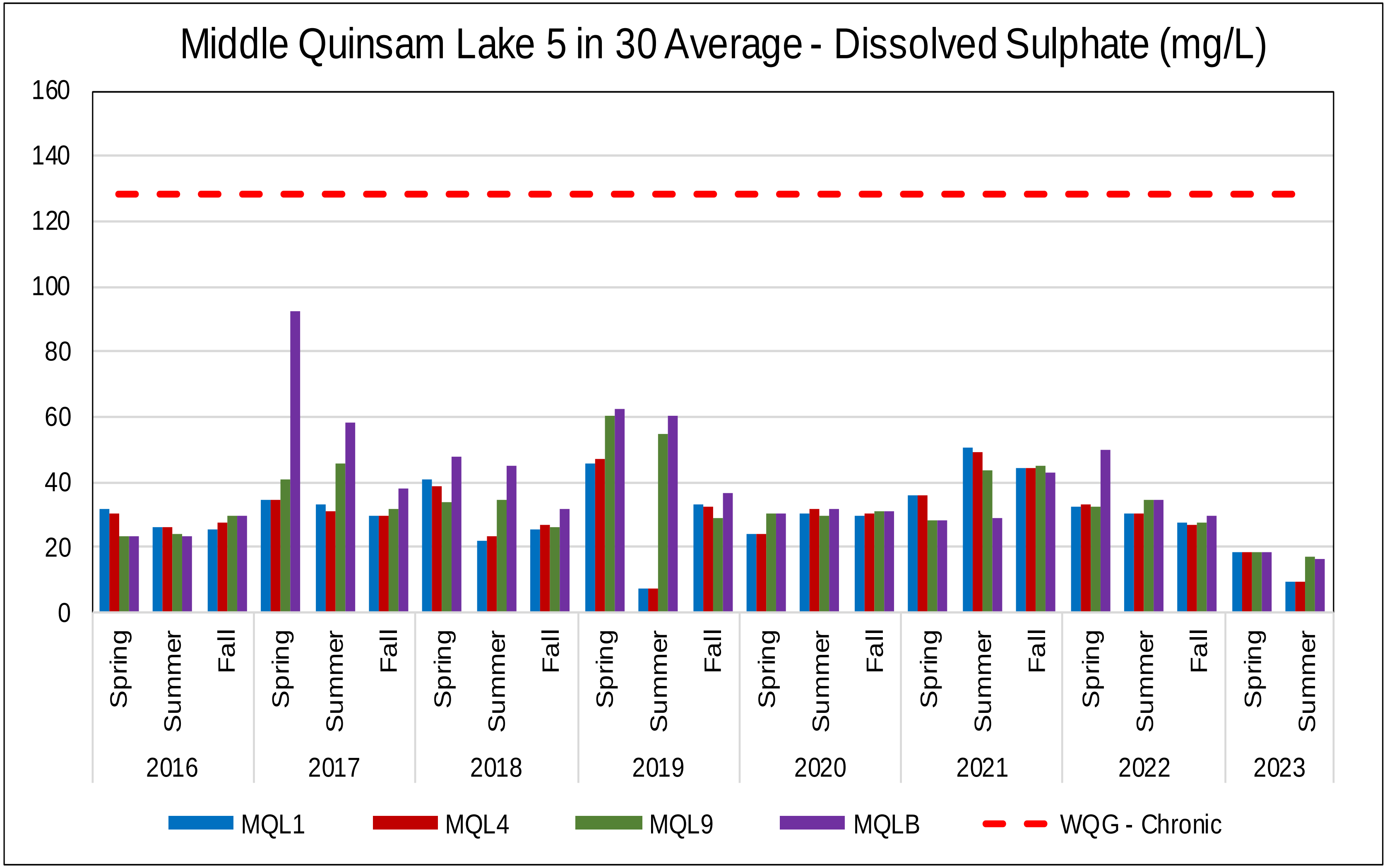

2022 Summer
Cu-D versus Chronic Guideline (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
NNO
LLO
WA
WB
QRDS1
7SQR
IRQR
IR6
IR8
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
Cu-D (mg/L)
Chronic WQG (mg/L)



