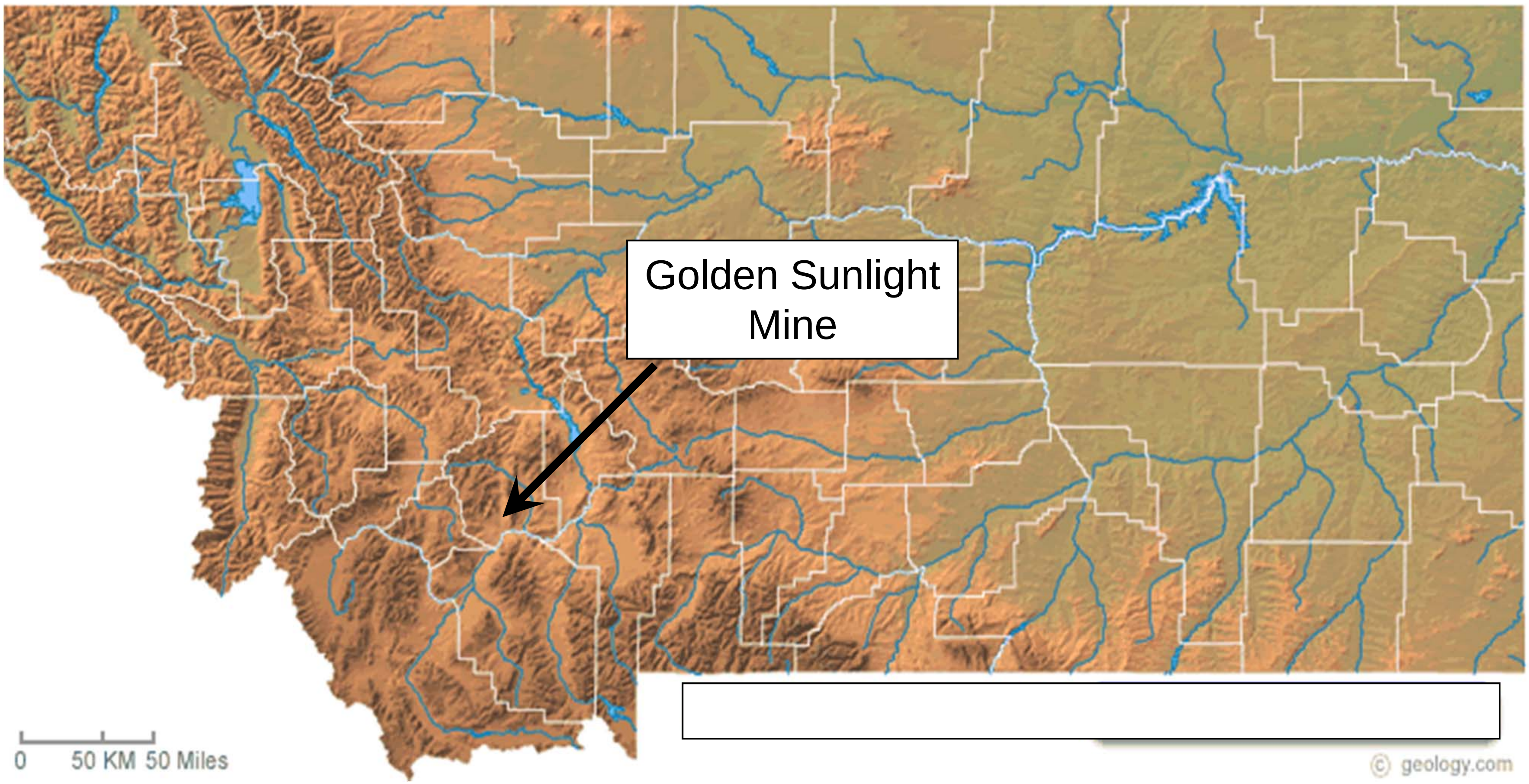

BARRICK
GOLDEN SUNLIGHT
Barrick - Golden Sunlight Mine
Mine Design, Operation and
Closure Conference
May 2011

