

# **The Impact of Surface Coal Mining on Water Quality in the Northern Great Plains**

*by*

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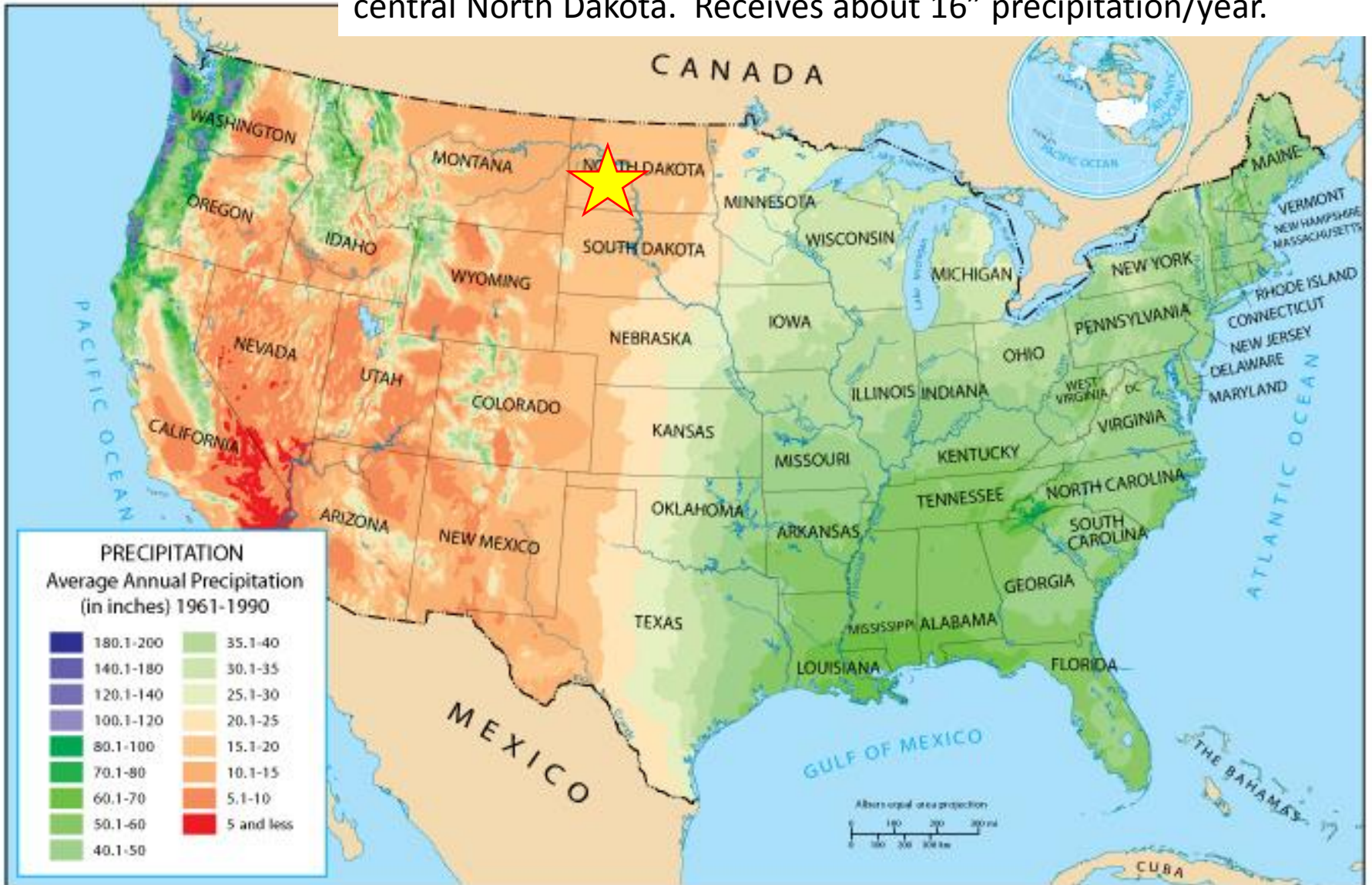
**The North American Coal Corporation**

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The Coteau Properties Company Freedom Mine is located in west-central North Dakota. Receives about 16" precipitation/year.



- Mine-mouth operation producing 14-16 mmtpy lignite coal
- The largest lignite mine in the US, and about the 10<sup>th</sup> largest coal mine overall in the country
- Typical surface coal mining operation, utilizing three 124 yd<sup>3</sup> draglines and a truck/shovel fleet to move 100 mm yds<sup>3</sup>+ /year
- Disturbs and contemporaneously reclaims 500-700 acres/year
- Since production began in 1983 more than 18,000 acres reclaimed
- Water is managed through sediment ponds designed to hold the 10 year/24 hour storm event prior to discharge
- Reclamation to premine conditions: native grassland, haylands and croplands, stockponds and wetlands constructed on reclaimed land



The Freedom Mine supplies fuel for Basin Electric Power Cooperative's Antelope Valley Station & Leland Olds Station, and feedstock for the Great Plains Coal Gasification Plant.





The entire mine permit area is about 50,000 acres. Stormwater runoff from active mining areas and disturbed lands is routed to sediment ponds, where it settles out prior to discharge from the mine.



Sediment ponds on the mine range in size from very small to very large.













# The Freedom Mine Surface Water Monitoring Program

- Median values were compared for water quality constituents of concern:
    - pH
    - Total Suspended Solids
    - Total Iron
    - Total Dissolved Solids
- Effluent limits in NPDES discharge permit*



# The Freedom Mine Surface Water Monitoring Program

## *Streams*



# The Freedom Mine Surface Water Monitoring Program

## *Streams*

- Records of 1,700 discharges from 105 sediment ponds over 11 years
  - Sediment ponds in active areas
  - Sediment ponds in reclaimed areas
- Monitored 16 downstream sites over 23 years
  - Baseline – no disturbance upstream
  - With active mining upstream
  - With reclaimed lands upstream

Premining  
no activity



Active mining



Postmining  
reclaimed land



**OFFSITE DOWNSTREAM MONITORING**

# The Freedom Mine Surface Water Monitoring Program

## *Stockponds*



A 24-year record comparing 86 baseline and undisturbed stockponds with 35 stockponds constructed on reclaimed land.



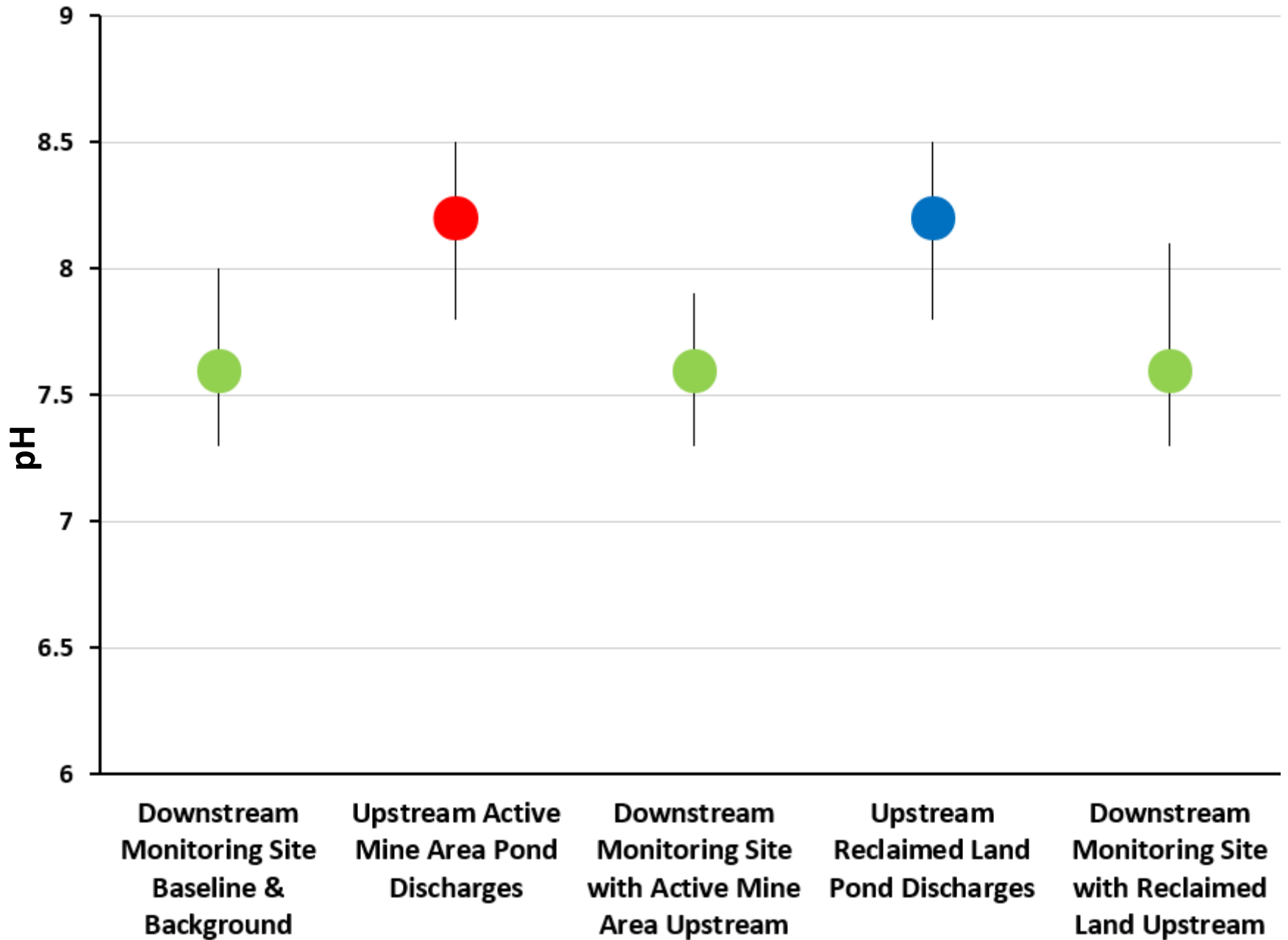
# The Freedom Mine Surface Water Monitoring Program