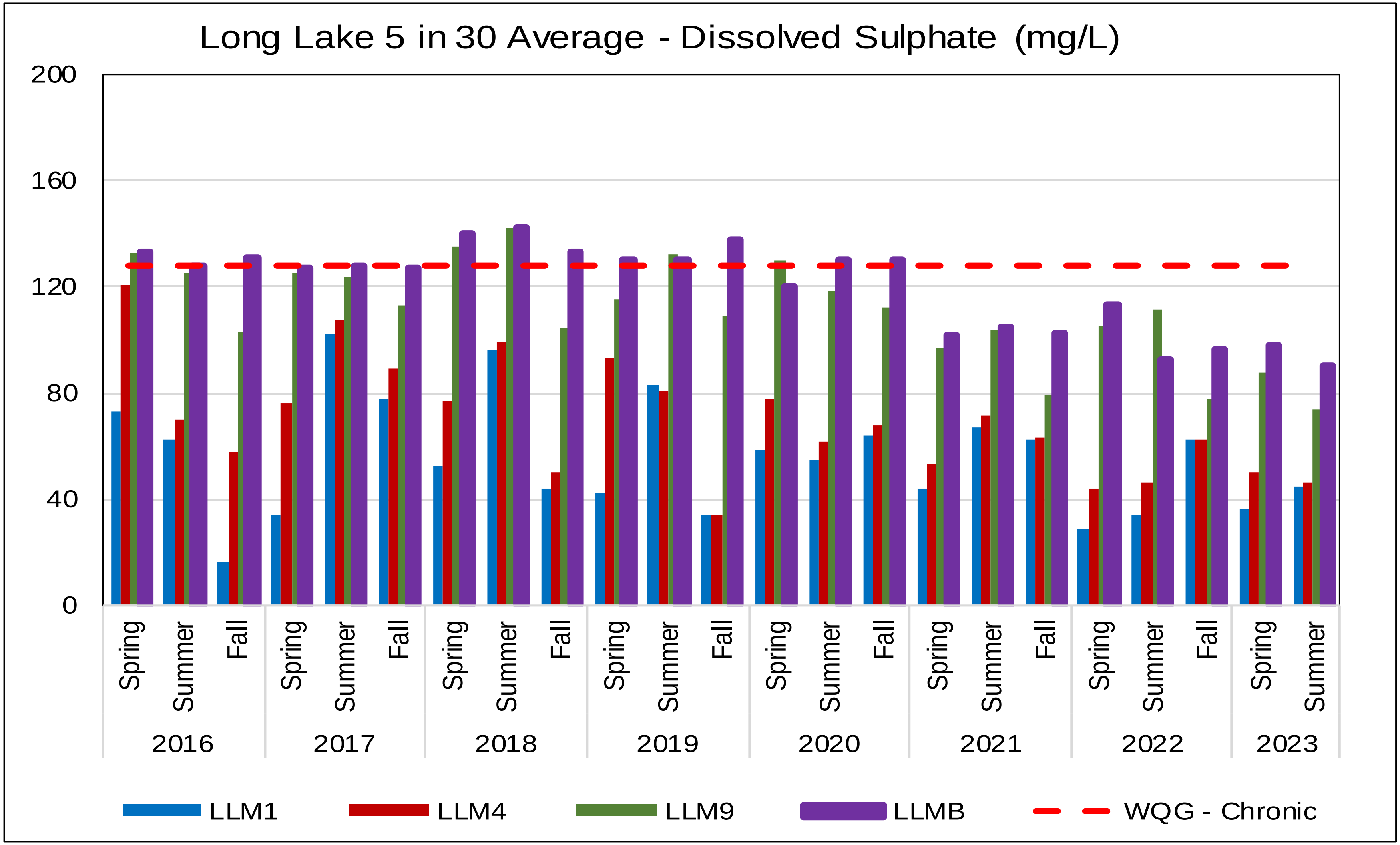
Fall 2022
Cu-D versus Acute Guideline (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
LLEZ2
WA
WB
LLO
NNO
QRDS1
7SQR
IRQR
IR6
IR8
Cu-D (mg/L)
Acute WQG (mg/L)