Golden Sunlight Mine



Golden Sunlight Mine

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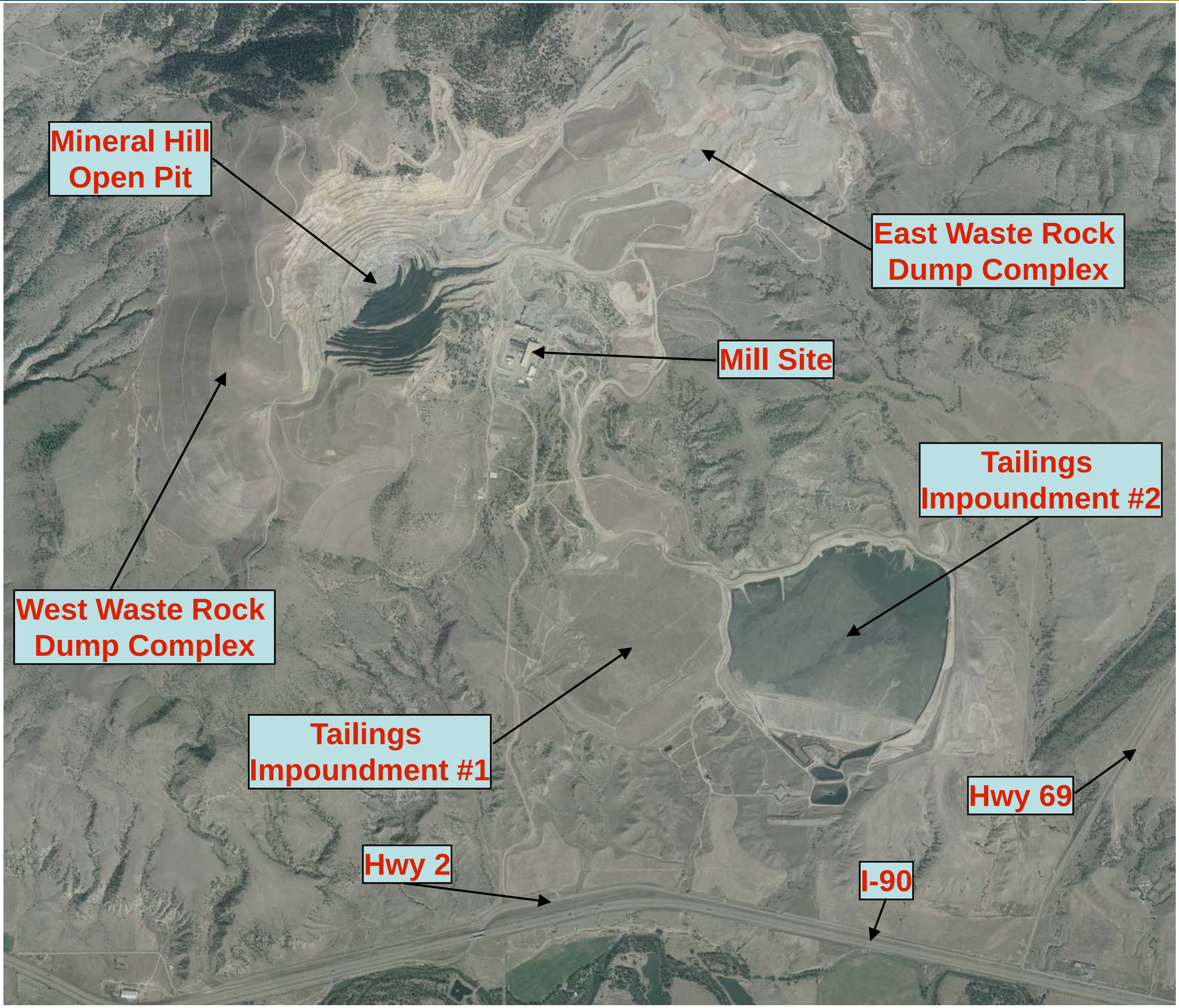

Water Management

- During Operation
  - Use as makeup water for mill circuit
  - Major sources
    - Pit
    - Tailings Impoundment #1 containment wells

Water Management

- Closure
  - Pump – Treat - Discharge
  - Major sources
    - Pit
    - Tailings Impoundment #1 containment wells
    - Tailings Impoundment #2 drain-down

Water Types

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- Pit Water
  - ARD signature
    - Low pH, sulfate, iron, trace metals, and TDS
- Tailings Impoundment Waters
  - Process water residuals
    - Cyanide, thiocyanate, nitrate, ammonia, and TDS
    - Slight signature of neutralized ARD

Treatment

- Pit Water
  - Active HDS type treatment (pH adjustment, metals precipitation), possibly polishing for TDS removal.
- Tailings Impoundment Water
  - Active biological treatment (aerobic and anaerobic), possibly followed by HDS and polishing for TDS removal.

Biological Treatment

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- Desired Reactions:
  - Aerobic

    $CN + Bacteria \rightarrow HCO_3 + NH_3$

    $SCN + OH + Bacteria \rightarrow SO_4 + HCO_3 + NH_3$

    $NH_3 + Bacteria \rightarrow NO_2 + Bacteria \rightarrow NO_3$ (nitrification)

  - Anaerobic

    $NO_3 + CH_3OH + Bacteria \rightarrow CO_2 + N_2 (g) + OH$ (denitrifaction)

  - Adsorption and Absorption of Heavy Metals

Passive Biological Treatment

- Acknowledgements
  - Jim Whitlock – Whitlock and Associates
  - Chris Nelson – Barrick Golden Sunlight Mine
  - Rory Tibbals and Shannon Dunlap
  - Rick Henderson and Tom Monfortan – Barrick Golden Sunlight Mine
  - Kathy Gallagher - SPSI

