From BS to BMP- Using Biosolids for Taconite Tailings Reclamation

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Outline

- Background
- History of research
- Development of new Best Management Practice
- Agricultural practices

Background

- Standard mineland reclamation practice (inorganic fertilizer, seed, mulch)
- Works well on fine tailings

Background

- Coarse tailings are difficult to revegetate
- Standard mineland reclamation practice not successful
  - Typical cover 30-50%
  - Repeated applications improves cover to a maximum of ~ 70%
- Mineland reclamation rules require:
  - 90% cover after 3 years (5 years on south or west slopes)
  - Self sustaining vegetation after 10 years

Coarse Tailings

New Paradigm Needed

- Organic amendments
  - Peat
  - Yard waste compost
  - Municipal solid waste compost
- Series of studies conducted
  - Percent cover increased with increasing organic matter
  - Cost effective rate was about 20 dry tons/acre
    - Vegetation met 90 % cover standard

Standard mineland reclamation

MSW Compost

Problem

- Availability
  - Small amounts of yard waste produced used by public
  - Plans for nearby large-scale municipal solid waste composting facility never materialized
  - Other MSW Compost facilities closed
    - No nearby source


WANTED
Readily available source of nutrients with enough supply to meet mineland reclamation needs
Biosolids!
dreamstime.com

What really are Biosolids?

- Solid residuals from wastewater treatment plant
  - Treated to reduce pathogens and meet EPA standards
- Previously known as “Sludge”
- Now called a “slow release nitrogen fertilizer ” (USEPA)
  - Nutrient-rich organic product of wastewater treatment

Biosolids application rate

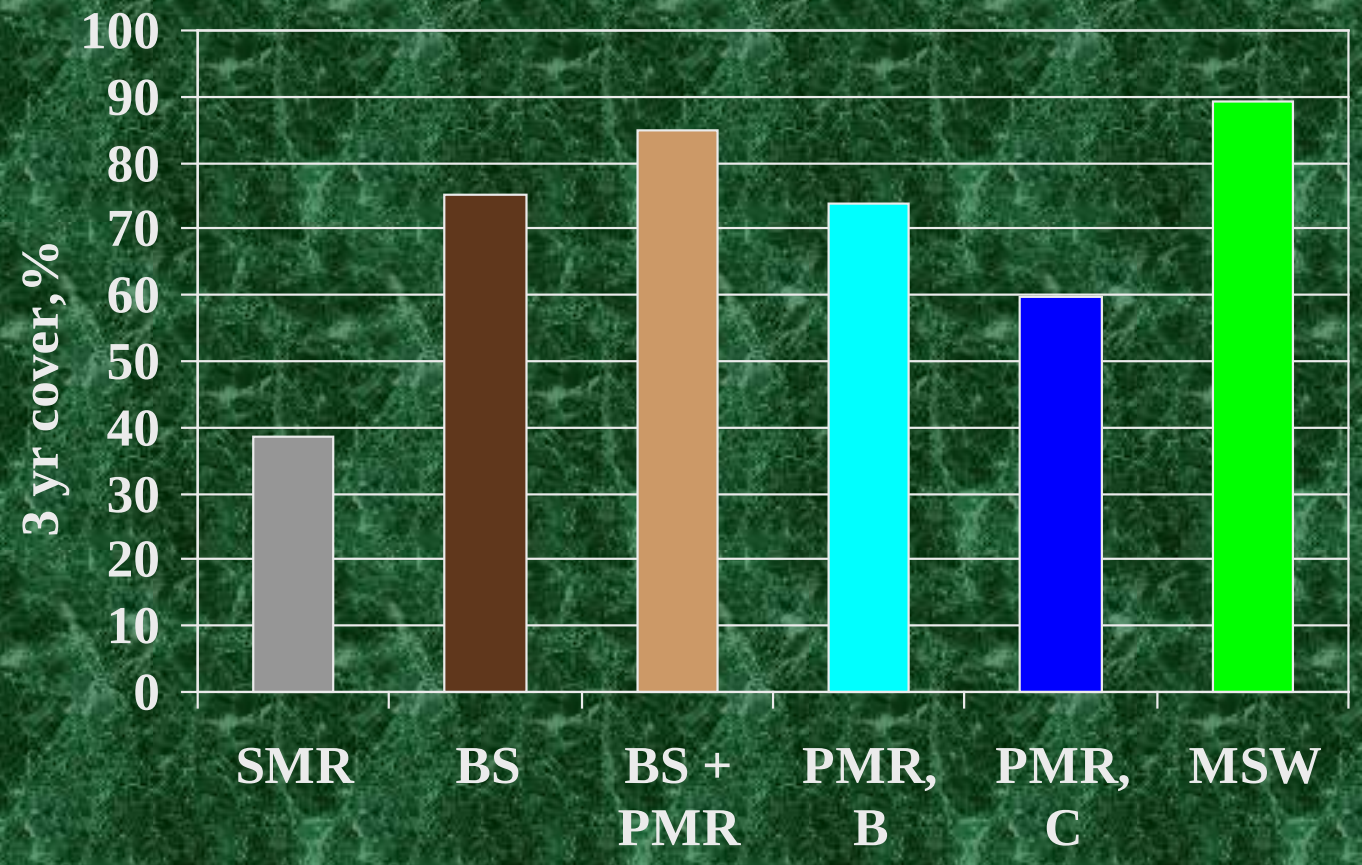
- Biosolids quality has generally improved over time
  - Better treatment, lower metals
- Main concern is nitrate leaching
- Agronomic limits
  - Apply only as much nitrogen as the plants growing on the site can use
  - Typical is about 100 lbs N/acre
    - Type of plants
    - Amount of anticipated plant growth