Fall 2022
Cu-D vs. Chronic Guideline (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
WA
NNO
LLO
WB
QRDS1
7SQR
IRQR
IR6
IR8
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
Cu-D (mg/L)
Chronic WQG (mg/L)

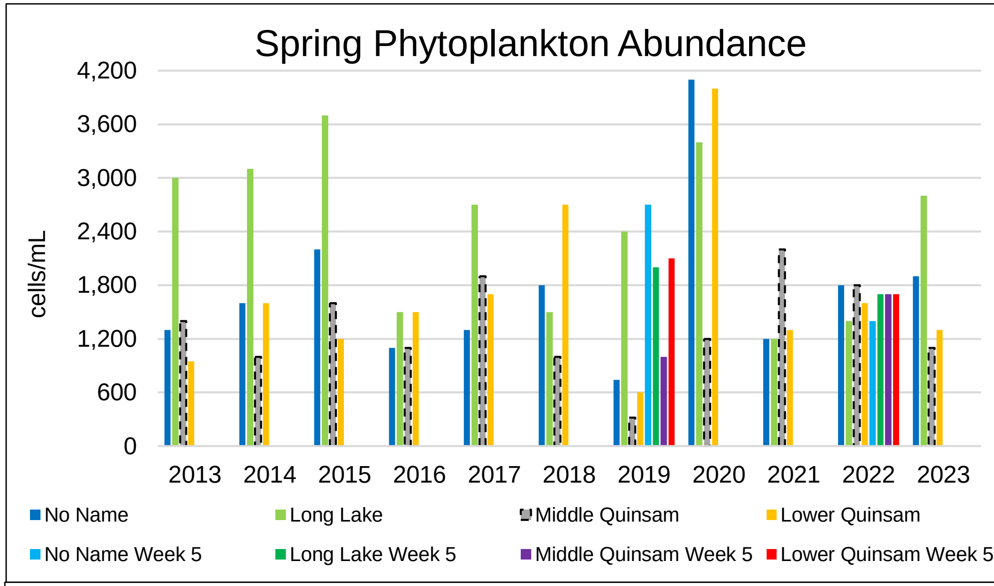


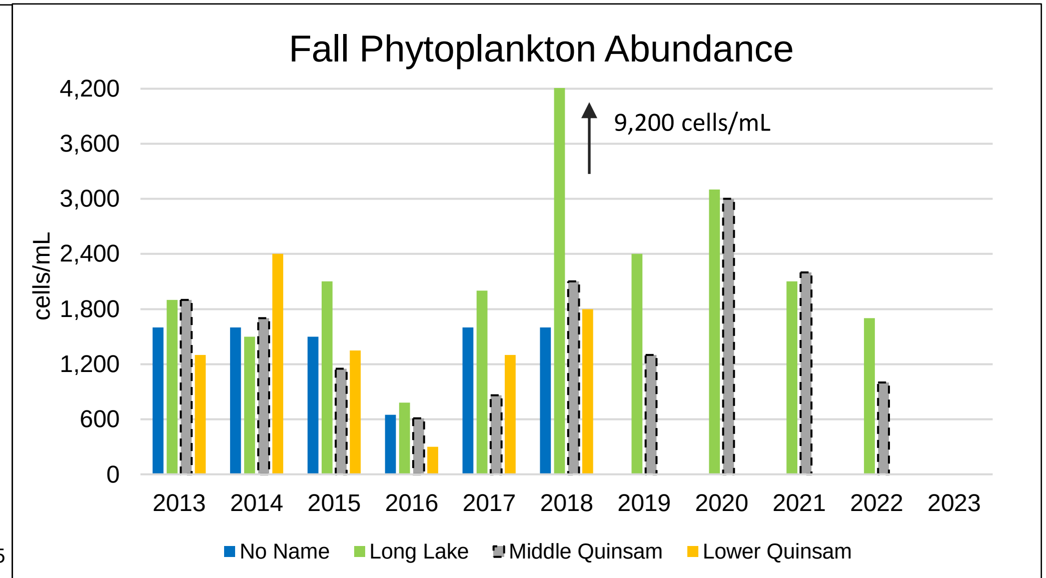
WQG - Chronic (128 mg/L) calculated from background hardness 30 mg/L