## *Wetlands*

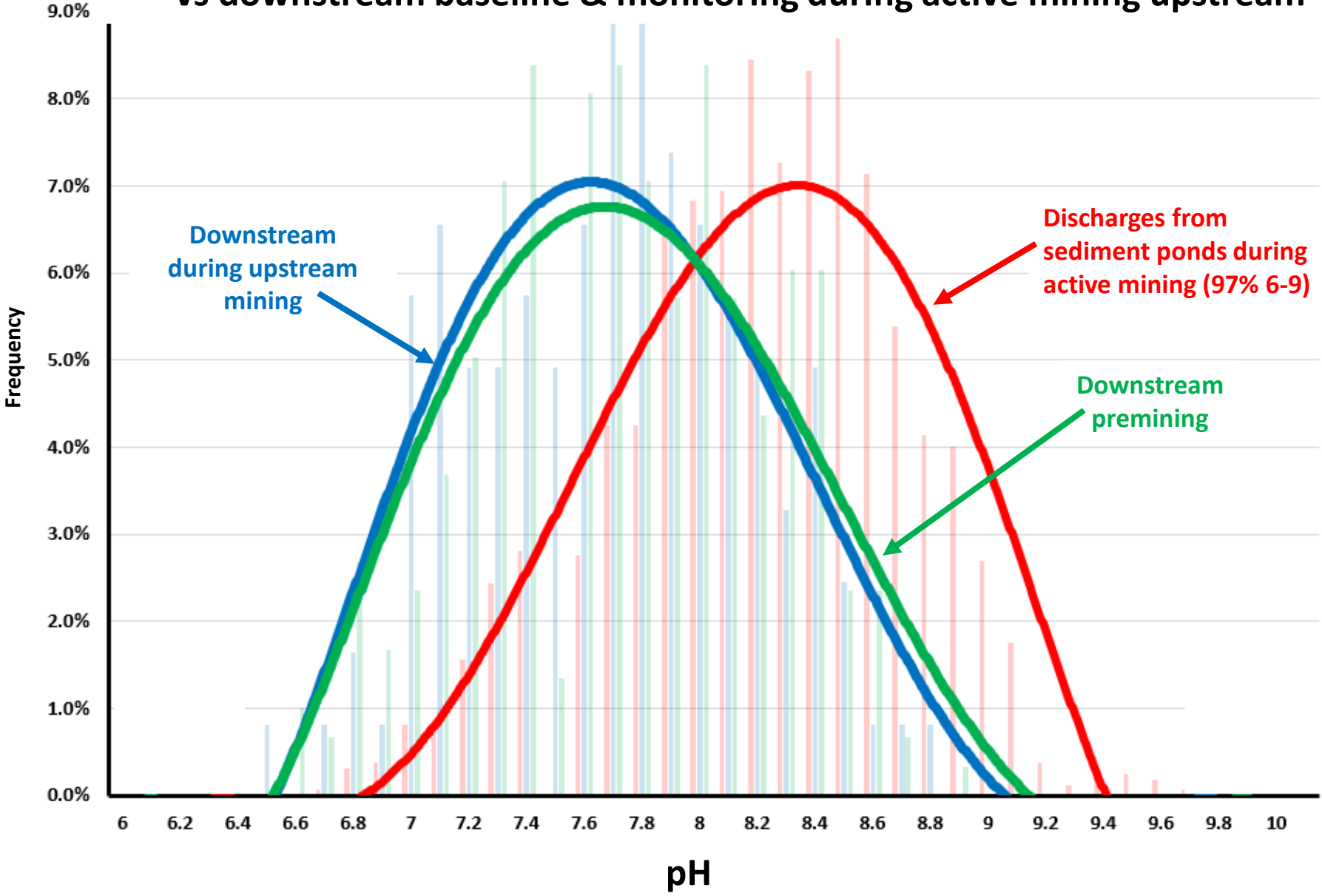


A 24-year record comparing 89 baseline and undisturbed wetlands with 29 wetlands constructed on reclaimed land.

