

Groundwater Discharge Impacts

**ASSBT General Meeting
March 2011**



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Land Application and Groundwater Discharges of Wastewaters

- Past limits for Groundwater Discharge
 - Good question – none established for a long time.
- Past criteria for compliance and successful operation for land application.*
 - No pooling or ponding
 - No runoff
 - No odors

*Batt, D., Land Application of Food Processing Wastewater Challenges and Opportunities, Oct 2010, MFPC

Regulation framework

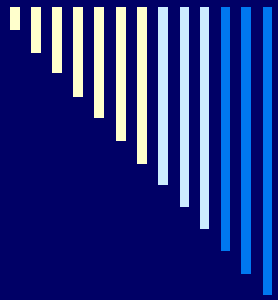
- Much discussion for years.
- EPA has yet to establish limits or guidelines
- States are developing their own rules.

Recent History (Michigan)

- Discolored odiferous water with an undesirable taste reported in some private drinking water wells.
 - Found to contain several metals including Arsenic

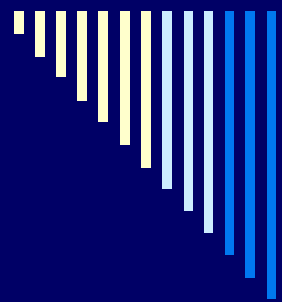
Michigan History (continued)

- Hydrogeological studies showed the groundwater flow was from the land application sites of nearby food processors.
 - None of the metals of concern were in the wastewater
- DEQ press releases \Rightarrow bad PR
- Research conducted



Research – Why & How

- Land application one of the oldest type of wastewater treatment
- No studies found into impacts, proper methods, etc.
- MSU & MTU started researching (still in progress)
 - Early results are in



Research Findings

- In anoxic or anaerobic soils several metals become soluble in water. - Why?
- In the absence of oxygen some bacteria will find alternative electron acceptors.
 - Nitrate
 - Manganese
 - Iron
 - Sulfate

Solutions

- Prevent Anoxic / Anaerobic conditions
 - Avoid high organic loads
 - Avoid high hydraulic loads
 - Some mixture of high hydraulic and organic loading.

Maximize soil treatment

- Generally keep BOD < 50 lb/acre/day
- Minimize hydraulic loading
- Avoid soil compaction
- Allow soil to breath (dry)
- Remove material (harvest crops)
- Cold weather can increase challenges
 - Subsurface injection.
 - Snow manufacture

Conditions at the site will have impacts

- Upstream groundwater quality
- Depth to groundwater
- Soil type

Alternative

- Air Sparging
 - Injecting air (oxygen) into the groundwater.
 - Has been used for years for remediation.
 - Injection wells across the width of plume & / or application site.
 - Spacing of injection points is dependent on:
 - soil type
 - loading
 - Depth to groundwater
 - Amount of air (oxygen) needed

Air Sparging

- Can be used to increase the loading to the site.
- Can be used to fix a metal solubility issue rather quickly.

Sampling rates

- Use logic to determine an appropriate rate.
- Sampling prior to application – easy and low cost.
- Of groundwater, the sampling is more labor intensive.
- Groundwater travels slowly.

Groundwater travel speed

Example sites

■ Superfund site in Michigan

- Approximately 90 feet of foundry grade sand.
- Groundwater travels 1,900 feet in 17 years
- 112 feet per year = ~4 inches/day

■ Sugar Beet factory

- Hydraulic Conductivity $\sim 1.0 \times 10^{-5}$ cm/s
- Time of travel = 0.3 in/day

Best Parameters to monitor Groundwater impacts

- Dissolved Oxygen
- ORP (oxygen reduction potential)
- Inorganic Nitrogen (types)
- Dissolved Manganese
- Dissolved Iron
- Sulfate / Sulfide



Questions?