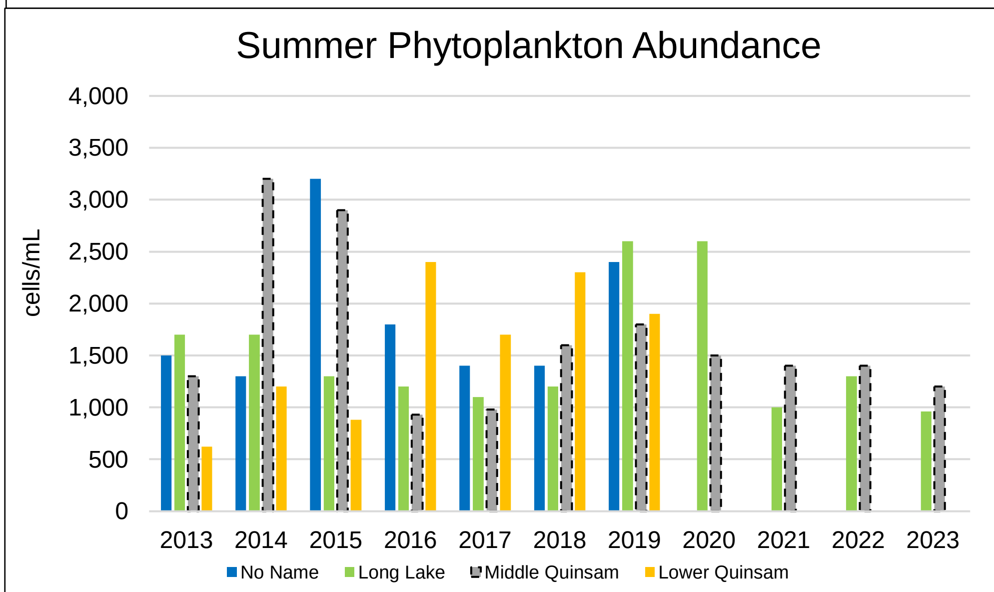


WQG - Chronic (128 mg/L) calculated from background hardness 30 mg/L

Biota Monitoring in Lakes - An understanding of the phytoplankton population and its distribution enables conclusions to be drawn about a water body's health, composition, and ecological status.







Phytoplankton includes algae and cyanobacteria, both of which contain at least one form of chlorophyll (chlorophyll a), the major photosynthetic pigment. Sensitive to changes in water quality (Wetzel 2001). Many lakes have a spring and fall phytoplankton bloom (peak growth period) following the seasonal "overturns" or mixing of the water column, redistributing nutrients.

Historical Chlorophyll “a” concentrations reported for these lakes reflected oligotrophic conditions (mean of 1.7 µg/L, maximum of 4.5 µg/L). Oligotrophic is defined as relatively low in plant nutrients and abundant oxygen in the deeper parts.