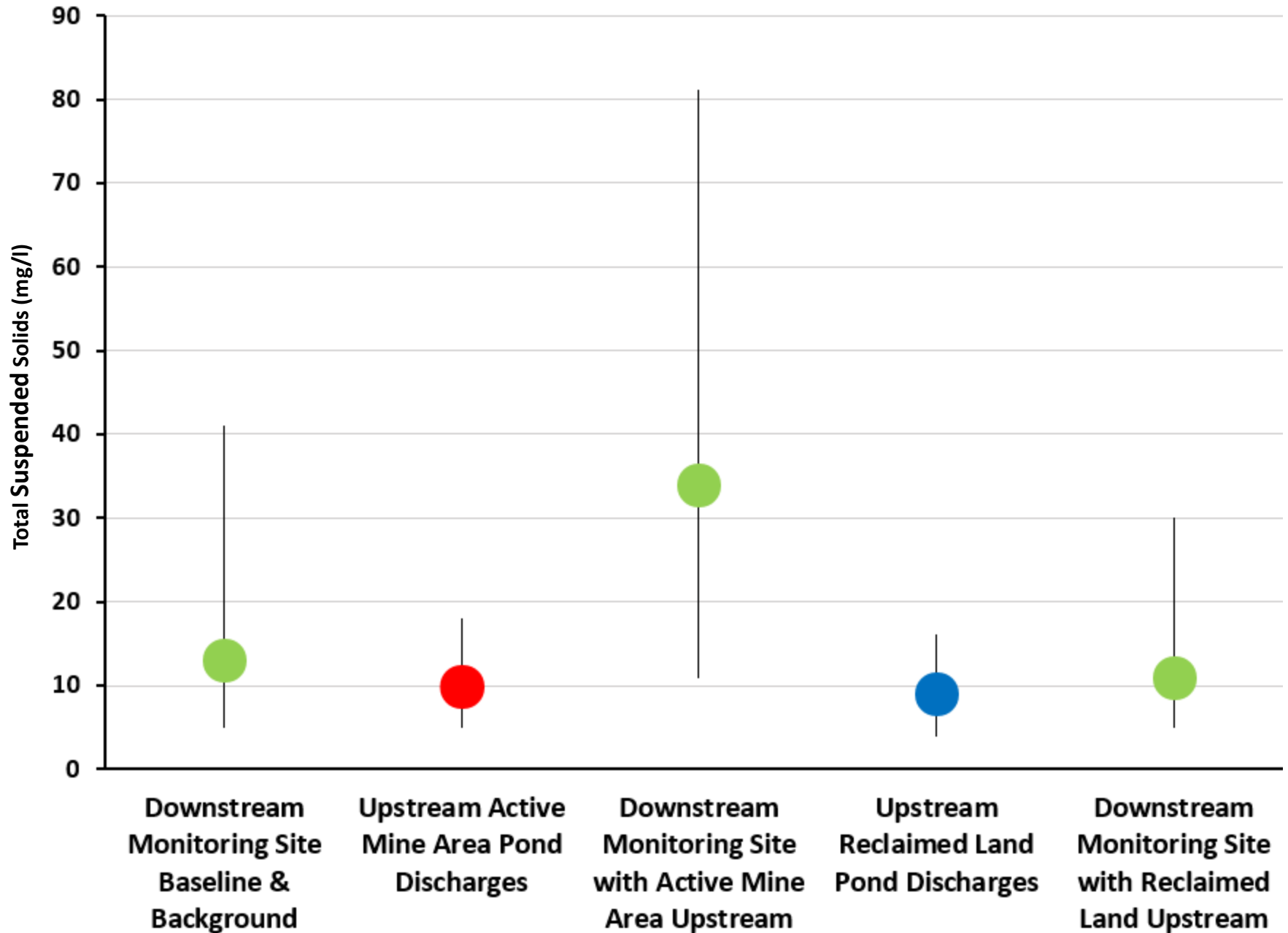
# Stream Impacts from Mining - pH



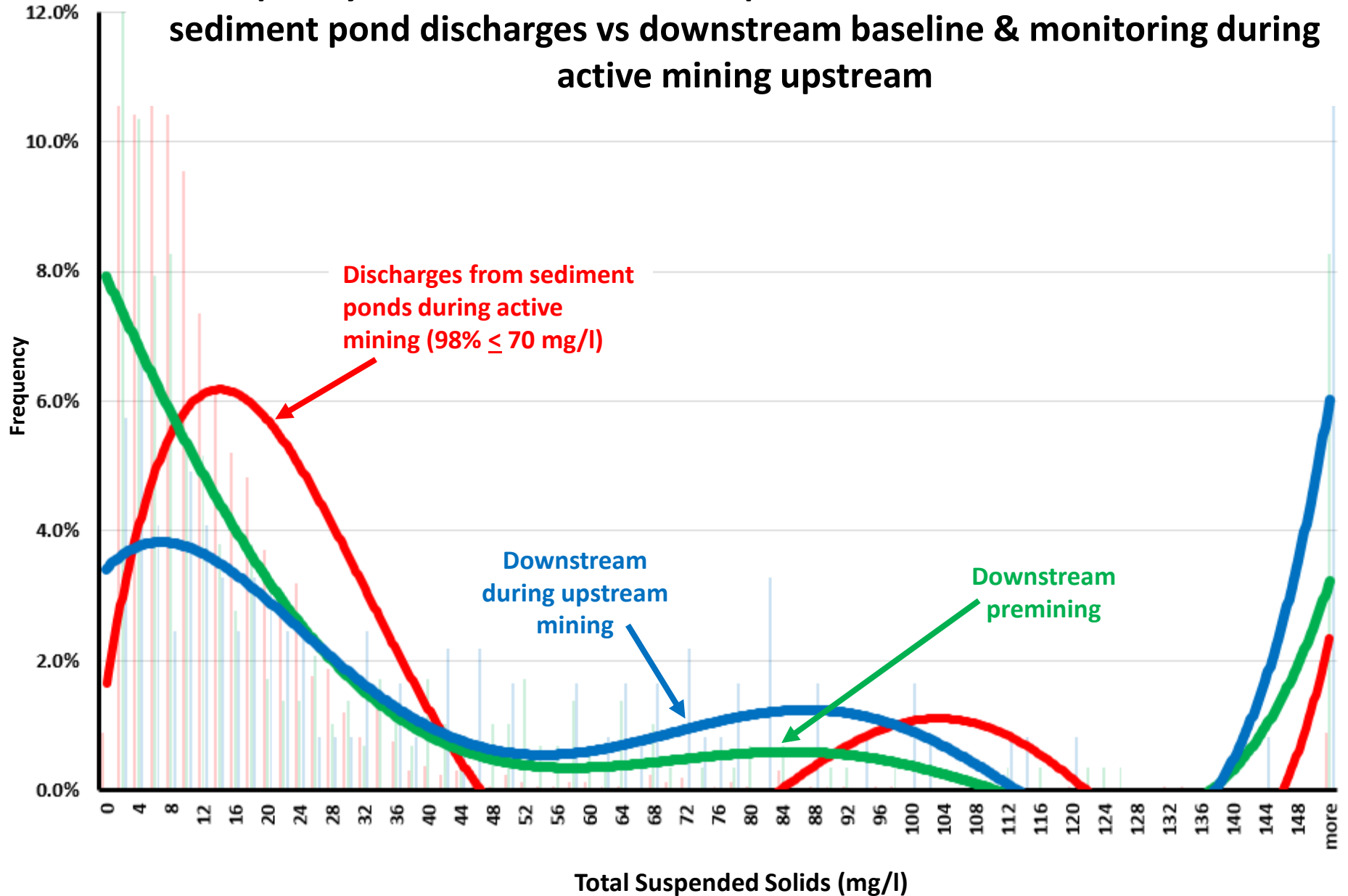
# Frequency distribution of pH for active mine area sediment pond discharges vs downstream baseline & monitoring during active mining upstream



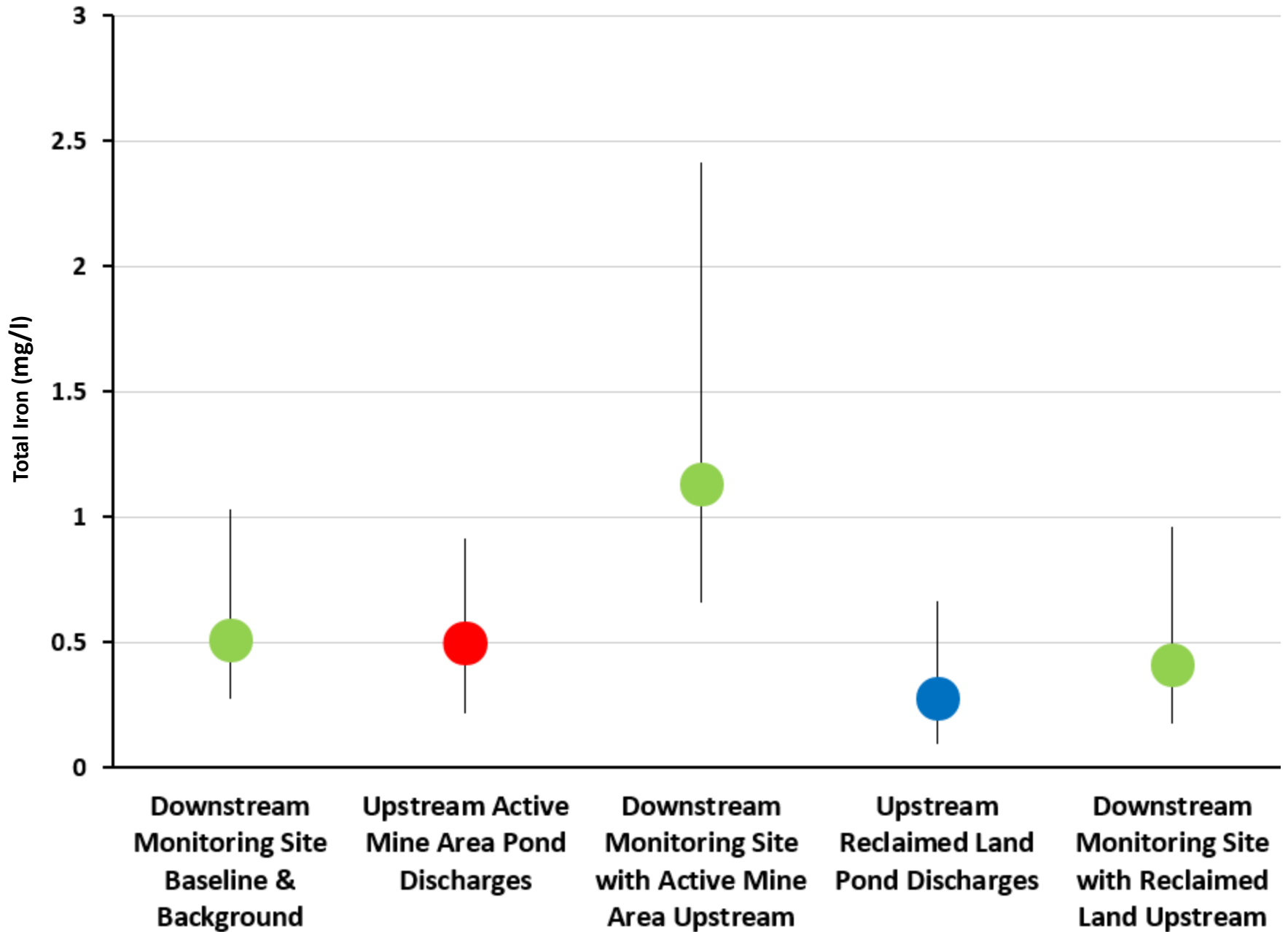
# Stream Impacts from Mining - Total Suspended Solids



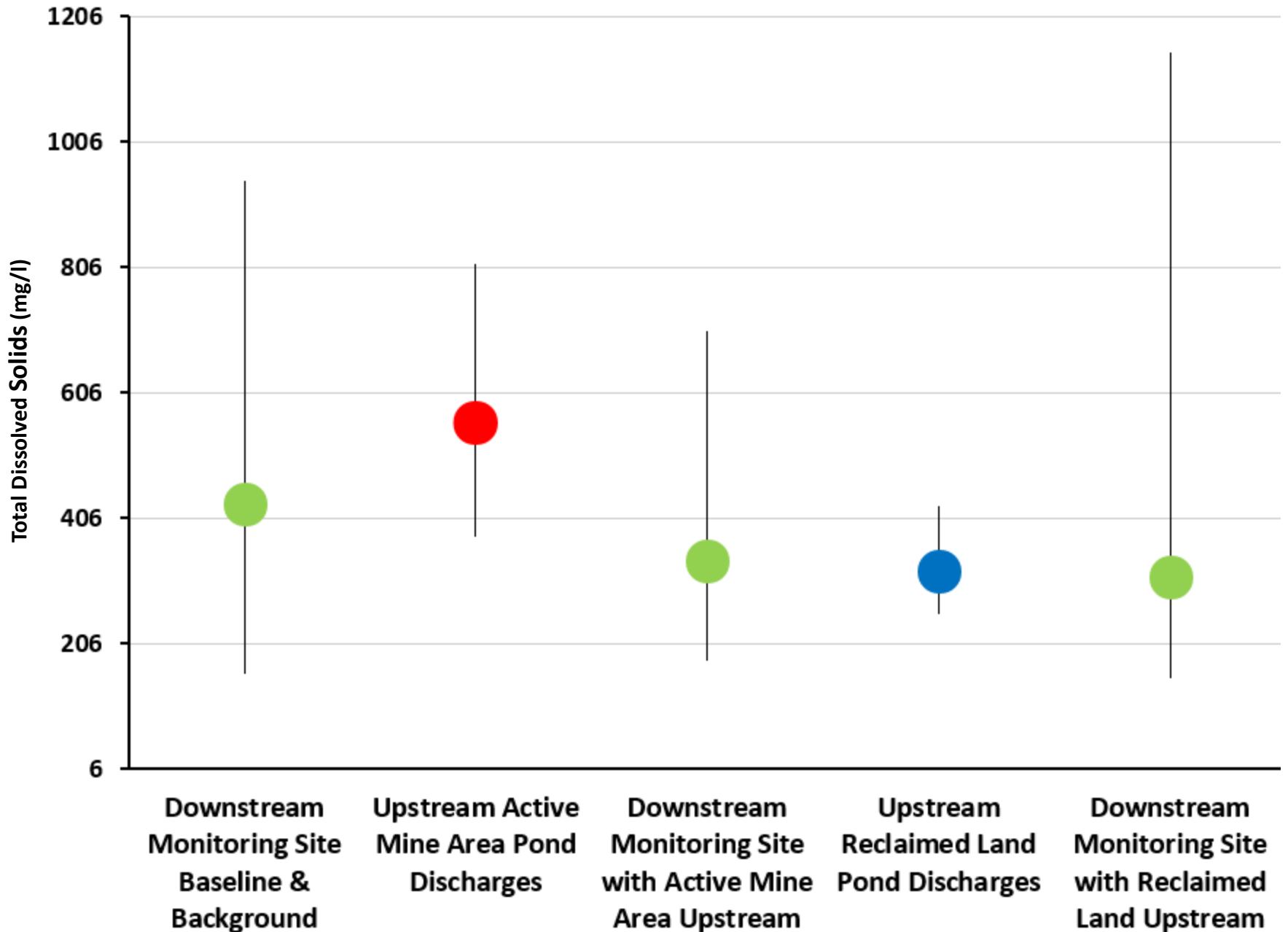
# Frequency distribution of total suspended solids for active mine area sediment pond discharges vs downstream baseline & monitoring during active mining upstream



