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The Limestone Neutralization of Potential Acid Mine Drainage from Bald Mountain in Aroostook County, Maine

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The Limestone Neutralization of Potential Acid Mine Drainage from Bald Mountain in Aroostook County, Maine



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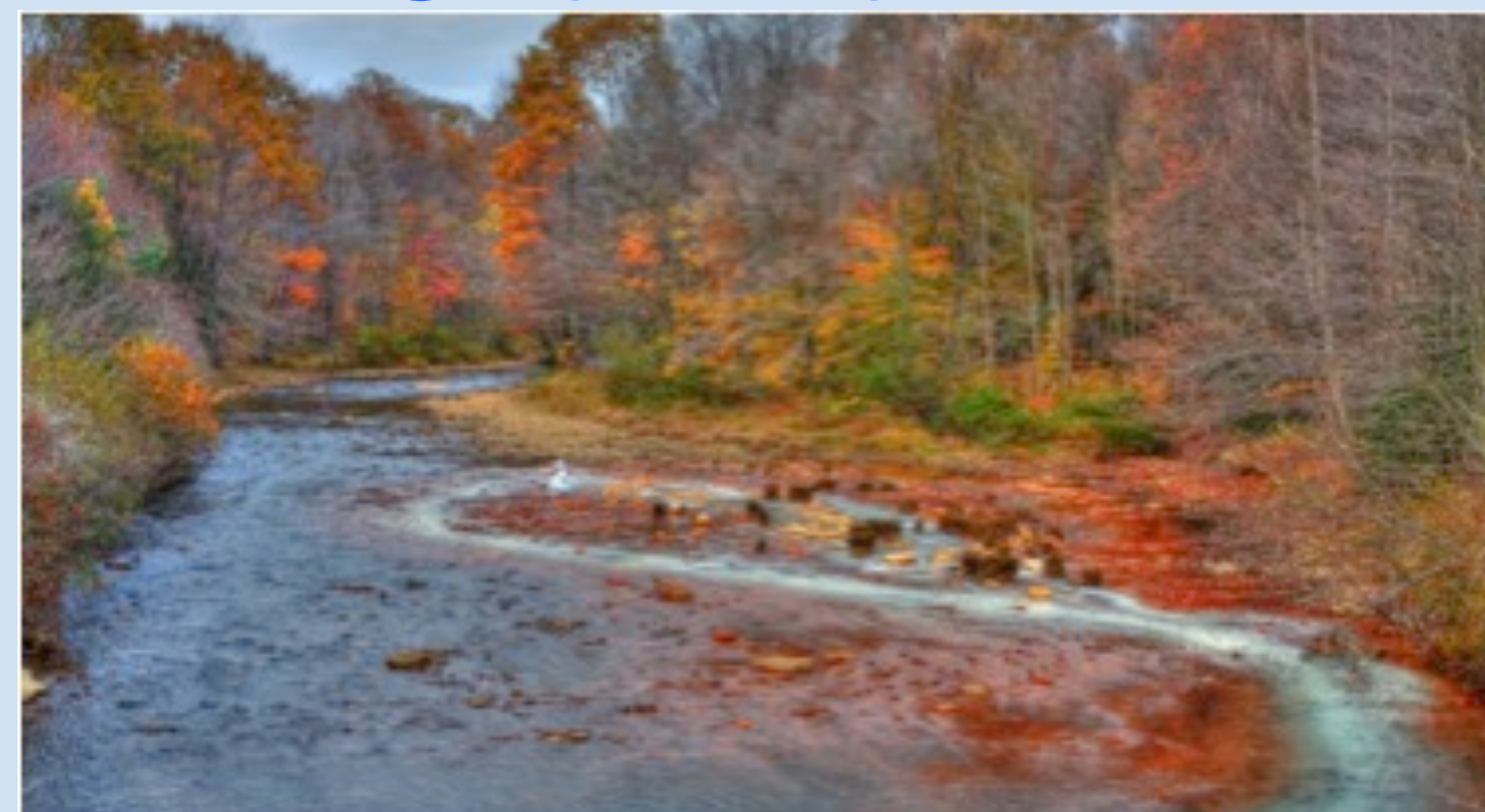
Abstract

Due to the loosening of environmental regulations in 2012, J.D. Irving, Limited, may begin mining operations on massive Cu-Zn sulfide ore at Bald Mountain in Aroostook County, Maine. The Bald Mountain Project will positively and negatively impact the local economy with job creation, higher wages and income levels, but a potential decline in the recreational industry. **The likely acid mine drainage (AMD) of the Bald Mountain Project can degrade aquatic ecosystems and reduce water quality and brook trout populations by metal contamination and acid loading in the local watershed.** In West Virginia, in-stream limestone sand application has successfully restored streams affected by AMD from coal mining operations. **The limestone sand method may serve as a valuable solution to treating AMD in the Bald Mountain watershed.**

