Ten Years After: The Operation of the Luttrell Biochemical Reactor

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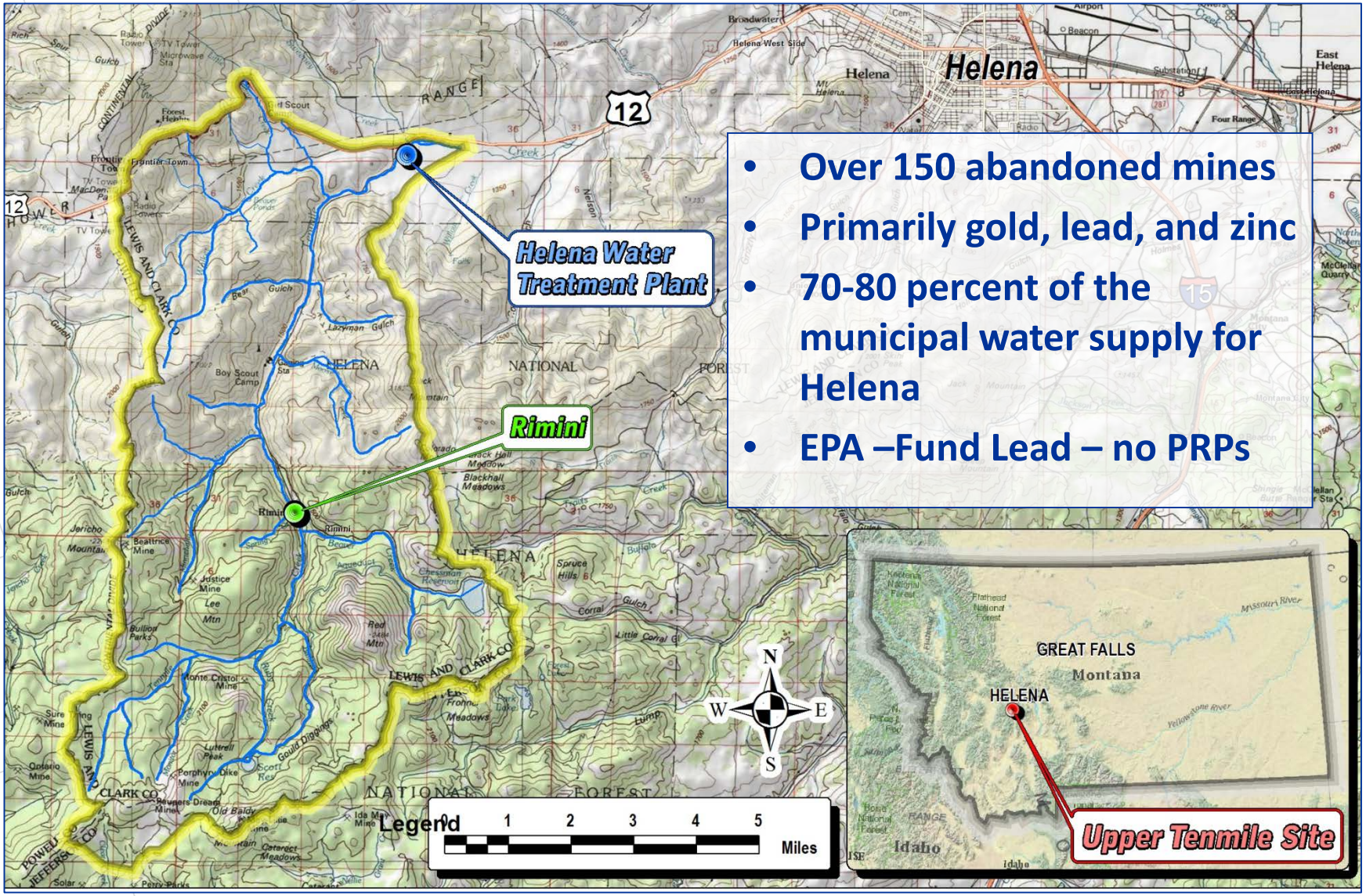
About the Luttrell Biochemical Reactor