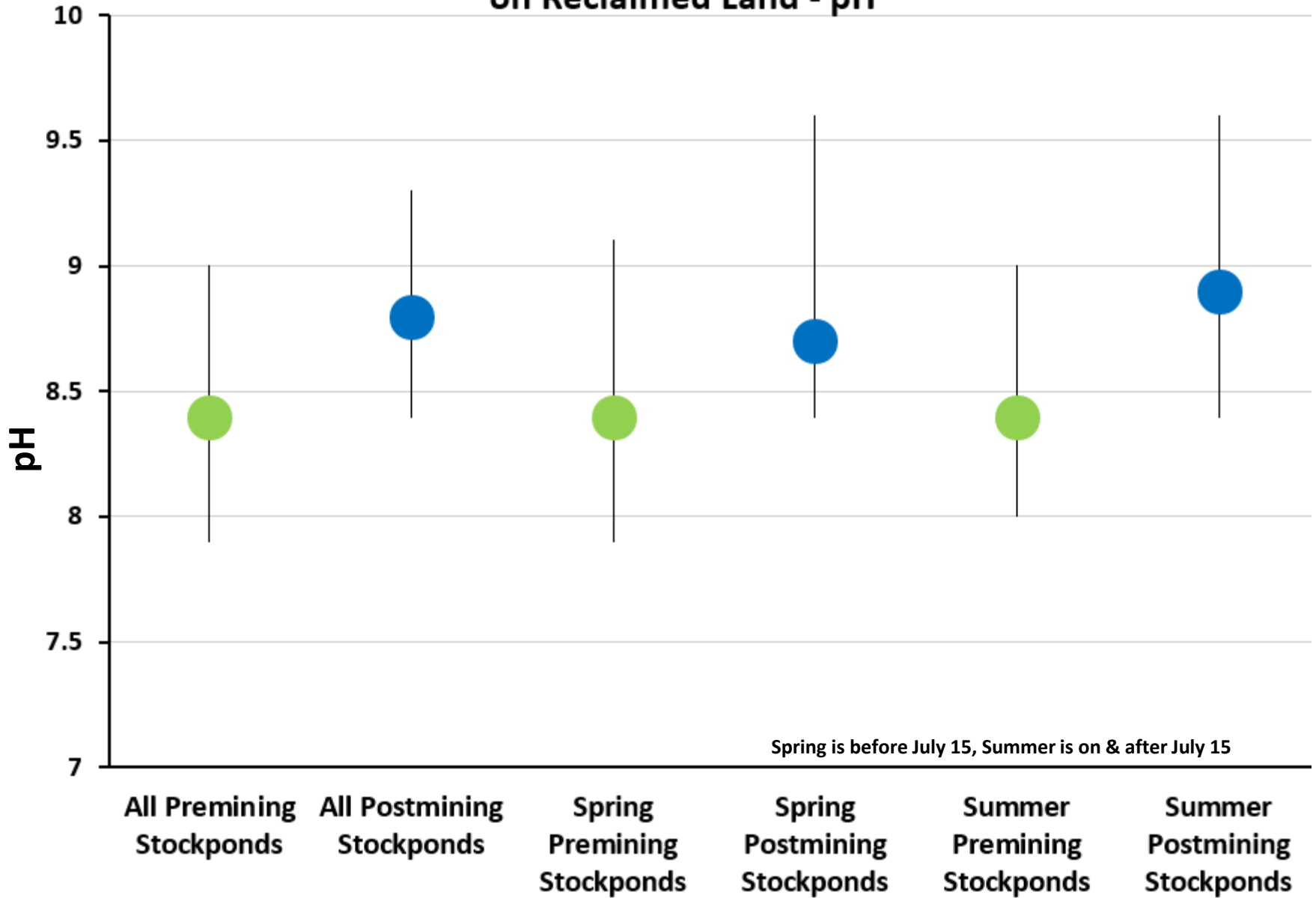
# Stream Impacts from Mining - Total Iron