Pilot Plant Testing

- Down flow columns constructed in GSM mill facility - 42 inch diameter and 14 foot height
- Counter current air flow (convective)
- Inert rock media used (1/4 - 5/8 inch nominal size)
- Tailings Impoundment #2 reclaim water used for testing
- Flow rate - 3 gallons/day/ft^2
- Inoculated

Pilot Test Results

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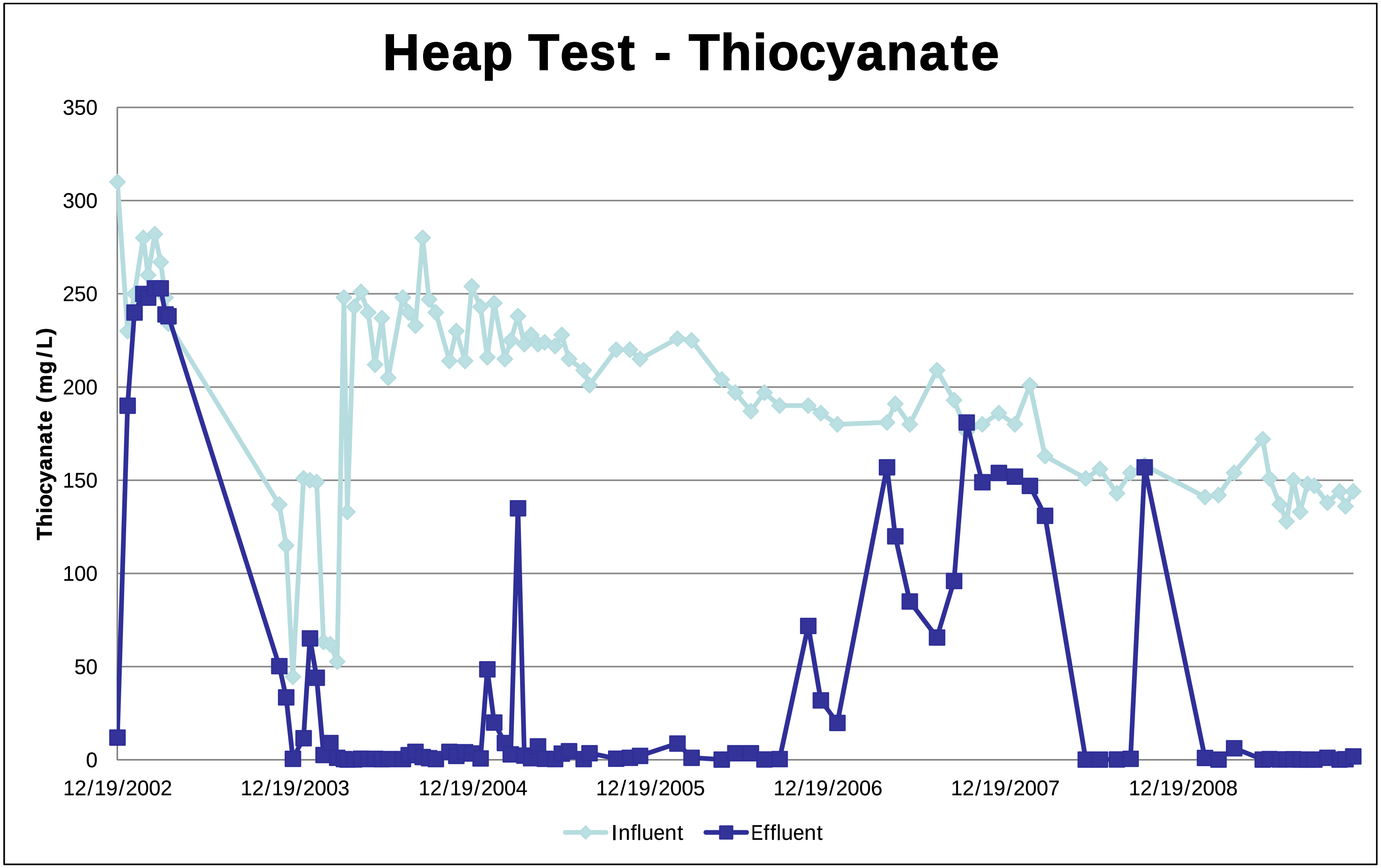
- 96 % removal of cyanide
- 98-99% removal of thiocyanate
- Nearly complete nitrification
- Anaerobic column used to effectively denitrify
- 98-99% removal of copper (19 ppm to 1 ppm)
- Slight decrease in TDS
- pH relatively unchanged at approximately 8 s.u.