EVTAC, 1997

- First large scale test with biosolids
  - 5 acre demonstration plots

Results, EVTAC (1997 application)

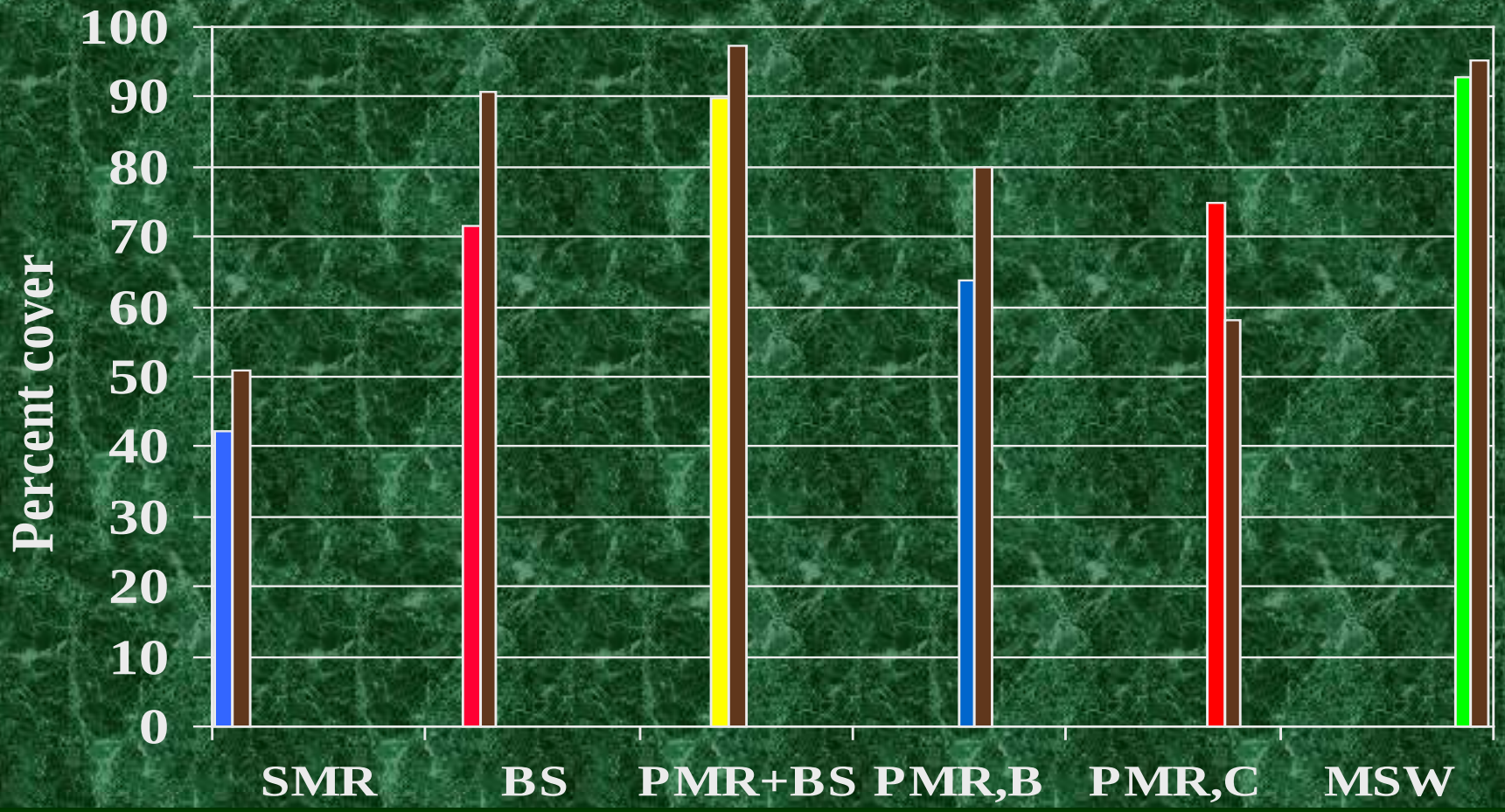
- 100 lbs N /acre improved vegetation but did not meet cover standard