# Stream Impacts from Mining - Total Dissolved Solids

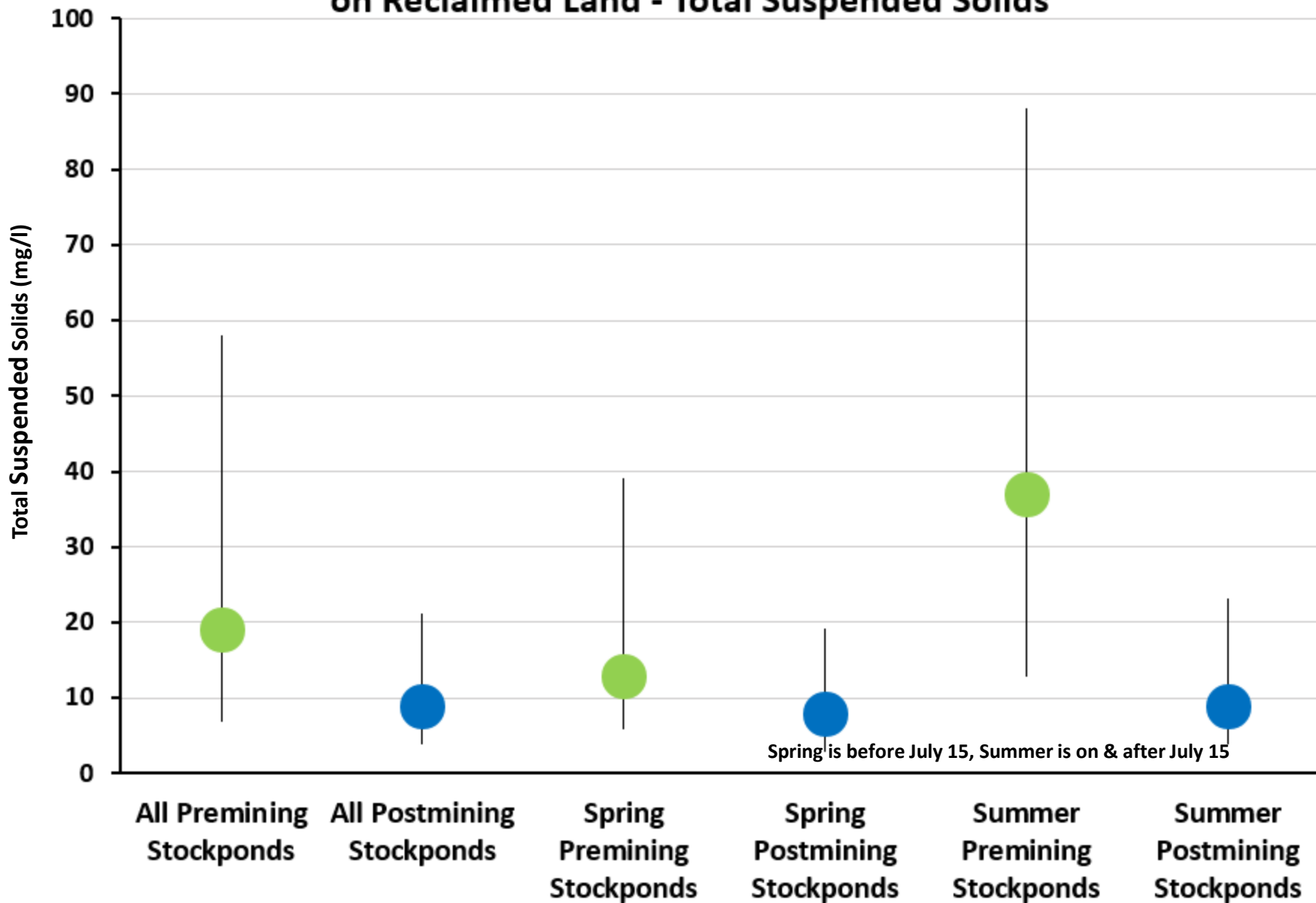


# Premining Stockponds & Postmining Stockponds Constructed on Reclaimed Land - pH

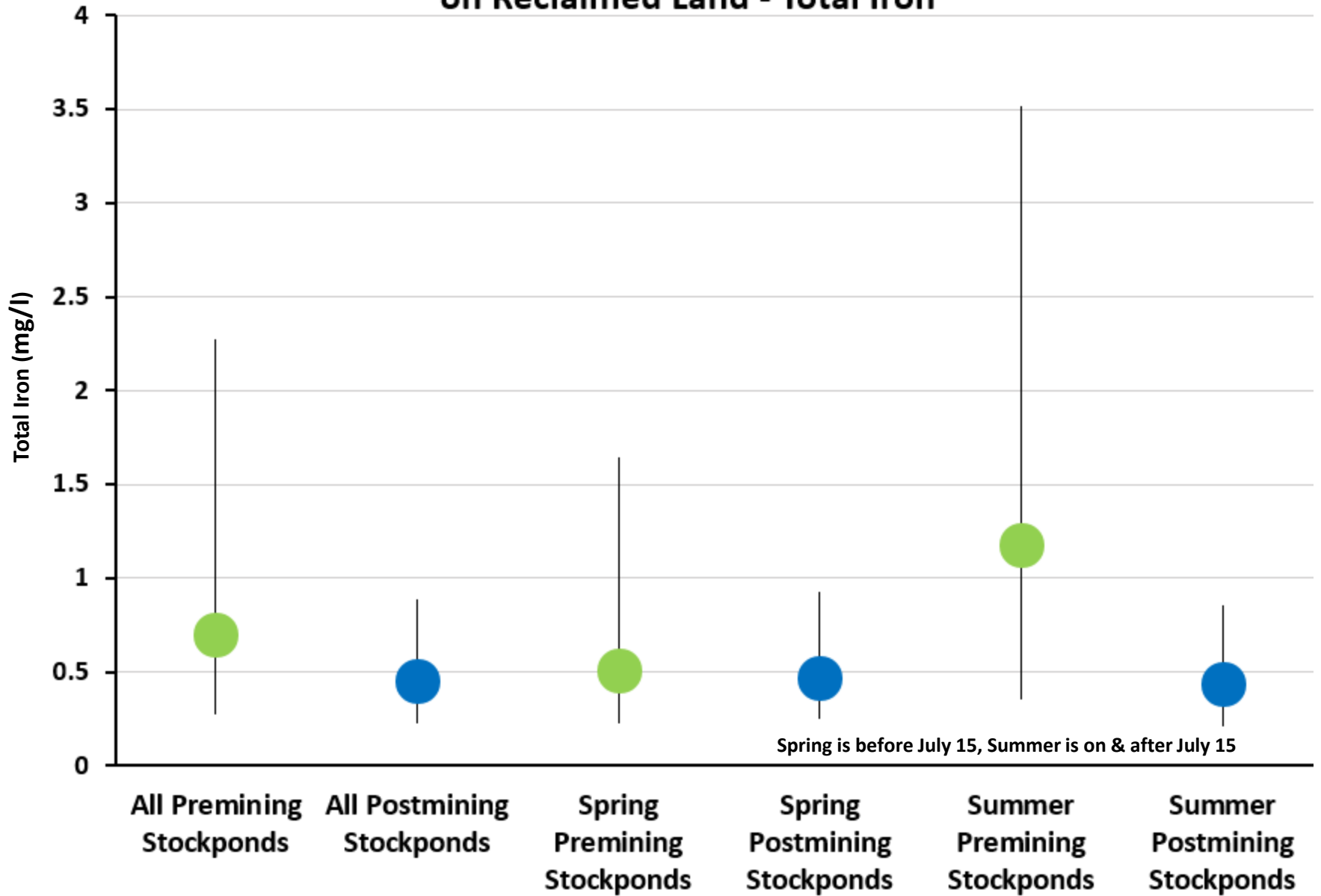




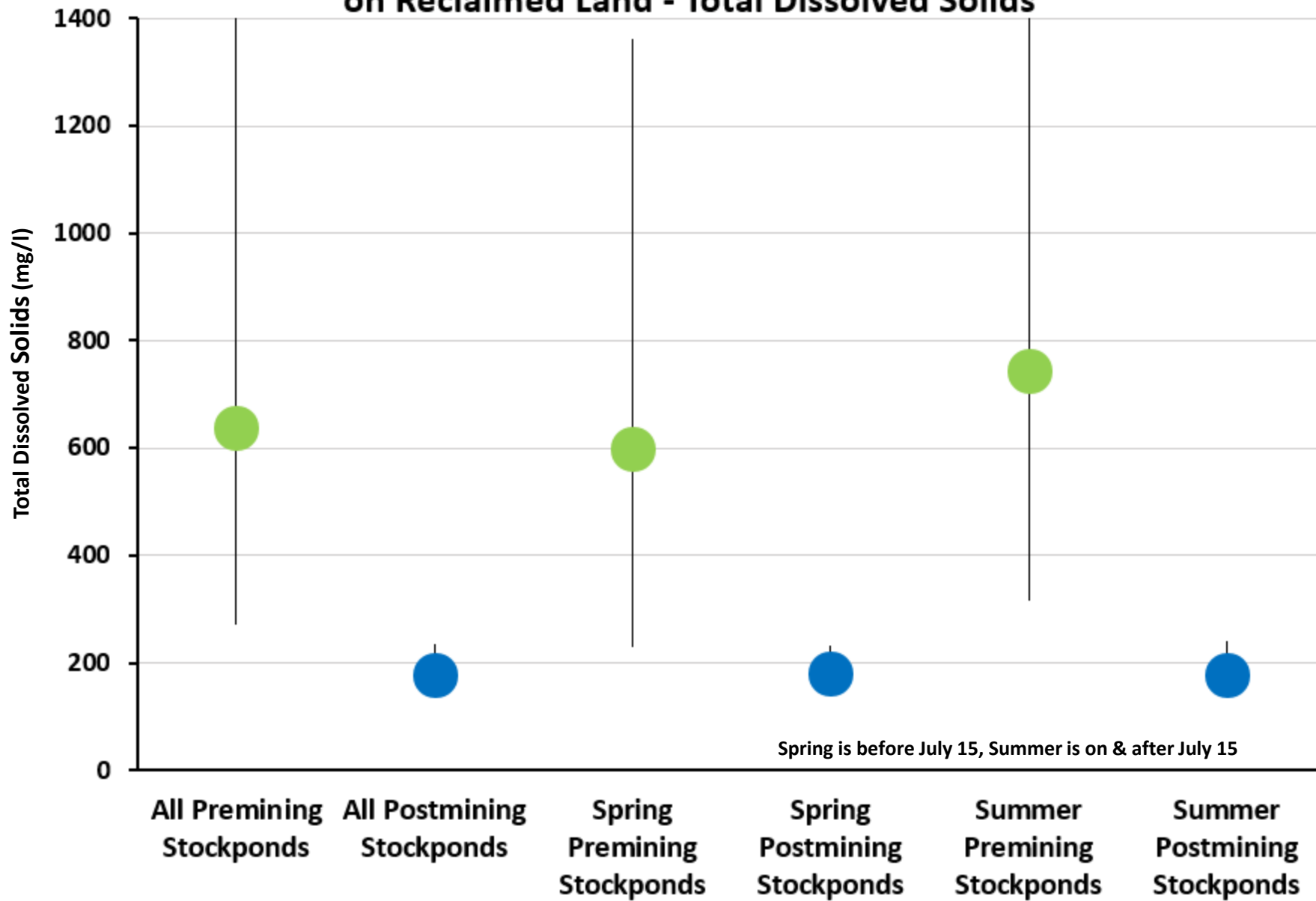
# Premining Stockponds & Postmining Stockponds Constructed on Reclaimed Land - Total Suspended Solids