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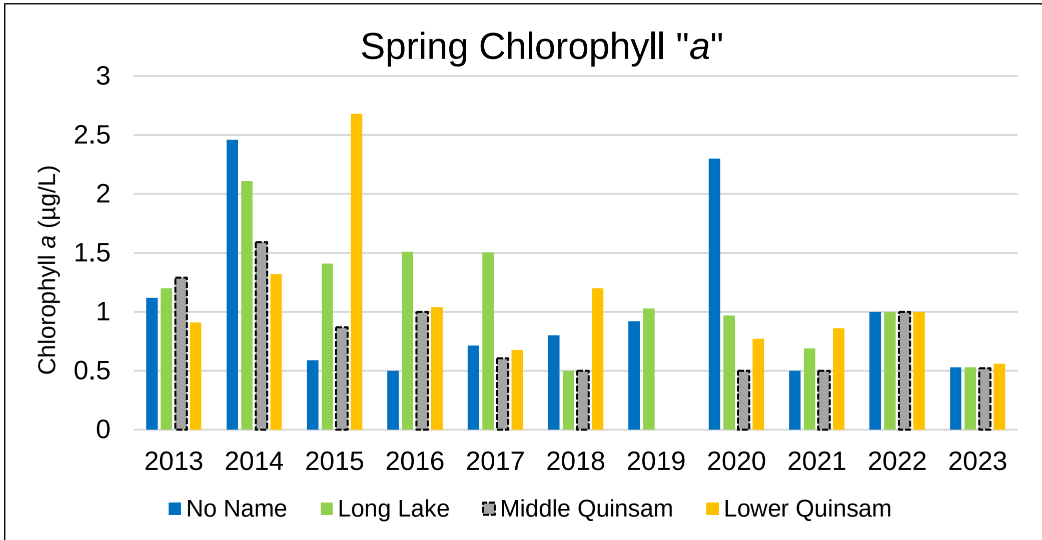