Heap Treatment

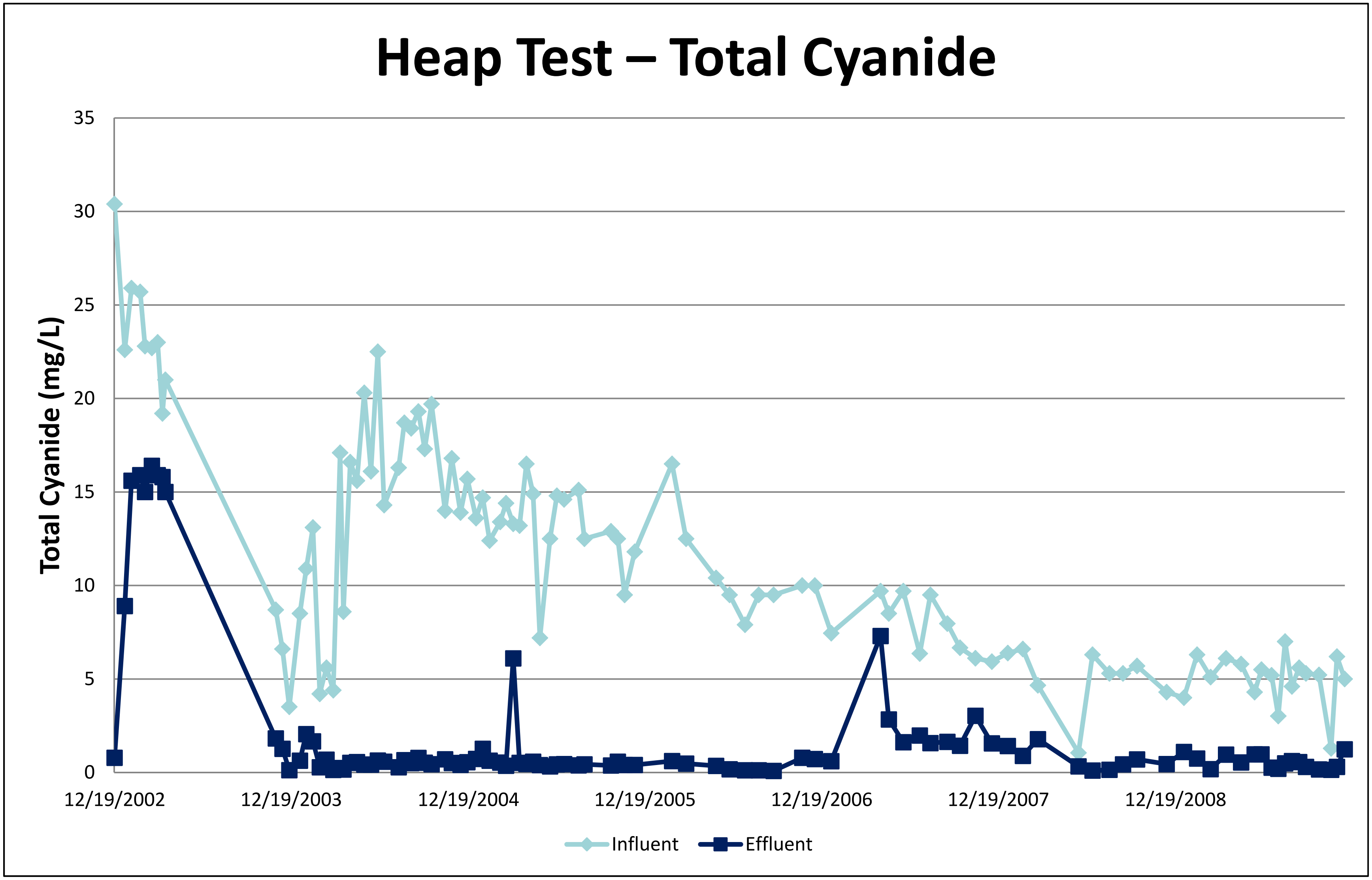
- One acre limestone based pad on a synthetic liner
- Limestone - 20% > 1.5”, 50% > 1” and 70% < ¾”
- Buried drip line distribution system
- Counter current convection air in heap
- Flow rate - 3 gallons/day/ft^2
- Soda ash (alkalinity) and phosphate added to influent
- Source water - T1 containment well water