Paper mill residue

Results, EVTAC (2000 application)

- Top dressing with an additional 100 lbs/N
- Generally improved vegetation



Goal

- Determine an optimum one-time biosolid application rate that will
  - produce vegetation that will meet the reclamation requirements
  - Will not adversely impact water quality
  - Will be cost-effective

Experimental Design

- 5 acre demonstration plots
- Small bin studies to look at the effect of biosolids on water quality
- Treatments
  - Standard mineland reclamation
  - Biosolids
  - Biosolids + paper mill residue
    - Add high carbon material to tie up extra nitrogen

Experimental Design - Details

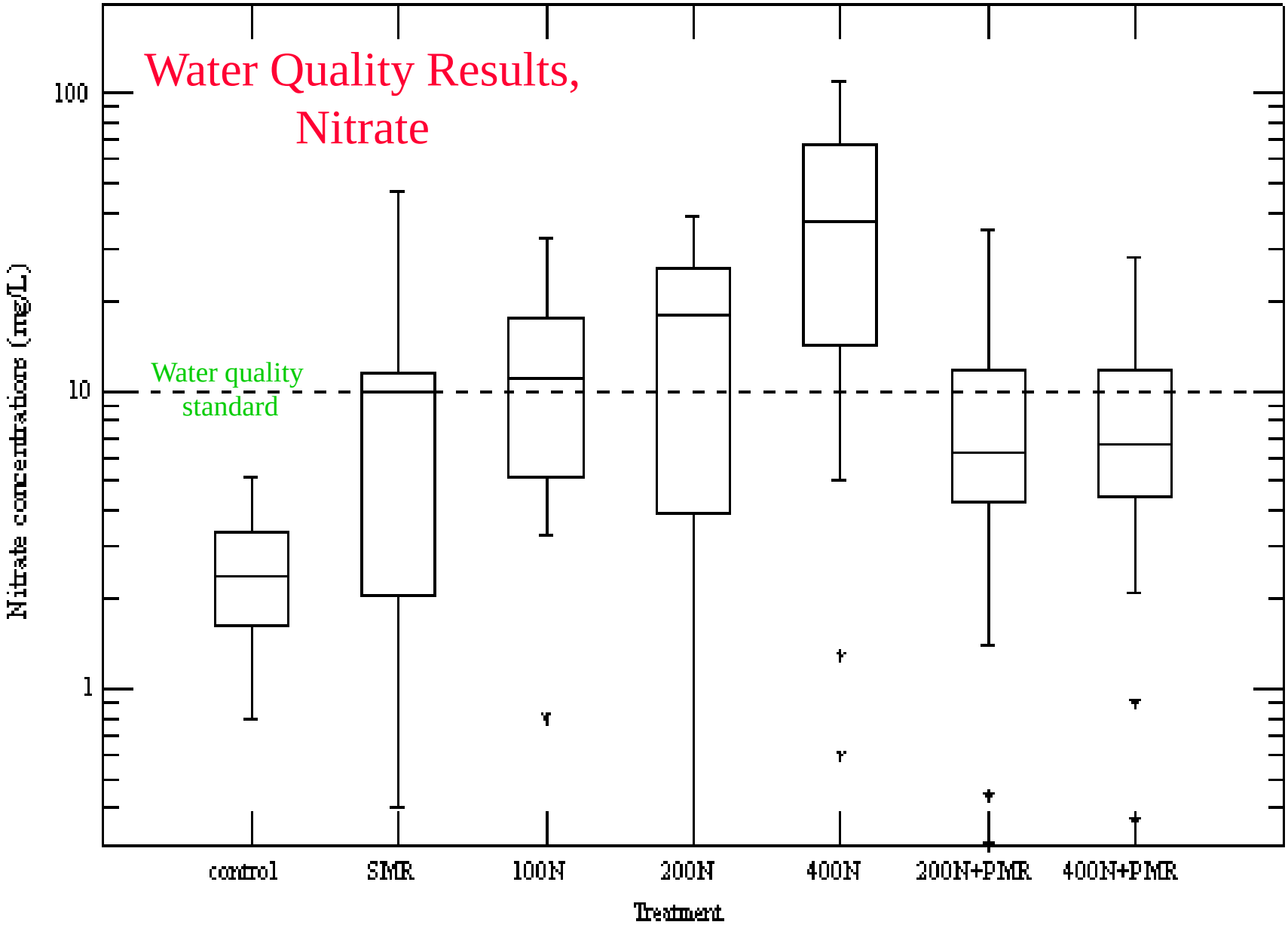
- Treatments
  - Standard mineland reclamation
    - Seed; grass, legume mix
    - 500 lbs/acre, 18-46-0
    - Mulch, 2 tons/acre
  - Biosolids
    - 100 lbs N/acre (3.1 dry tons/ acre)
    - 200 lbs N/acre (6.2 dry tons/ acre)
    - 400 lbs N/acre (12.4 dry tons/ acre)
  - Biosolids + paper mill residue
    - 200 lbs N/acre + 28 dry tons/ acre
    - 400 lbs N/acre + 56 dry tons/ acre