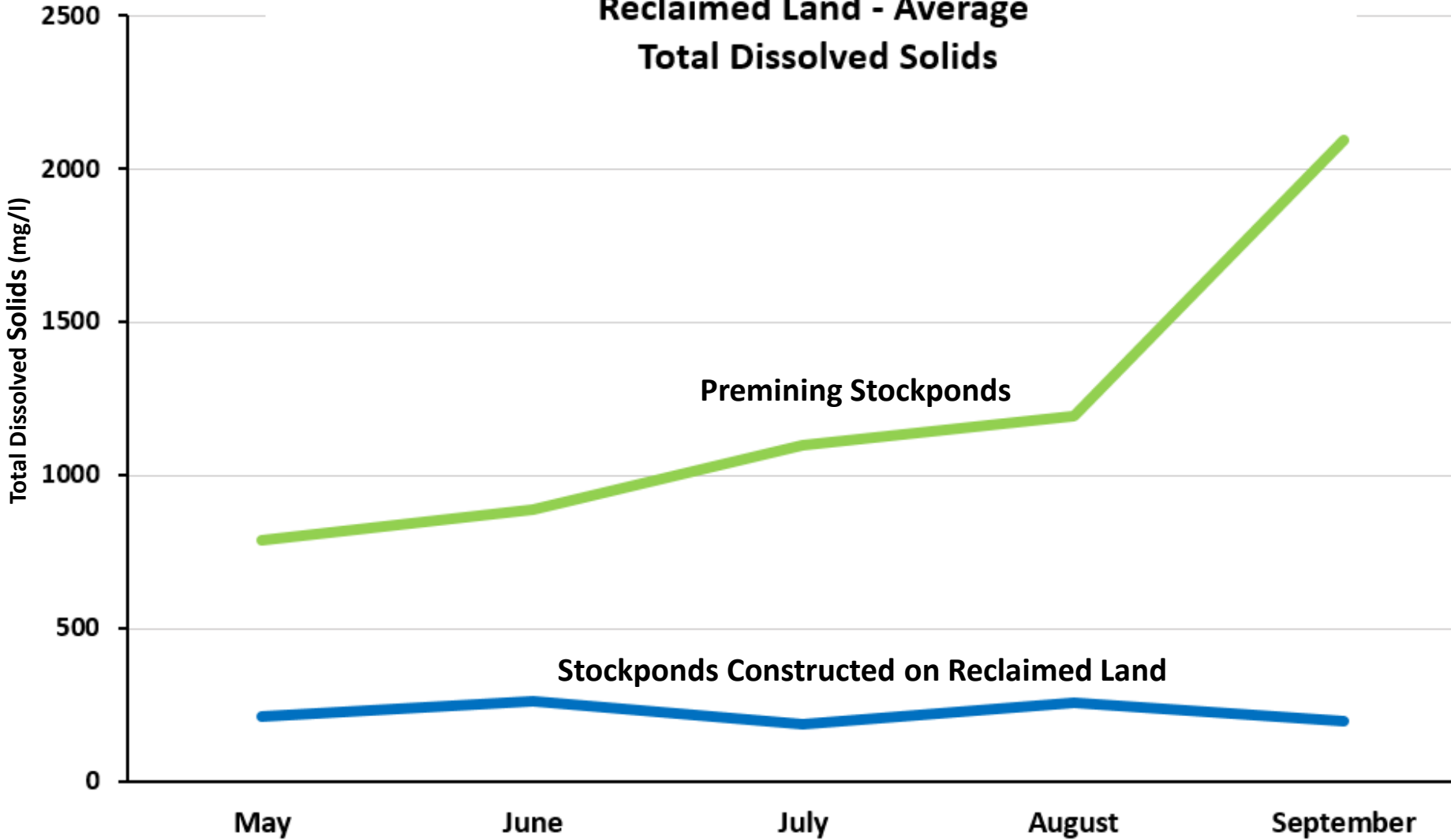
# Premining Stockponds & Postmining Stockponds Constructed on Reclaimed Land - Total Iron



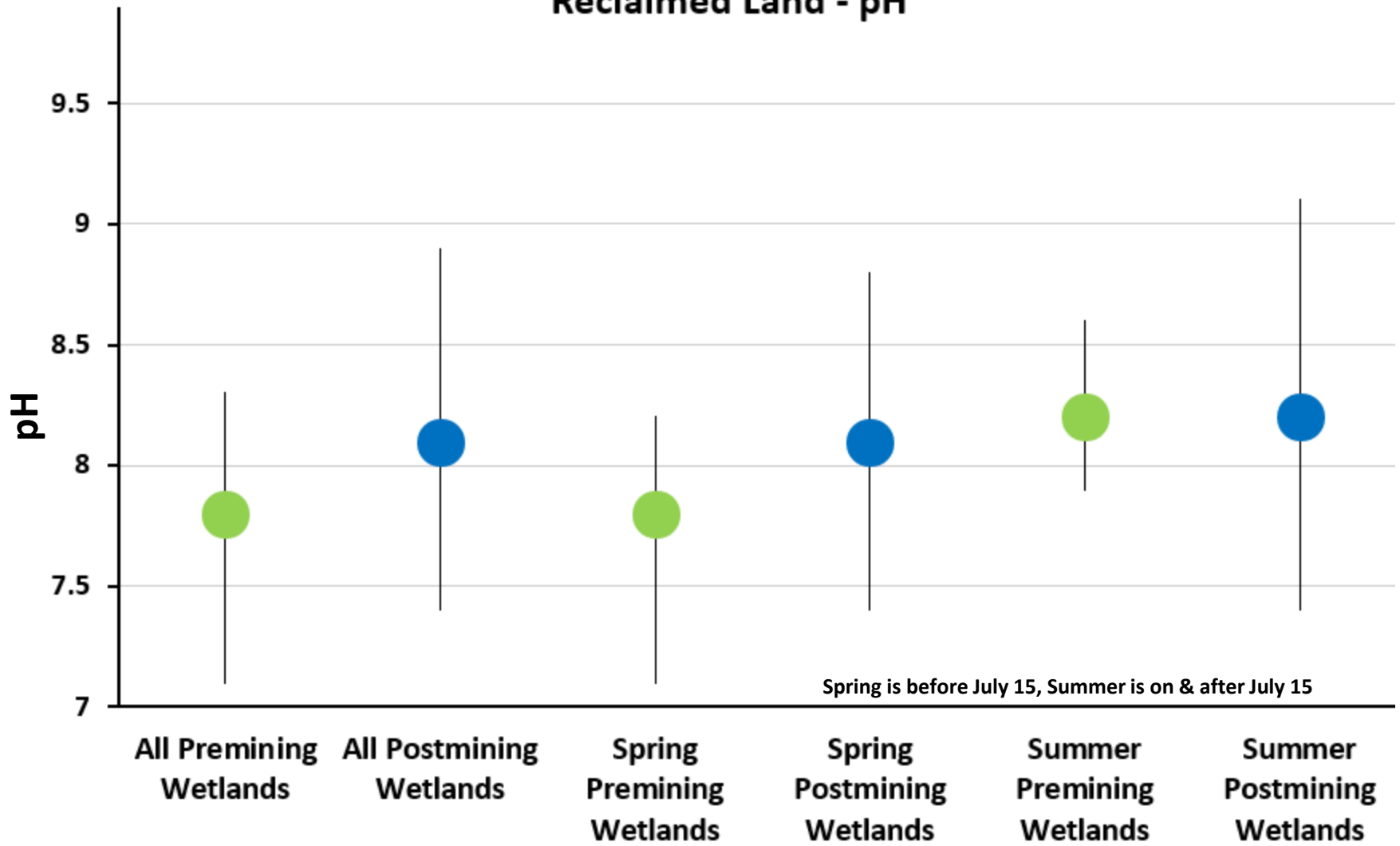
# Premining Stockponds & Postmining Stockponds Constructed on Reclaimed Land - Total Dissolved Solids



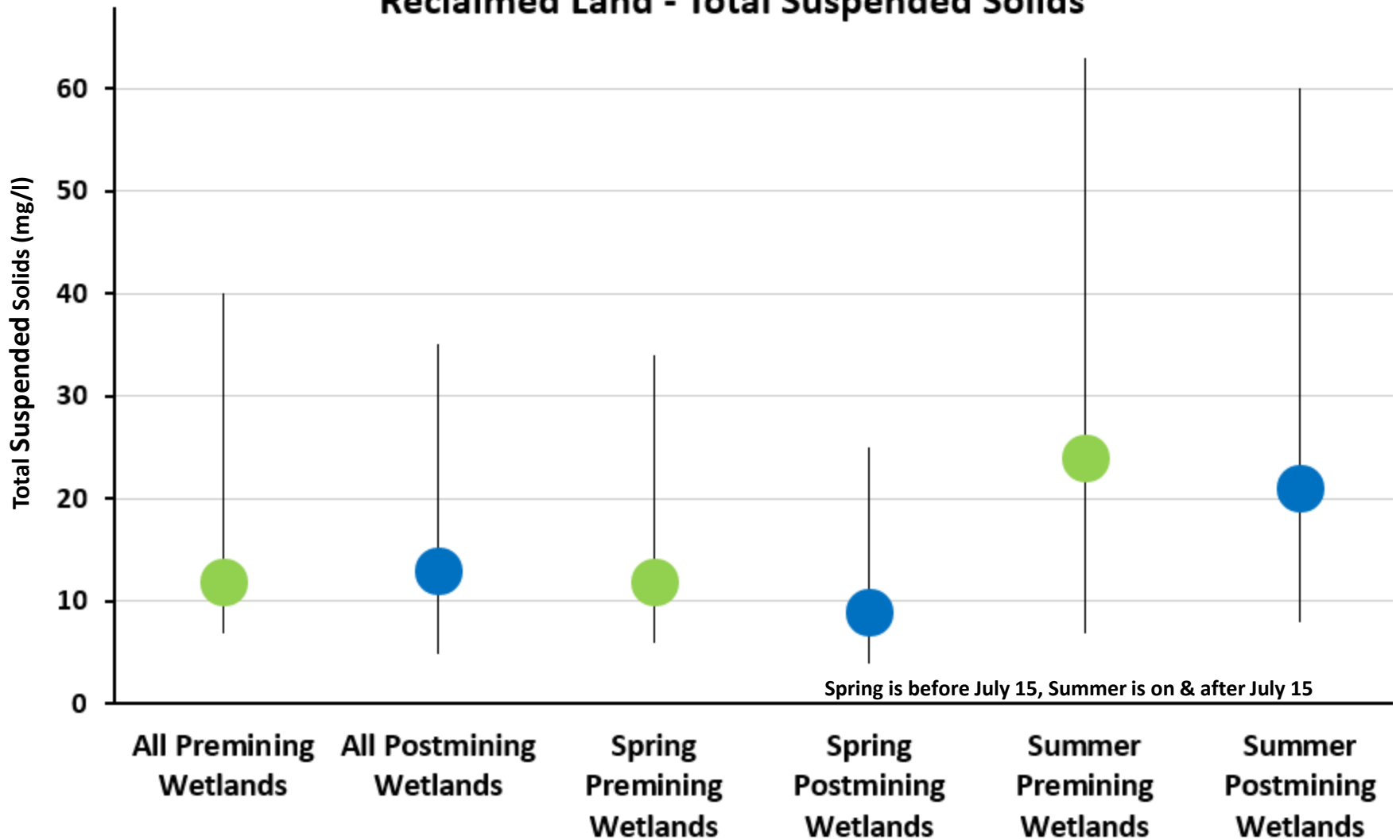
**Premining Stockponds & Postmining Stockponds Constructed on Reclaimed Land - Average Total Dissolved Solids**