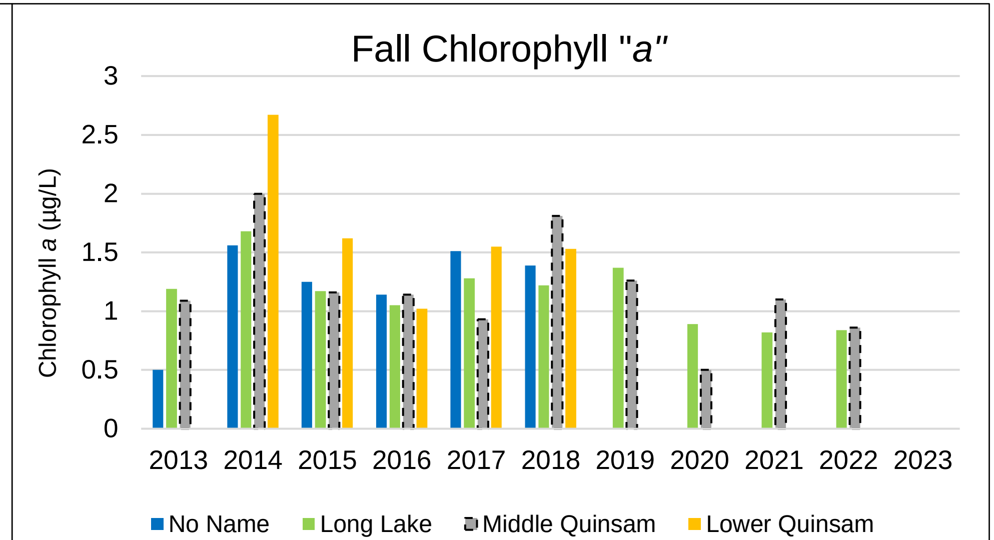

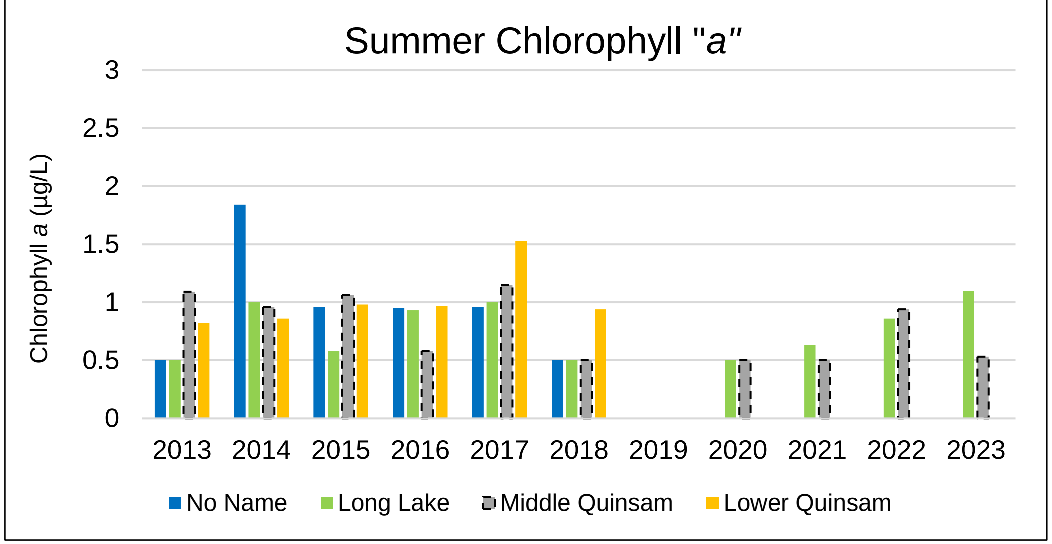

Chlorophyll ”*a*” - absorbs sunlight and converts it to sugar during photosynthesis. In lakes and rivers, it is produced by microscopic plants called algae.

Concentrations are an indicator of phytoplankton abundance and biomass in coastal and estuarine waters.

Measuring the chlorophyll concentration in water is important to estimate the abundance of phytoplankton. If a high level of chlorophyll is detected, it is an indication that a high level of phytoplankton is present in the water.

Abundance is the relative representation of a species in a particular ecosystem. It is usually measured as the number of individuals found per sample.