Heap Test Results



Heap Test Results



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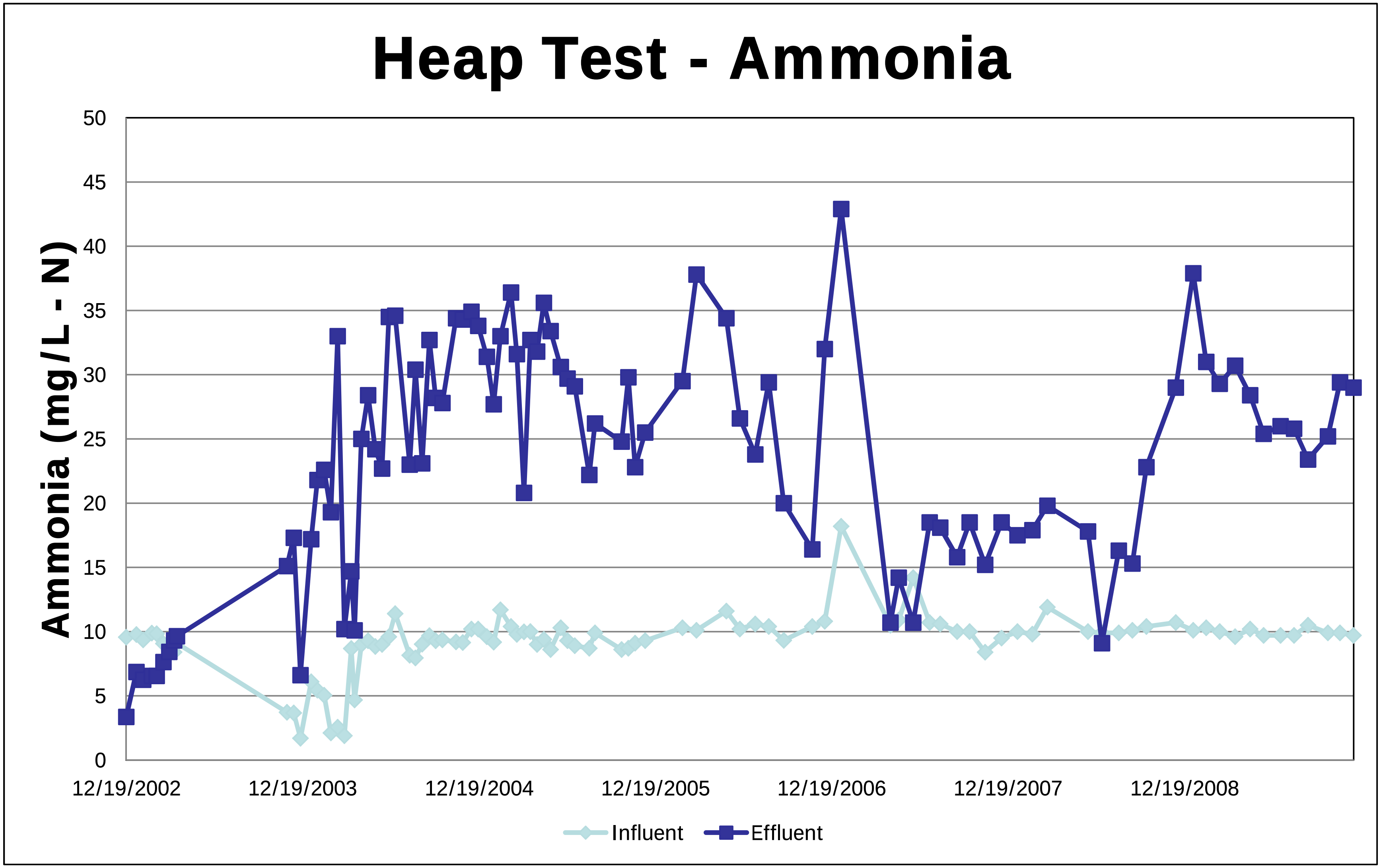
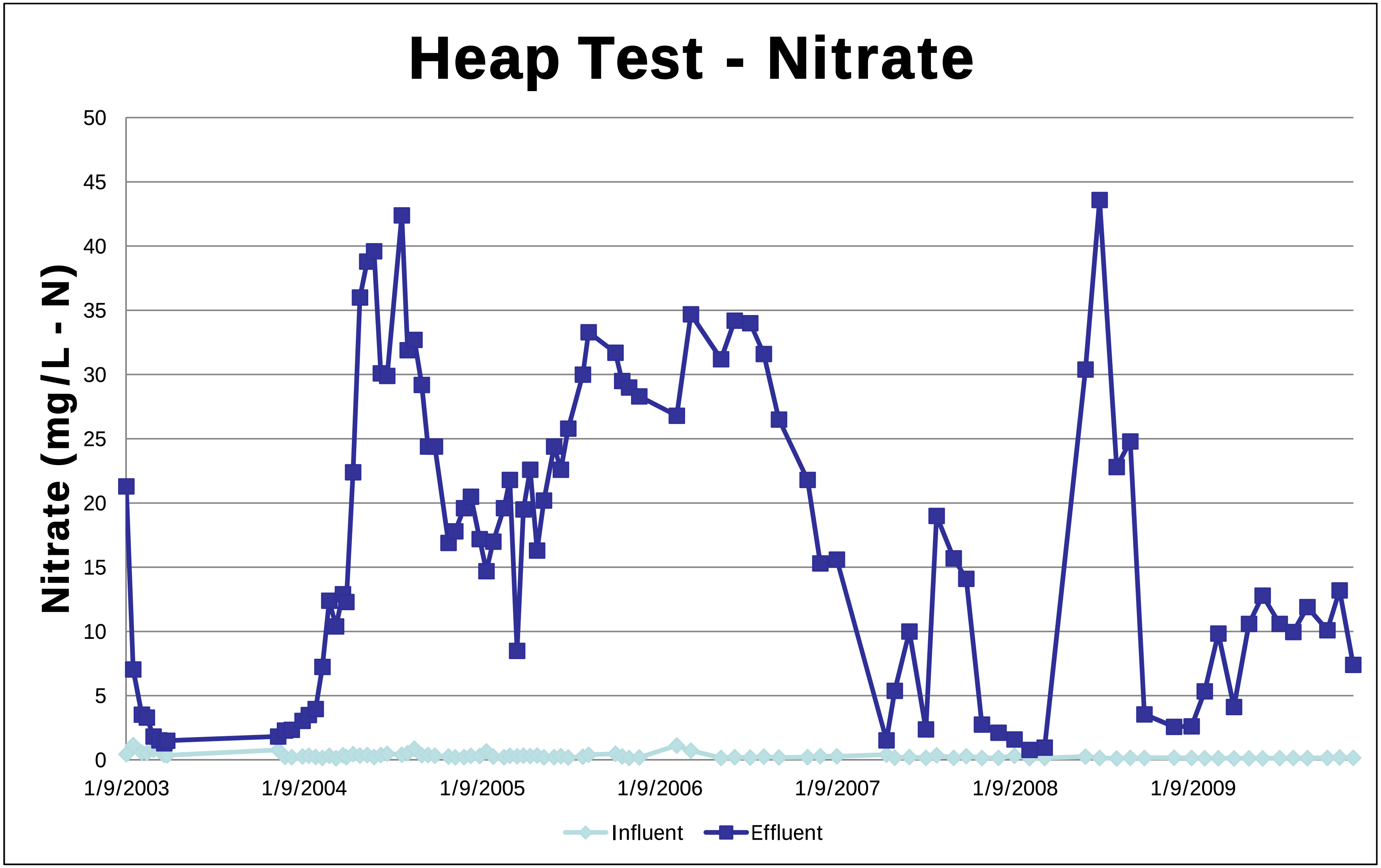