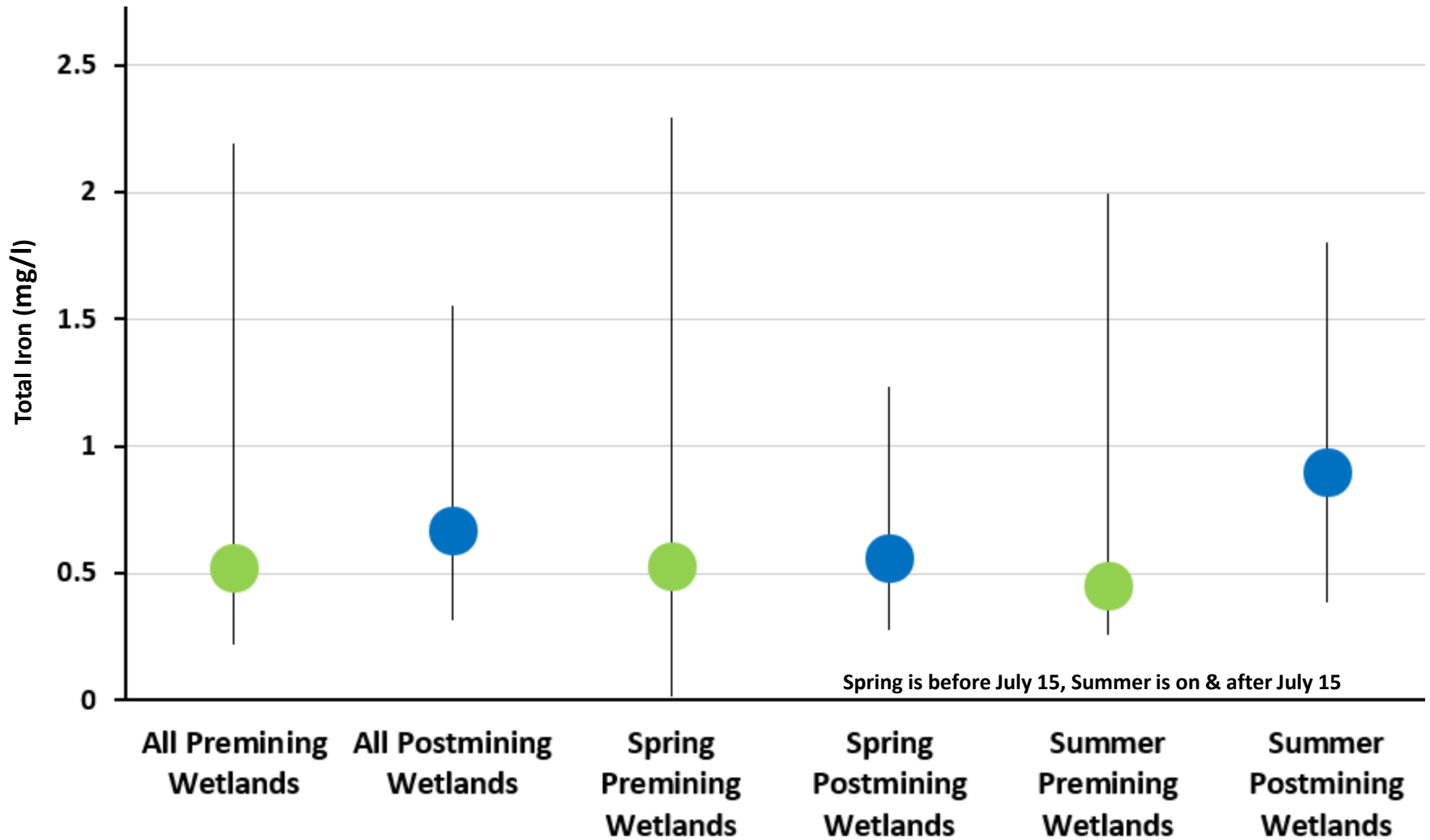
# Premining Wetlands & Postmining Wetlands Constructed on Reclaimed Land - pH



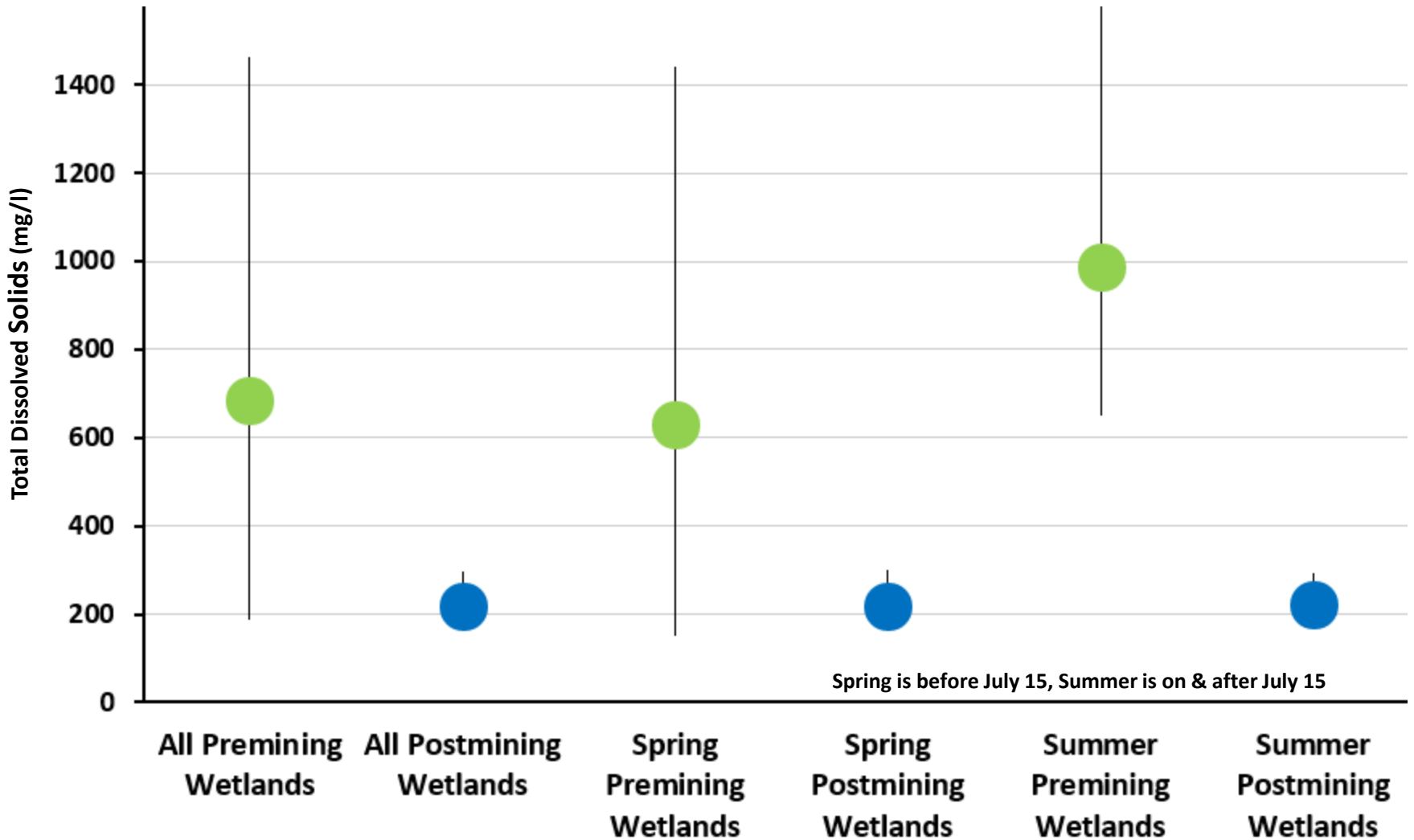
# Premining Wetlands & Postmining Wetlands Constructed on Reclaimed Land - Total Suspended Solids