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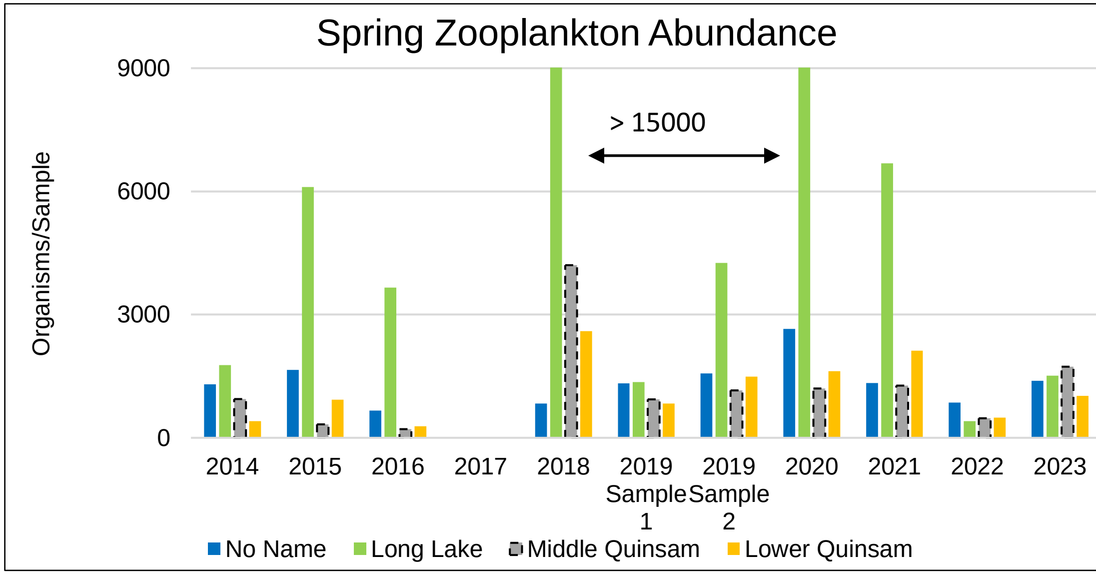
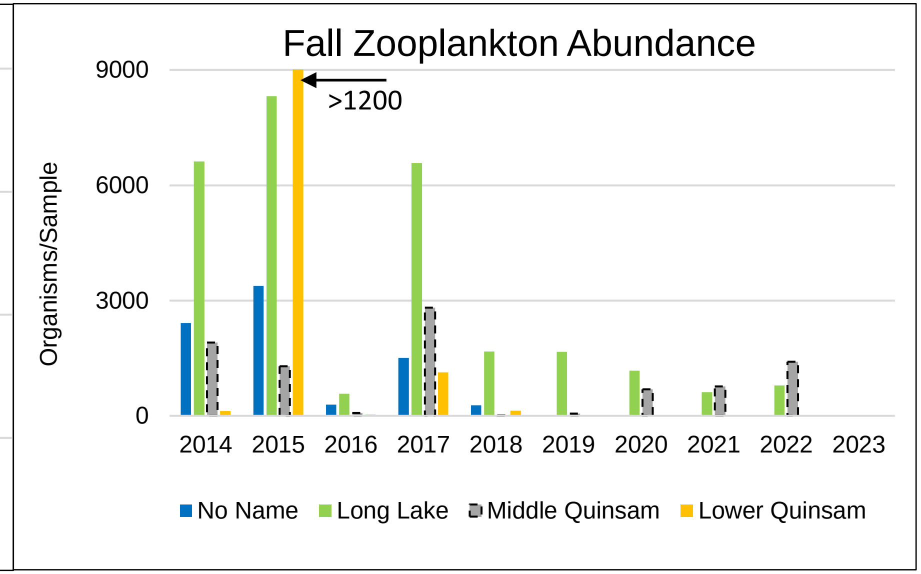
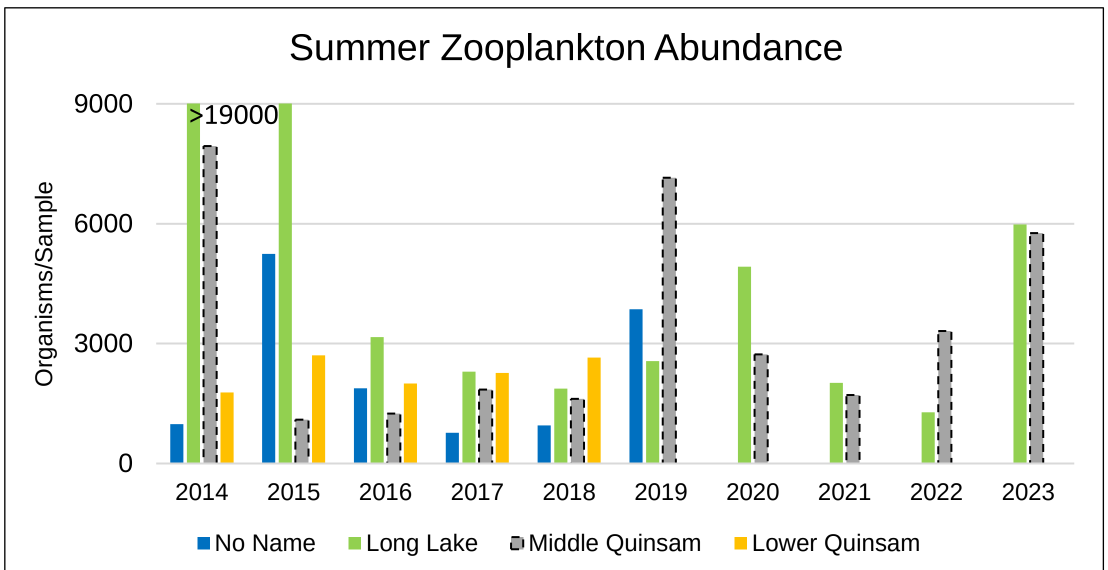
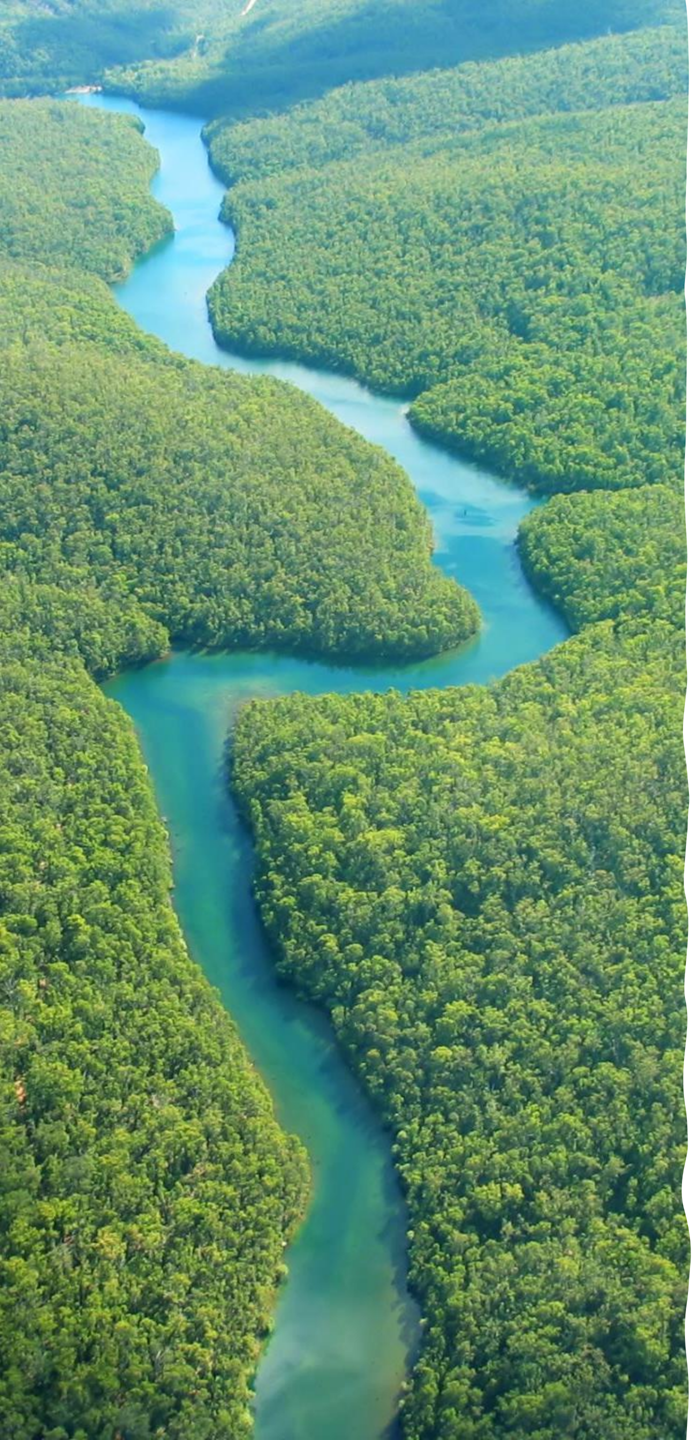