400N
400N
+PMR

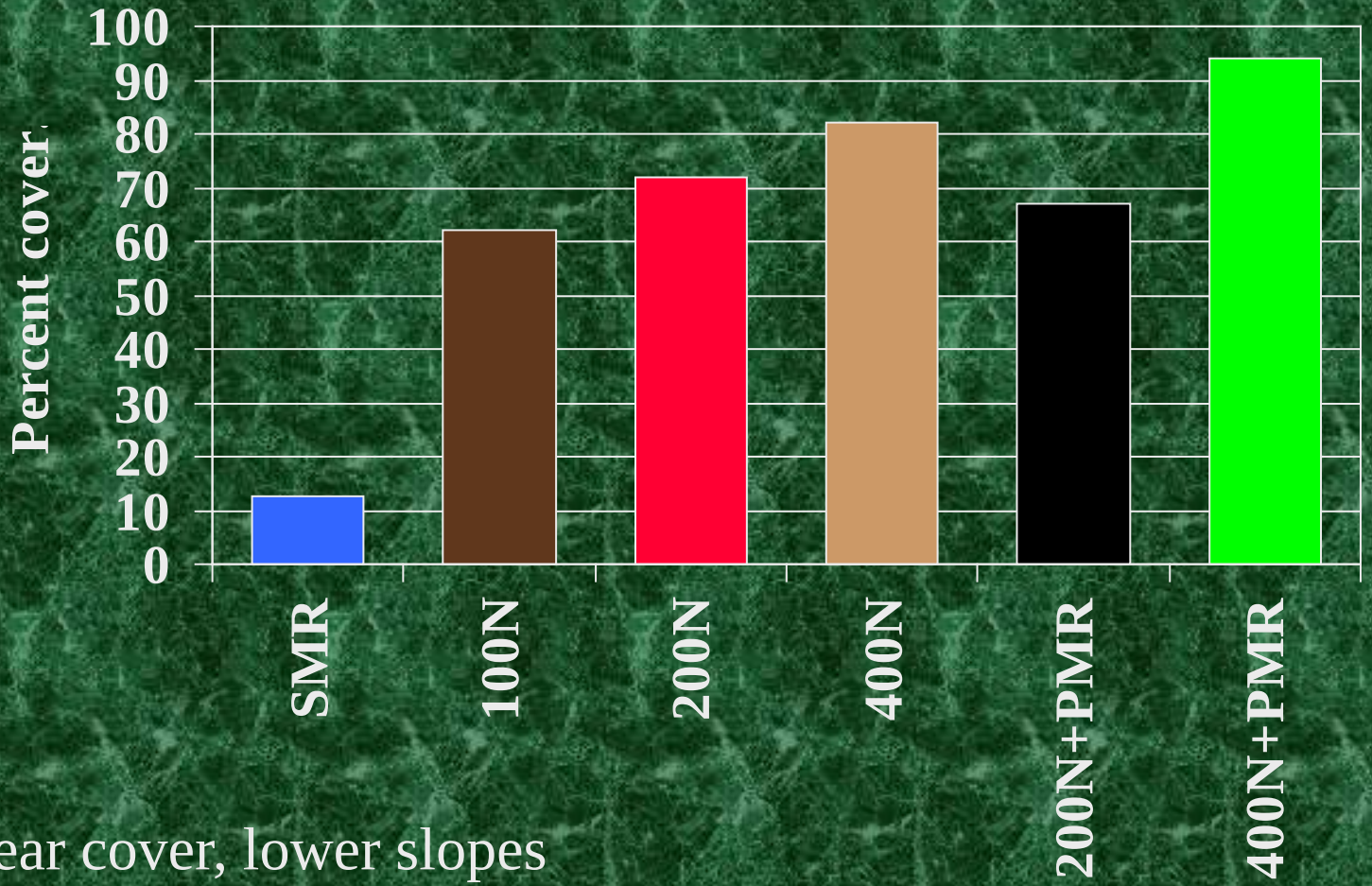
Results, Water Quality

- Total dissolved solids
  - Increased with increasing application of biosolids
  - Decreased with time
- Trace metals
  - Low levels associated with paper mill residue
  - Decreased with time
- Nitrate

Water Quality Results, Nitrate



Results, Percent Cover



3 year cover, lower slopes

Conclusions

- Biosolids at 200 lbs N/ acre
  - Suitable vegetation
  - Minimum impact on water quality

Standard mineland reclamation

Biosolids, 200N

New Best Management Practice

- In 2005, PCA approved the application of biosolids to provide 200 lbs N/acre for coarse tailings reclamation
- Applications
  - UTAC
  - Keetac
  - US Steel
- Vegetation has met standard

Biosolids and Fine Tailings

- Standard mineland reclamation
  - Successfully meets mineland reclamation standards
- Can we do better?
  - Biomass crops
  - Forage
  - Soil development

Hybrid Poplar

Forage Production

- Takala Farms wanted to expand dairy herd
- Needed more forage
- Biosolids
  - Provide Nitrogen and Phosphorus
- Tailings
  - Naturally high in Potassium
  - Suitable pH