# Premining Wetlands & Postmining Wetlands Constructed on Reclaimed Land – Total Iron

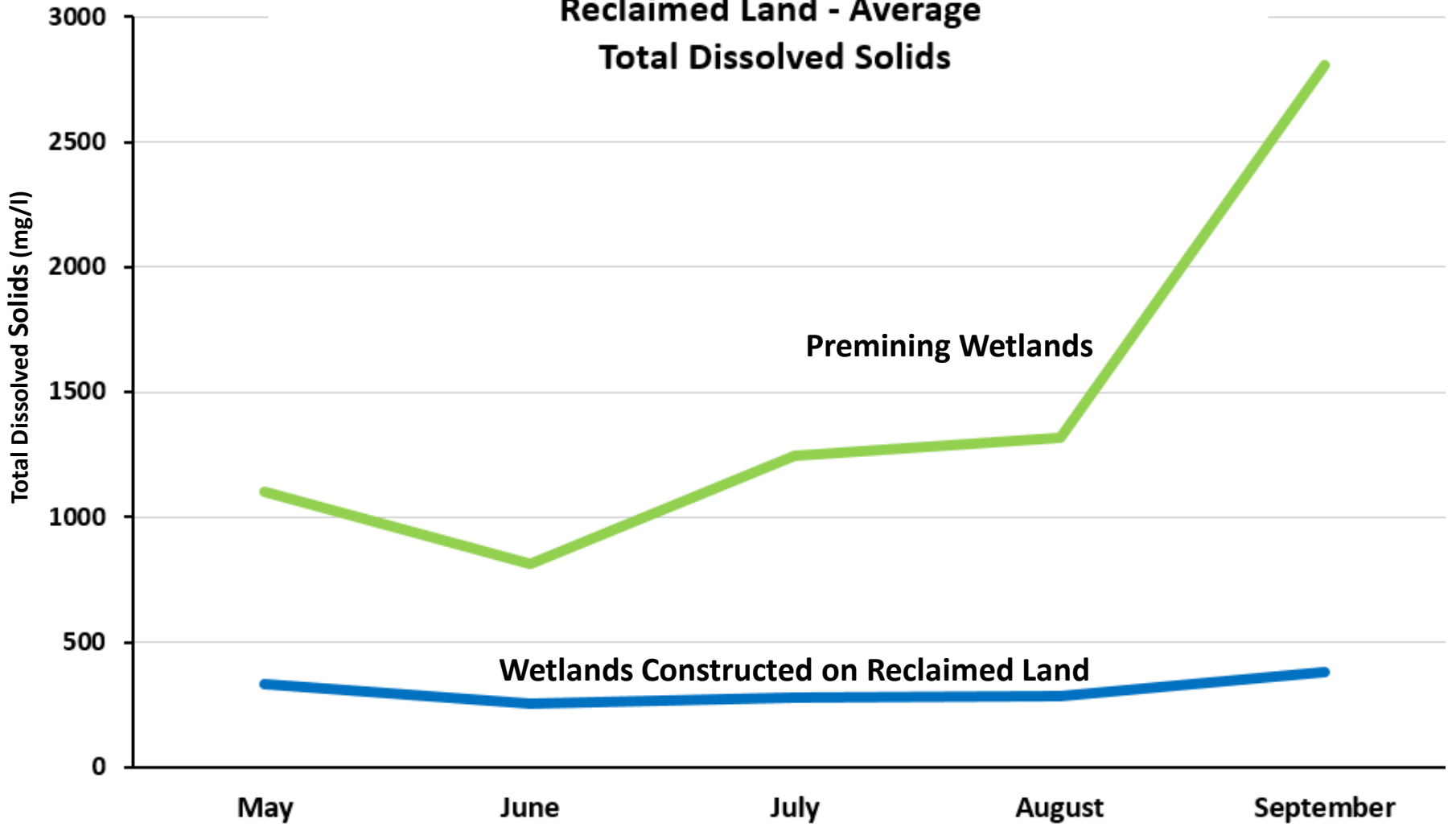


# Premining Wetlands & Postmining Wetlands Constructed on Reclaimed Land – Total Dissolved Solids





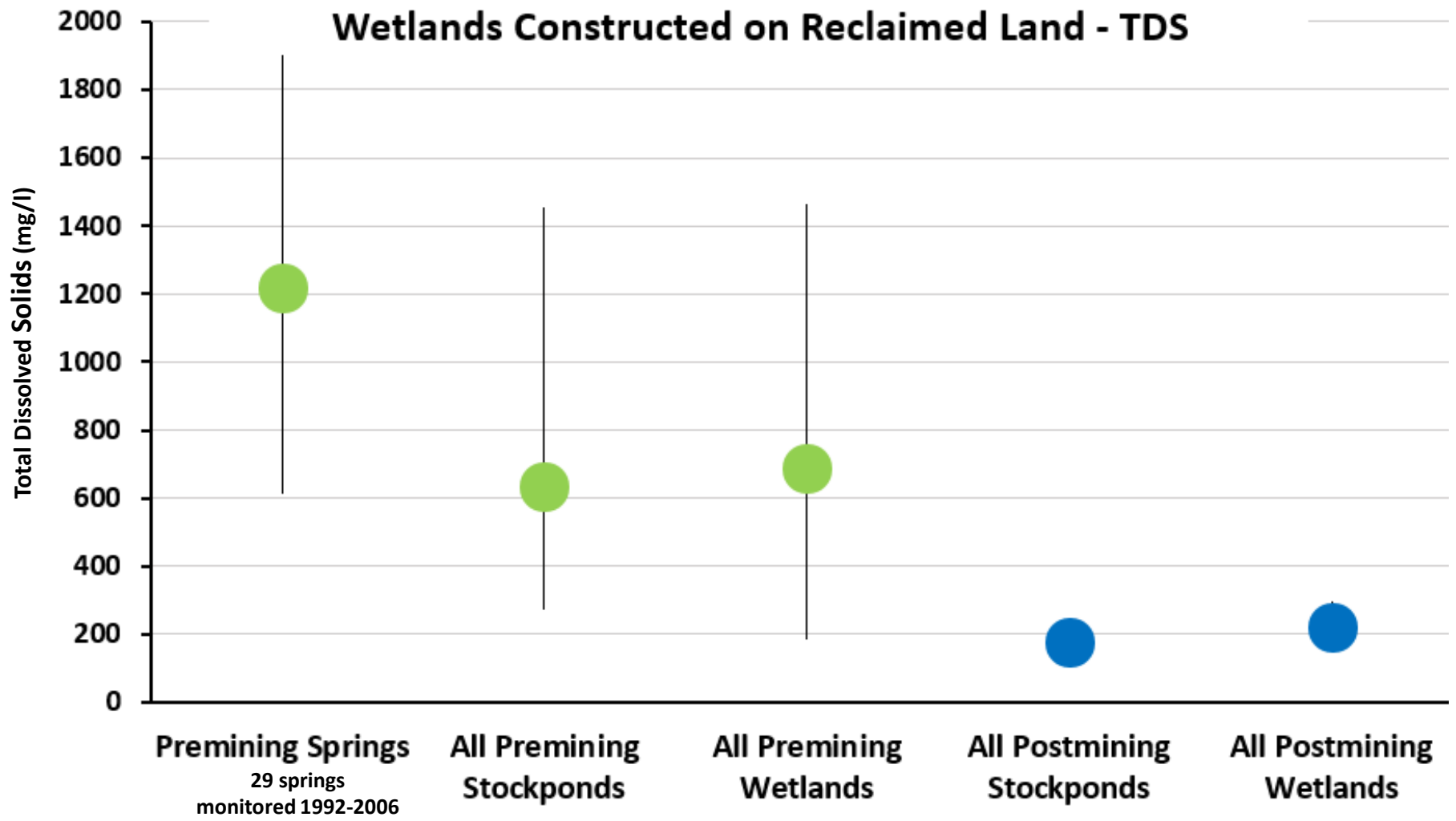
# Premining Wetlands & Postmining Wetlands Constructed on Reclaimed Land - Average Total Dissolved Solids





Undisturbed springs and seeps have highly localized impacts on water quality in premining baseline stockponds and wetlands.

# Premining Springs, Stockponds & Wetlands vs Stockponds & Wetlands Constructed on Reclaimed Land - TDS



# Conclusions from long-term surface water monitoring

- Although pH of discharges from the mine is slightly higher than background, there is no offsite effect, as downstream pH remains consistent between premining, active mining and postmining reclamation conditions.
- A nominal increase in median downstream sediment loads during mining may be related to high storm variability or other events or activities, but cannot be attributed directly to mine activity controlled by sediment ponds, because active mine discharges consistently have low sediment loads. Total suspended solids concentrations at downstream monitoring sites decline and become less variable during the upstream reclamation condition.
- Iron concentrations appear related to total suspended solids concentrations, and are not a concern for streams, stockponds or wetlands under any condition.
- Total dissolved solids concentrations in sediment pond discharges are not high and do not appear to affect moderate downstream TDS levels in streams.

# Conclusions from long-term surface water monitoring

- pH values in constructed stockponds and wetlands are slightly higher than baseline and undisturbed stockponds and wetlands, but are generally less than 9.
- Total dissolved solids concentrations in constructed stockponds and wetlands is substantially lower and much less variable than in baseline and undisturbed stockponds and wetlands, indicating improved water quality following mining. Favorable differences in TDS concentrations between constructed and undisturbed stockponds and wetlands is much more pronounced later in the summer.
- Elevated and highly variable TDS concentrations in baseline and undisturbed stockponds and wetlands may be related to seasonal inflows from premining springs in some locations. These springs generally have high TDS concentrations. This indicates that surface runoff-supplied postmining stockponds and wetlands provide an improved quality water source for livestock and wildlife compared to premine waters impacted by high-TDS spring flows.

Questions?