- Pilot constructed in 2002
- Oldest constructed bioreactor at elevation – 7,800 ft
- Treats leachate from the Luttrell Repository
- Operated for 10 years
- >98% metal removal efficiency for Cd, Cu, Pb, Zn
- No added substrate
- Low maintenance (hydraulics)

Presentation Overview

- Site Background
- Luttrell Repository
- Leachate Management and Treatment
  - Water Treatment Plant
  - Land Application
  - Pilot Biochemical Reactor
- Biochemical Reactor Performance Data
- Upcoming Work

Upper Tenmile Site Background



- Over 150 abandoned mines
- Primarily gold, lead, and zinc
- 70-80 percent of the municipal water supply for Helena
- EPA –Fund Lead – no PRPs

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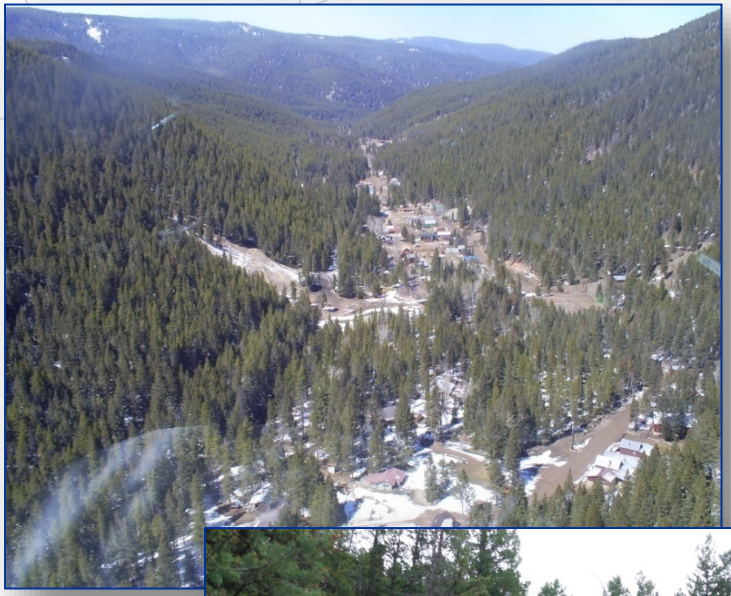
Record of Decision (2002)



Overall Goals of Selected Remedy:

- Protect watershed which serves City of Helena
- Remove mine wastes from 70 abandoned sites to repository
- Remove contaminated residential yard soils to repository
- Adit discharge source control and treatment

