TRaP-ping Ghosts From Gold Mining's Past– Arsenic and Mercury Haunting Wetlands For Over 150 years

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Project Background

- In the late 1800's, **mercury (Hg)** and **arsenic (As)** contaminated gold mine tailings were discarded in low-lying areas close to the mines, including **wetlands**
- Elevated concentrations of contaminants still exist, potentially **impacting hundreds of wetlands in NS**, Canada
- Traditional risk management approaches, such as dredging and thick isolation caps could result in a net loss of wetland areas.
- Isolation caps can be improved using reactive capping materials which have higher sorptive capabilities.

OBJECTIVE:

Develop a cost effective in-situ risk management strategy for enhancing natural recovery of highly contaminated gold-mine-tailing impacted wetlands.

WHAT:

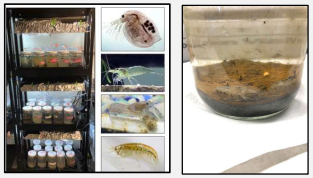
Thin Reactive amendment Protective Capping (TRaP)

How? – Six Research Phases

1. Development & Selection

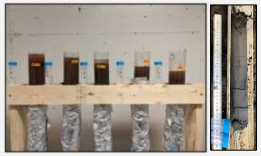
2. Adsorption & Sequential Extraction

3. Toxicity (TRaP efficacy, beaker)



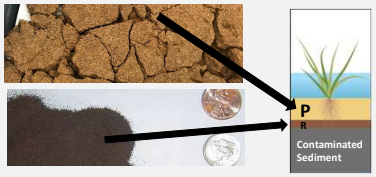
4. Toxicity (TRaP efficacy, bucket)

5. Long term efficacy & geochemistry (column)



6. Long term effectiveness & toxicity (field mesocosm)

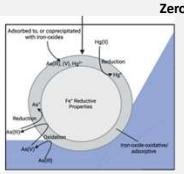
What? –TRaP



Protective Capping (P):
- Silica sand (00)
- Zeolite (Green Patch -36 mesh)
- Zerovalent iron (ZVI) (CC-1200)
- Bentonite (325 mesh)

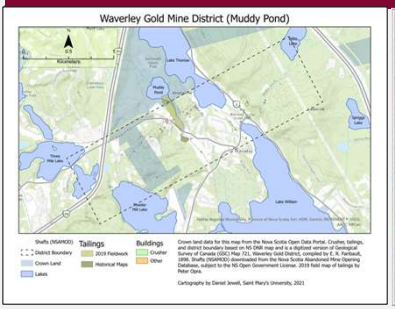
Reactive Amendment (R):
- Zerovalent iron (ZVI) (CC-1200)

Zerovalent iron (ZVI)



Has a metallic iron core with an iron oxide surface layer. ZVI provides reduction/oxidation/adsorption functions for contaminant transformation. After reaction, As(0) is found in layer between Fe(0) and iron oxide. As(III), As(V), and Hg(II) are adsorbed to, or coprecipitated with the iron oxide layer

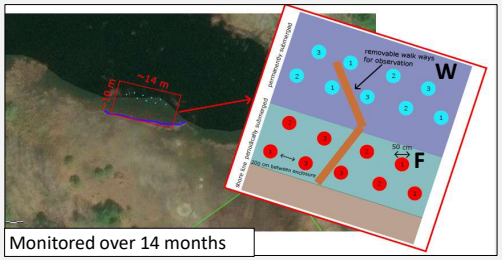
Field Testing (Phase 6) Study Area



As: 10,000-90,000 mg/kg
(CCME ISQG: 5.9 mg/kg)

Hg: 10-50 mg/kg
(CCME ISQG: 0.17mg/kg)

Field Testing (Phase 6) Experimental Design

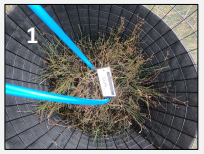


Monitored over 14 months

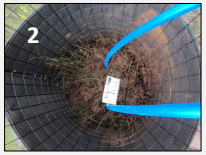
Two study areas with 9 "mesocosm" enclosures each at Muddy Pond:
- Area **W:** Consistently wet
- Area **F:** Fluctuating water levels

Enclosure design, construction and installation

3 Treatments (3 replicates) at W and F



Untreated Muddy Pond (U)
Untreated Second Lake (REF)

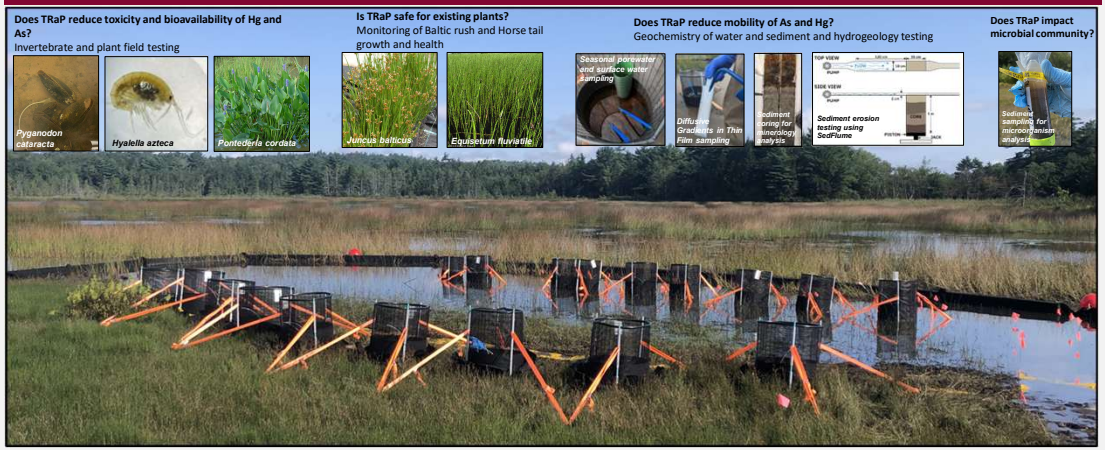


Treated with Reactive Amendment ZVI (R) – Muddy Pond only

Treated with Reactive Amendment and Protective Capping (RP) (full TRaP, 2.5 cm) – Muddy Pond only

Silt curtain + swamp mats for erosion control

Interdisciplinary 14-Month Field Testing of TRaP



Preliminary Conclusions – Efficiency of TRaP

- TRaP significantly improved survival and decreased bioaccumulation of As in *Hyalella azteca*
- TRaP promoted growth and health of transplanted pickerelweed plants and promoted germination of seeds
- TRaP reduced oxidative stress and increased frequency of valve openings in mussels suggesting improved health
- TRaP did not impact growth of existing plants
- TRaP maintained lower concentrations of dissolved As, As(III) and MeHg in surface water throughout the seasons
- TRaP did not impact dissolved As, As(III) and MeHg levels in porewater at 30 cm depth
- TRaP decreased DGT labile dissolved As(III) concentrations in surface water and sediment
- TRaP reduced mobility of As by co-precipitating dissolved, soluble and loosely adsorbed As with amorphous and crystalline Fe oxyhydroxides

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