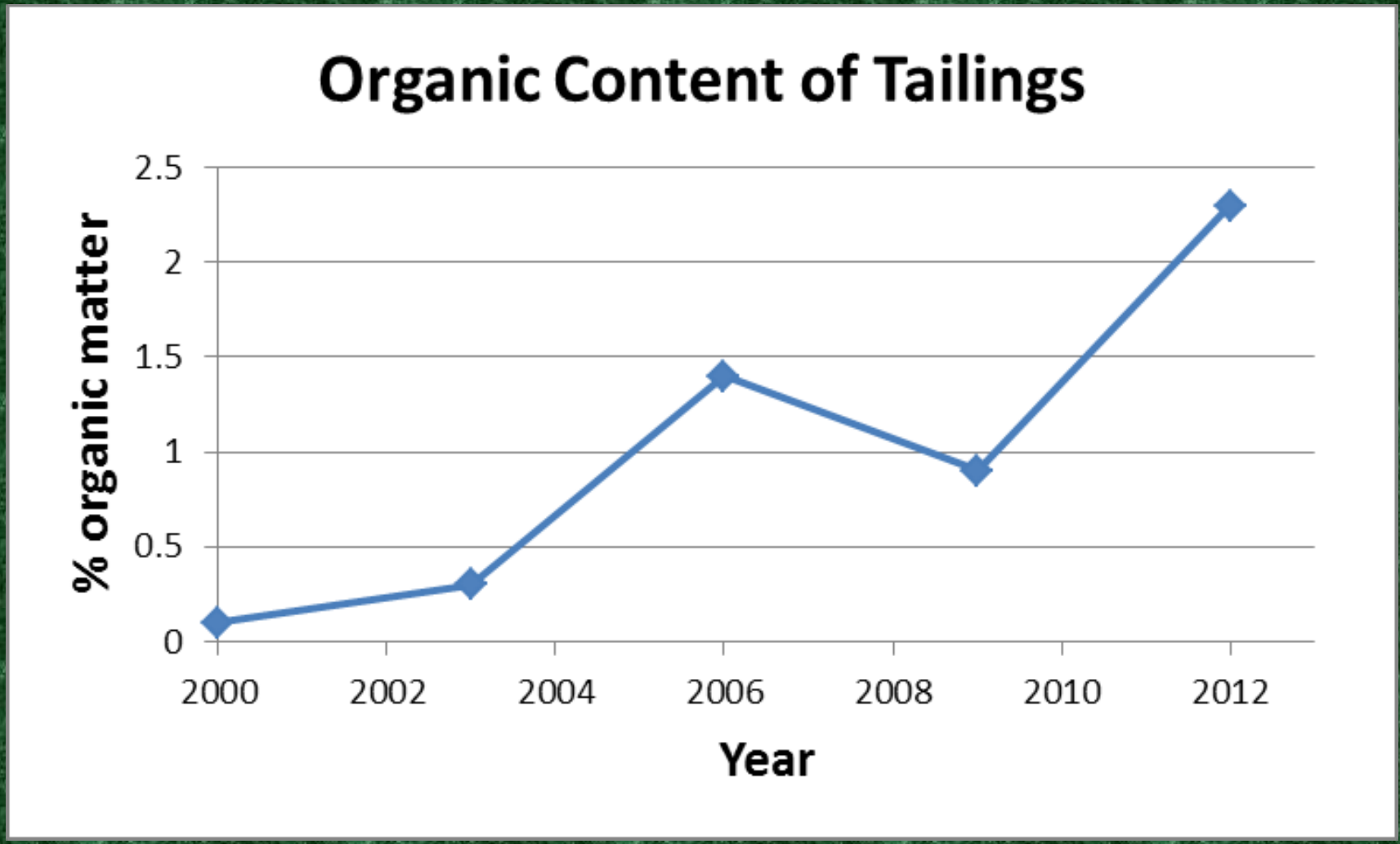
Forage Production

- St Louis County Extension organized partnership
- Takala Farms/UTAC/ DNR/PCA/ Extension Service
- Agreement
  - Alfalfa for Takala
  - Hay mulch for UTAC
-

Yield

Year	Yield , tons/acre (dry matter basis)	Number Cuttings
2008	1.7	1
2009	4.0	3
2010	4.1	3
2011	5.0	3
2012	3.1	2
Typical yield, managed fields	2.5-3.0	2
Typical yield, unmanaged fields	1.0-1.5	1

Got Soil?


Organic Content of Tailings
% organic matter
2.5
2
1.5
1
0.5
0
2000
2002
2004
2006
2008
2010
2012
Year

Better Living Through Biosolids

- Successful BMP for coarse tailings
  - Meet reclamation standards
- Successful forage production on fine tailings
  - Production as good or better than typical fields
- Increases in organic content of tailings with repeated applications
  - Increased soil development

Questions?

Costs

- Initially no cost
- Today
  - $19/acre for application
  - $13/acre to incorporate
  - ~ $1/ton surcharge (over 40 mile haul)
- Total ~ $50/acre