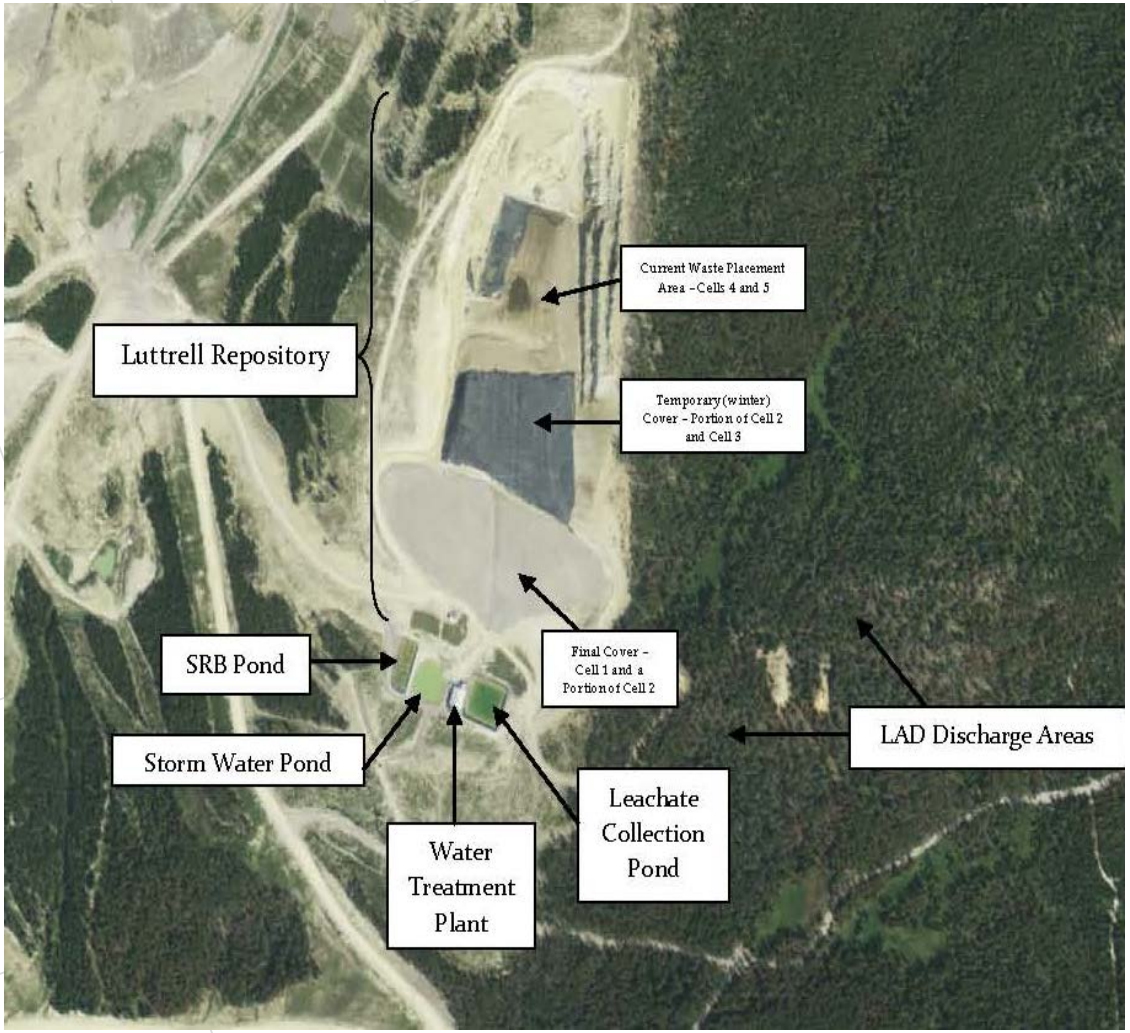
Luttrell Repository

- Regional repository
- Former Basin Creek Mine – Luttrell Pit
- Serves Tenmile Creek, Basin Creek Superfund sites, and other high priority mine cleanups nearby

Luttrell Repository (2003 – 2011)