Zooplankton form the second trophic level in the water column of lakes (secondary producers), grazing on phytoplankton, consuming organic matter, and providing a food source for juvenile fish (Wetzel 2001). Abundance and composition of the zooplankton community vary among lakes due to variation in water chemistry, lake characteristics, and grazing pressures from fish (Wetzel 2001).



Conclusion

No Name, Long, Middle Quinsam, and Lower Quinsam lakes support phytoplankton communities typical of oligotrophic conditions and distinct zooplankton communities in each lake that provide typical prey for fish.

There were no indications of adverse effects of mine discharges on the plankton communities (density, taxonomic richness and composition) in the spring, summer and fall samples for lakes.

Water Quality Modeling Project

Water Balance, Water Quality Prediction and Geochemical Source Term Update for the Post-Closure Mine

QUINSAM COAL

- Phase I - Completed in 2022- Gap analysis that identified components of the water balance requiring updated flow and source term information
- Phase II - Integration of the updated flow and source terms into a Goldsim model and preparation of a water quality prediction report
- Total project timeline is planned over 12 months
- Commencement was September 2023
- Presentation of interim results December 2023
- Delivery of the final report in Q3 (July - September) 2024
- Full year of data required from underground pumping and surface flow records.
- Flow meters and totalizers were installed in June 2023.

Questions?