Heap Test Results



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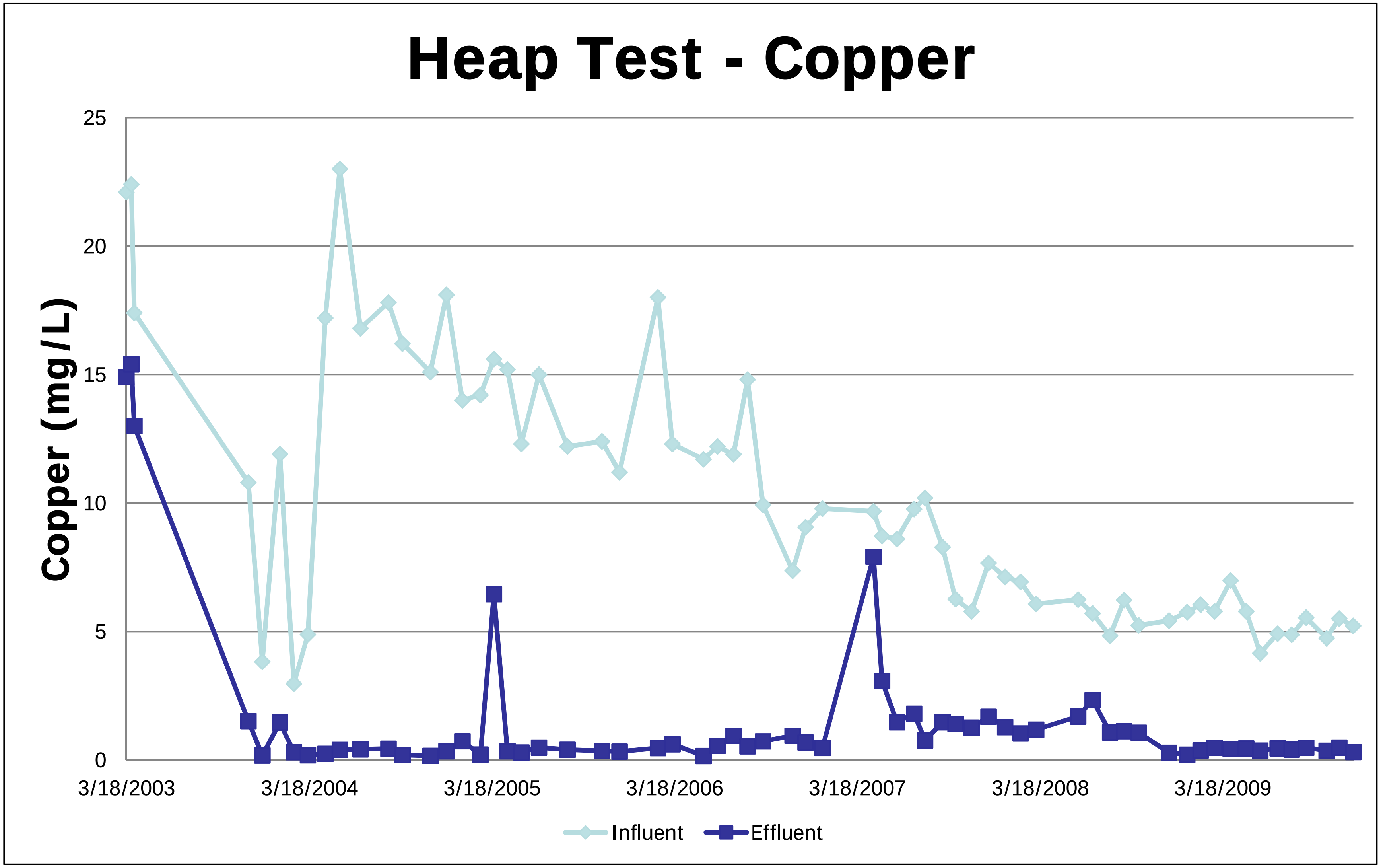
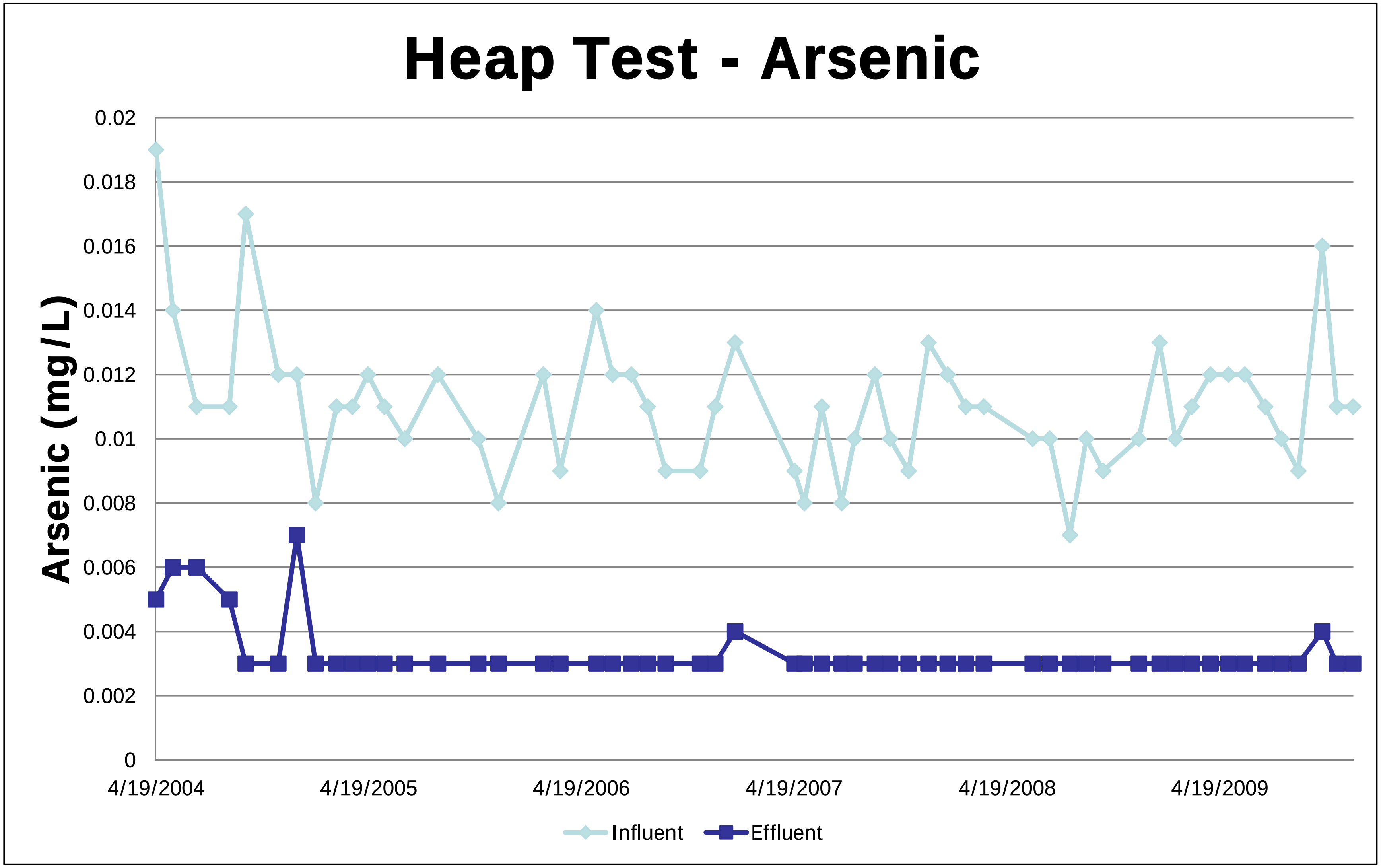