Introduction

- In 2012, mineral commodities were used to produce \$2.4 trillion of goods and services (15% of U.S. GDP)
- Mining industry represents 1.6% of Maine GDP
 - Over 8,000 jobs (1% of Maine employment)
 - Generated \$162 million in tax revenues
- Metal ores: iron, silver, lead, zinc, copper, and nickel

Acid Mine Drainage (AMD)

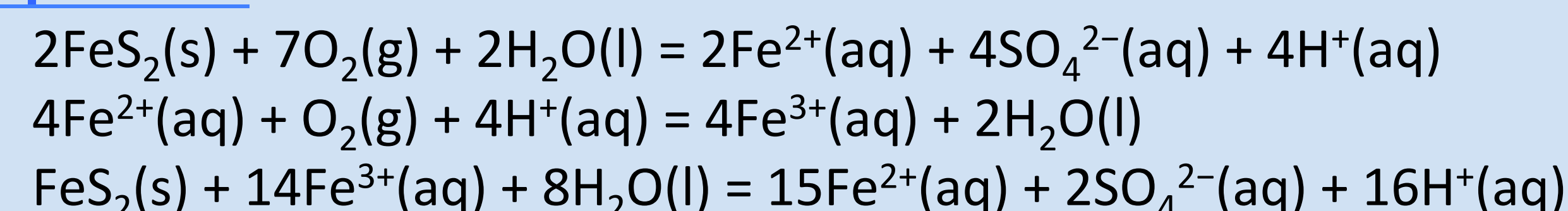


Acid Mine Drainage in Blacklick Creek, PA ²

Process

- Metal ore mining companies excavate sulfur-containing rock
- Sulfides in ore react with air and water to form sulfuric acid
- Sulfuric acid leaches out heavy metals in rock
- Contaminated groundwater drains out of mine and reaches local rivers and streams

Equations

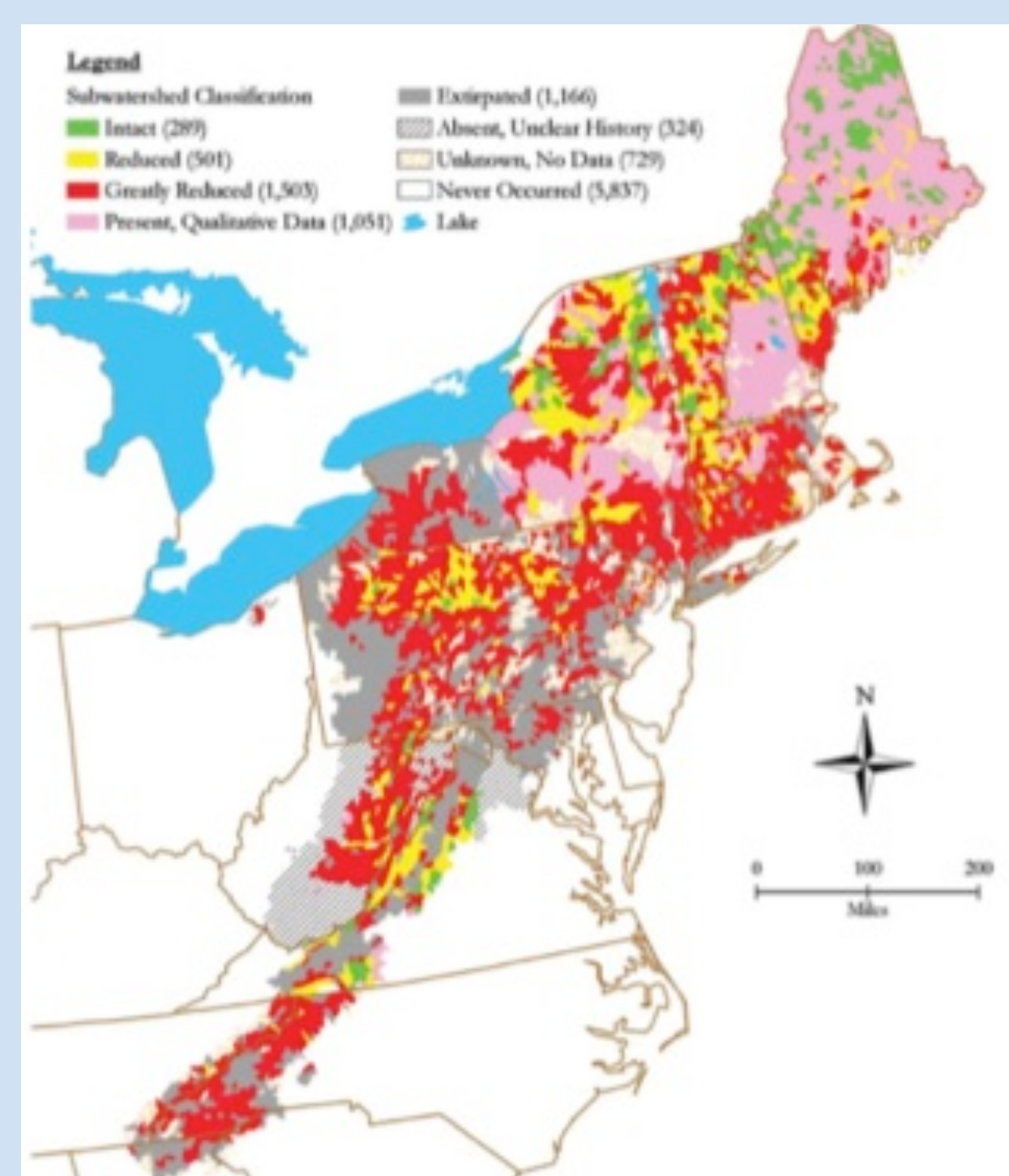


Brook Trout



Adult Brook Trout in Deschutes River, Oregon ⁴

- Native to northeastern North America
- Over the past century, brook trout populations have rapidly declined due to overharvest, introduction of exotic species, and AMD**
- Maine has the greatest reserve of brook trout in U.S.**



Brook Trout Population Status in the Eastern U.S. Range by Subwatershed ⁵

Bald Mountain Project



Bald Mountain with Greenlaw Pond in the Foreground ¹



Bald Mountain in County Map of Maine (represented by red star) ¹

Background

- Massive sulfide deposit
 - 352,000 tons of copper
 - 299,000 tons of zinc
 - 115 tons of silver
 - 5 tons of gold
- In 2012, J.D. Irving's bill (L.D. 1853) was passed in Maine Legislature
 - Loosened environmental regulations for open-pit mining

Potential Economic Impacts

- Tax revenue generation
- High remediation costs
- Boom-bust cycle of metal ore mining
- Create over 700 direct or indirect jobs during operation

Potential Environmental Impacts

- Major risk of AMD pollution to local rivers and streams
- Contaminated drinking water (extremely high arsenic levels)
- Significantly reduce brook trout populations

	pH	SO ₄	As	Cd	Cu	Fe	Al	Pb	Mn	Zn
Projected	4.7	64	0.075	0.004	0.229	2.28	0.35	0.004	0.21	0.865
Historic	7.7	10	<.001	<.001	0.002	0.37	0.1	<.001	0.03	0.01
EPA	-	250	0.05	0.01	1.30	0.30	0.75	0.02	0.10	6.00

The projected and historical pH, sulfate, and metal levels of the Bald Mountain Project compared to EPA standards for drinking water and aquatic organisms ⁷