Heap Test Results



Heap Test Results

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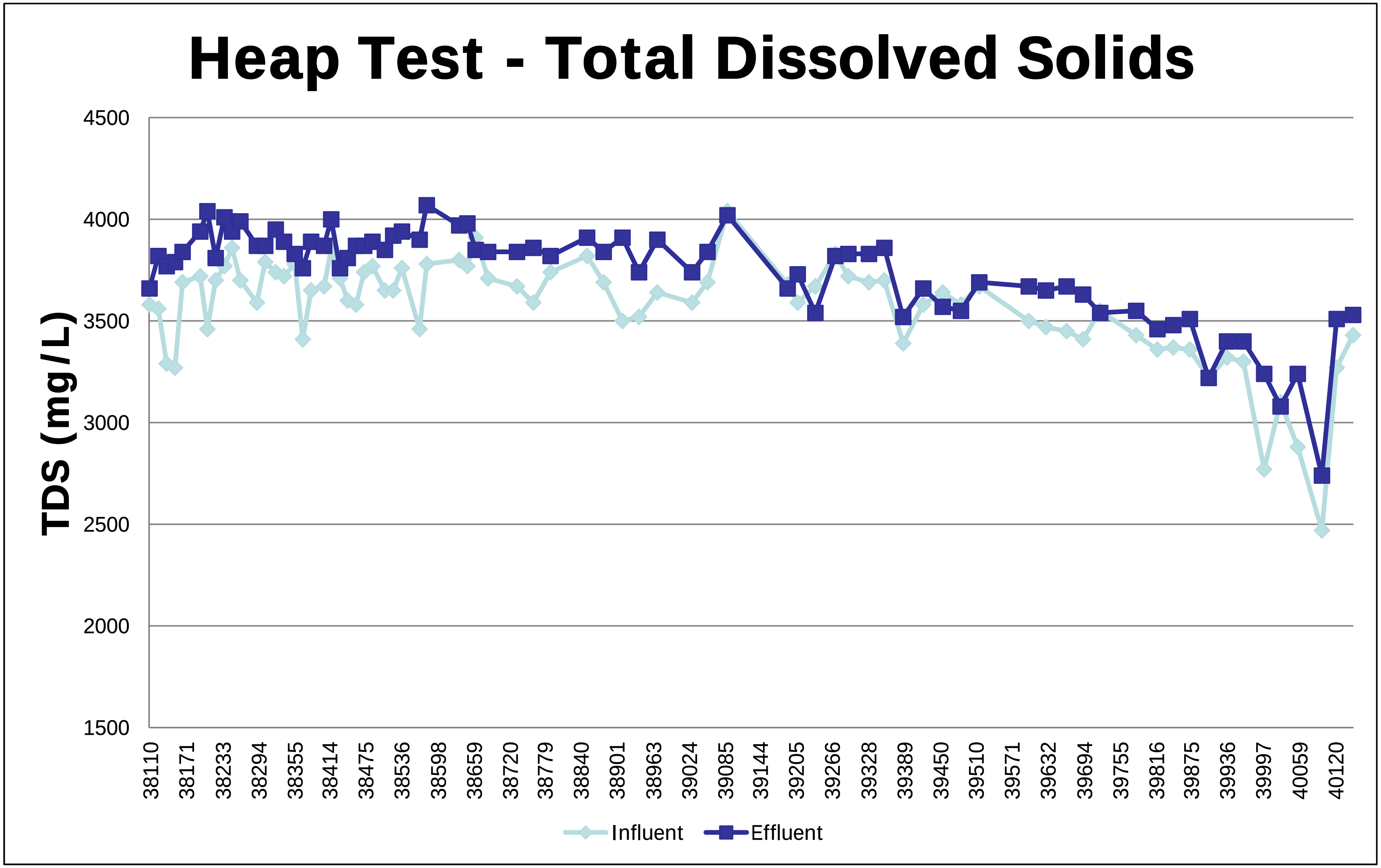

Heap Test Results

- Heap treatment can significantly reduce cyanide and thiocyanate concentrations
- Heap treatment can reduce metal and metalloid concentrations
- A single stage heap did not demonstrate complete nitrification
- Short circuiting due to plugged drip line filters was a problem
- Temperature effects on small heap reduced performance, particularly for nitrification
- Single stage heap could not meet WQ standards

Heap Treatment

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- Larger heaps could mitigate temperature effects
- A second stage heap could likely remove more cyanide and thiocyanate as wells have complete nitrification
- TDS is a problem – some sulfate could be removed in an anaerobic denitrification treatment step
- Heap treatment could reduce phytotoxicity for land application
- Heap treatment has the potential for a low capital and operating cost water management tool

Questions ?

(None – Thank You)

Jim Whitlock

- “A number of research people have tried to make this process(es) work without much success, probably because it is art as well as science. ”

- “If your audience wants to contact me with questions, that is fine as well.”