AMD Restoration in WV Streams with Limestone Sand



Map of the Monongahela River Basin with the Middle Fork River highlighted ²



Limestone sand dumped into a stream affected by AMD ²

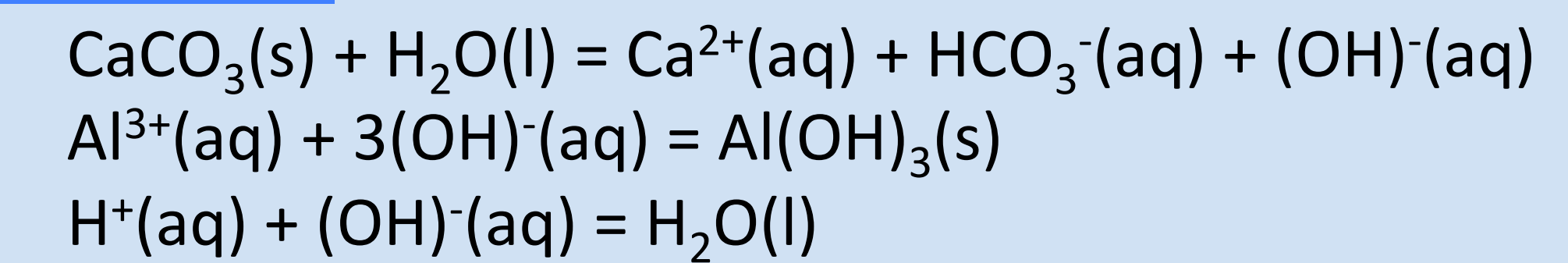


Limestone Sand Treatment of AMD in the Middle Fork River ²

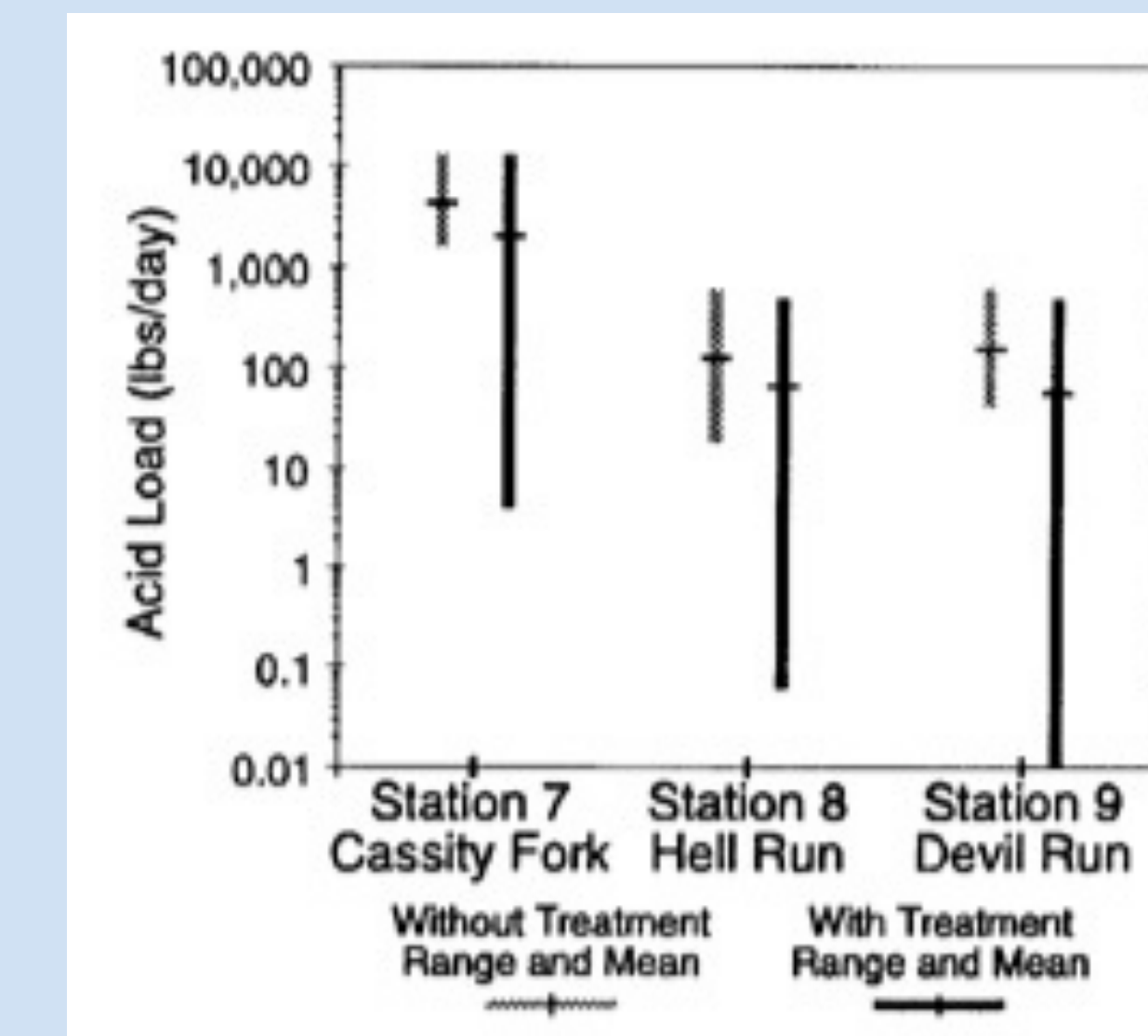
In-Stream Limestone Sand Method

- Dump crushed limestone into 41 downstream sites of the former coal mining site annually
 - Average particle size = 0.425 mm
 - Quantity = total annual acid load

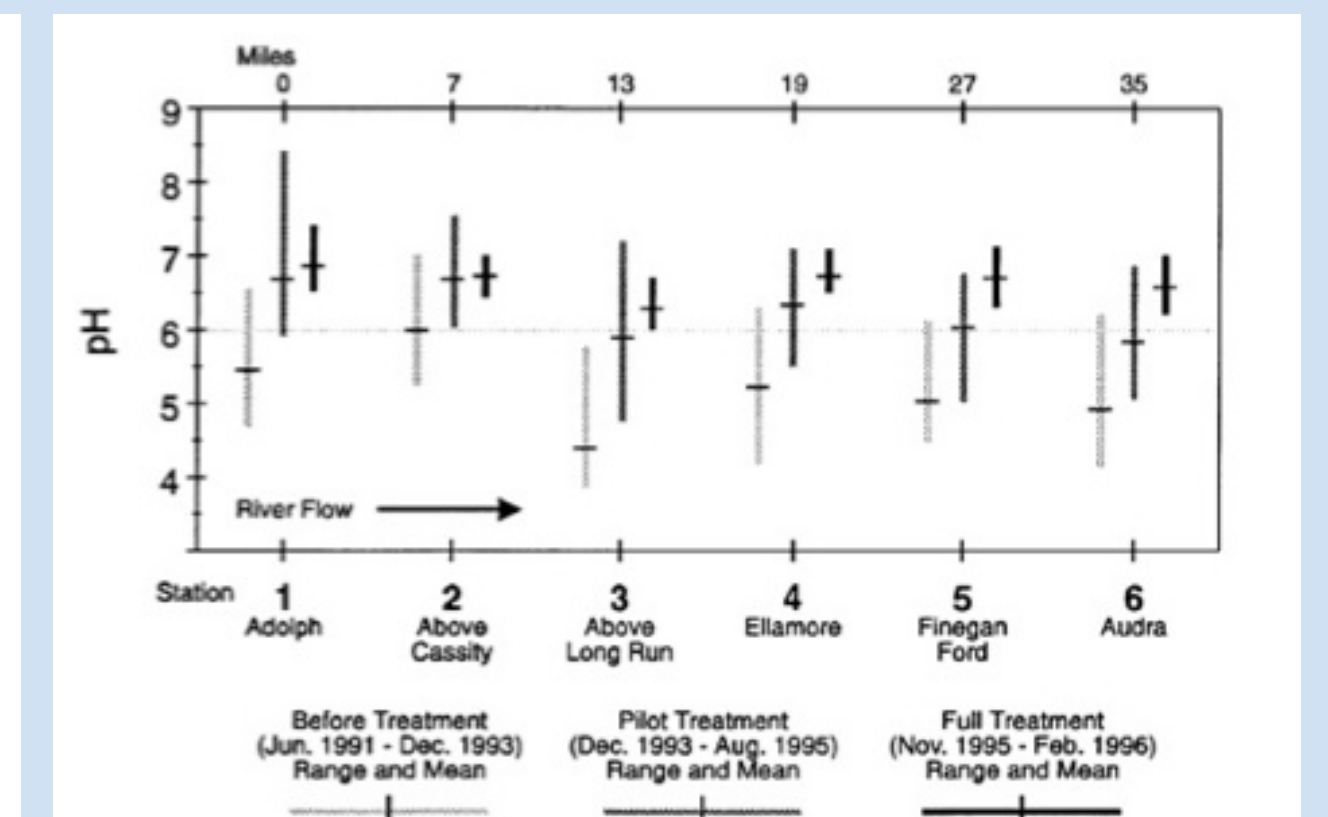
Equations



Results



Acid load response to instream limestone sand treatment in three Middle Fork River AMD tributaries ⁹



pH response to instream limestone sand treatment in six Middle Fork River AMD tributaries ⁹

- Instream limestone sand treatment restored the water quality and brook trout populations in the Middle Fork River**
 - pH levels significantly improved from 4.9 to 6.8
 - Toxic metal concentrations were significantly reduced
 - Total biomass of brook trout nearly doubled in five years

Benefits

- Very low economic cost (\$90,000/yr in Middle Fork River)
- Simple process and minimal maintenance
- Short-term effectiveness (1-10 years after treatment)

Potential Problems

- Limestone armoring and covering the stream bottom
- Long-term effectiveness is uncertain (> 10 years after treatment)

Conclusion

- Metal ore mining development has economic benefits in the short-term and environmental costs in the long-term
- The effectiveness and relatively low economic costs of limestone sand treatment make it a viable solution for Bald Mountain**

Policy Recommendations

- Based on the Callahan Mine Superfund site in Brooksville, ME, there are major costs associated with waiting to treat AMD
- Reclamation efforts for the Bald Mountain Project need to start sooner rather than later in order to limit long-term costs**
- J.D. Irving should be required to allocate sufficient funds to cover reclamation and AMD treatment costs**

Acknowledgements

- I express my gratitude to Dr. Robert E. Nelson at Colby College and the Maine Department of Environmental Protection (DEP) in Augusta, ME

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