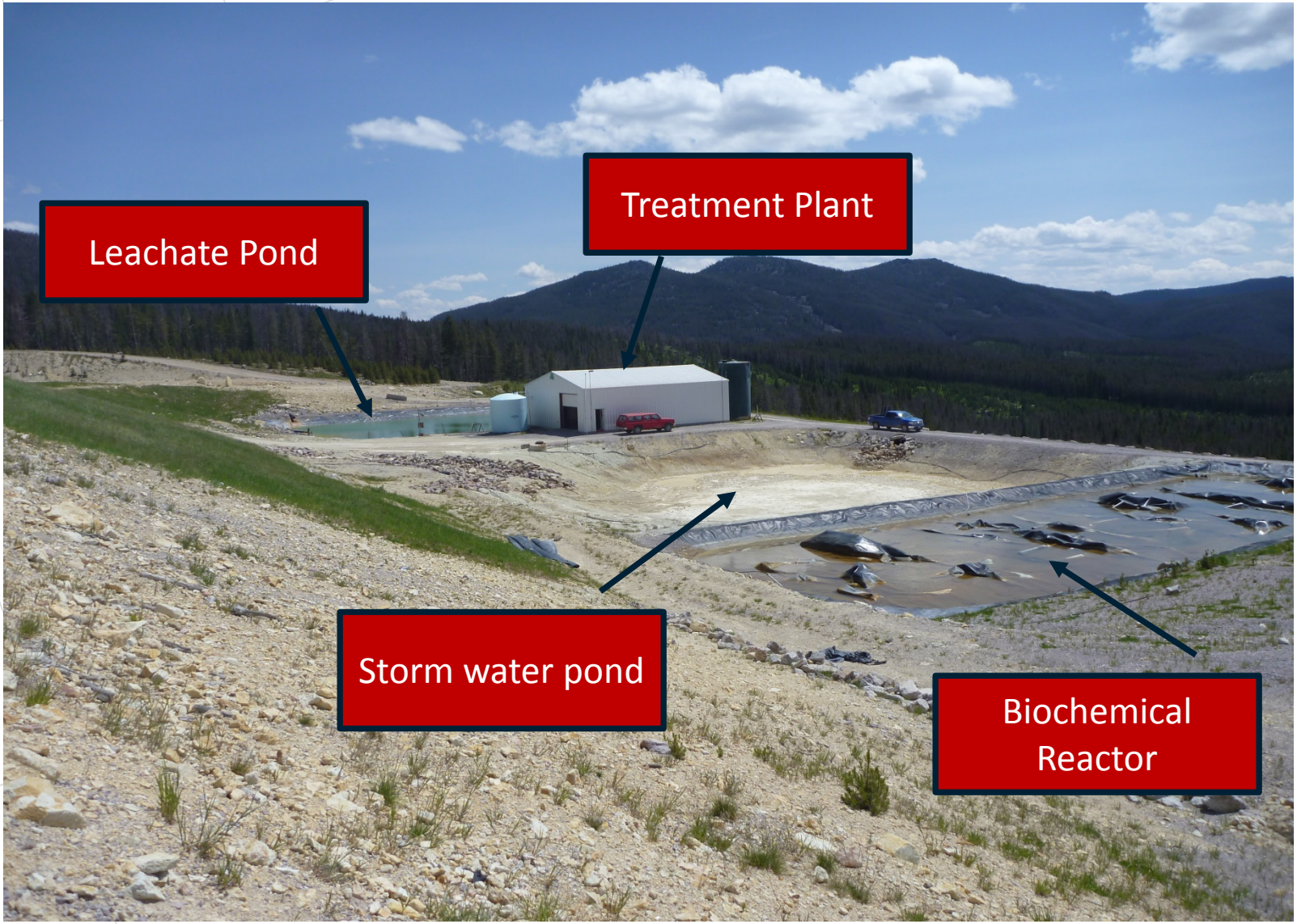
- Located at old mine pit
- About 500,000 cy of waste placed through 2011
- Full liner system with leachate collection and treatment

Luttrell Leachate Water Treatment System



- Leachate drains to a 775,000 gallon pond
- **Some leachate is pretreated in the biochemical reactor**
- ~1 million gallons per year leachate is treated per year in the water treatment plant
- Discharge to a Land Application Disposal (LAD) system
- Only operated June – September

Leachate Collection and Treatment



Luttrell Leachate Water Treatment Plant

- Powered by a large diesel generator
- WTP can meet standards for discharge to LAD, but not surface water
- Leachate pond fills to near overflowing with snow/ice and snowmelt each spring
- Necessary to plow road to get to WTP each year to begin treatment in mid-May

Luttrell Biochemical Reactor (BCR) Pilot

- Constructed in 2002
- 3,600 square feet
- Manure, wood chips, sawdust, straw, and coarse limestone for structure
- Treats 2-5 gpm
- Begin operation in mid- to late-June, once the period of potential pipe-freezing is over
- 2006 added black liner on top, to limit snowmelt infiltration and warm the cell
- Freezes to a depth of 18 inches in winter, remains 2-5 C at depth

Luttrell Biochemical Reactor (BCR) Pilot

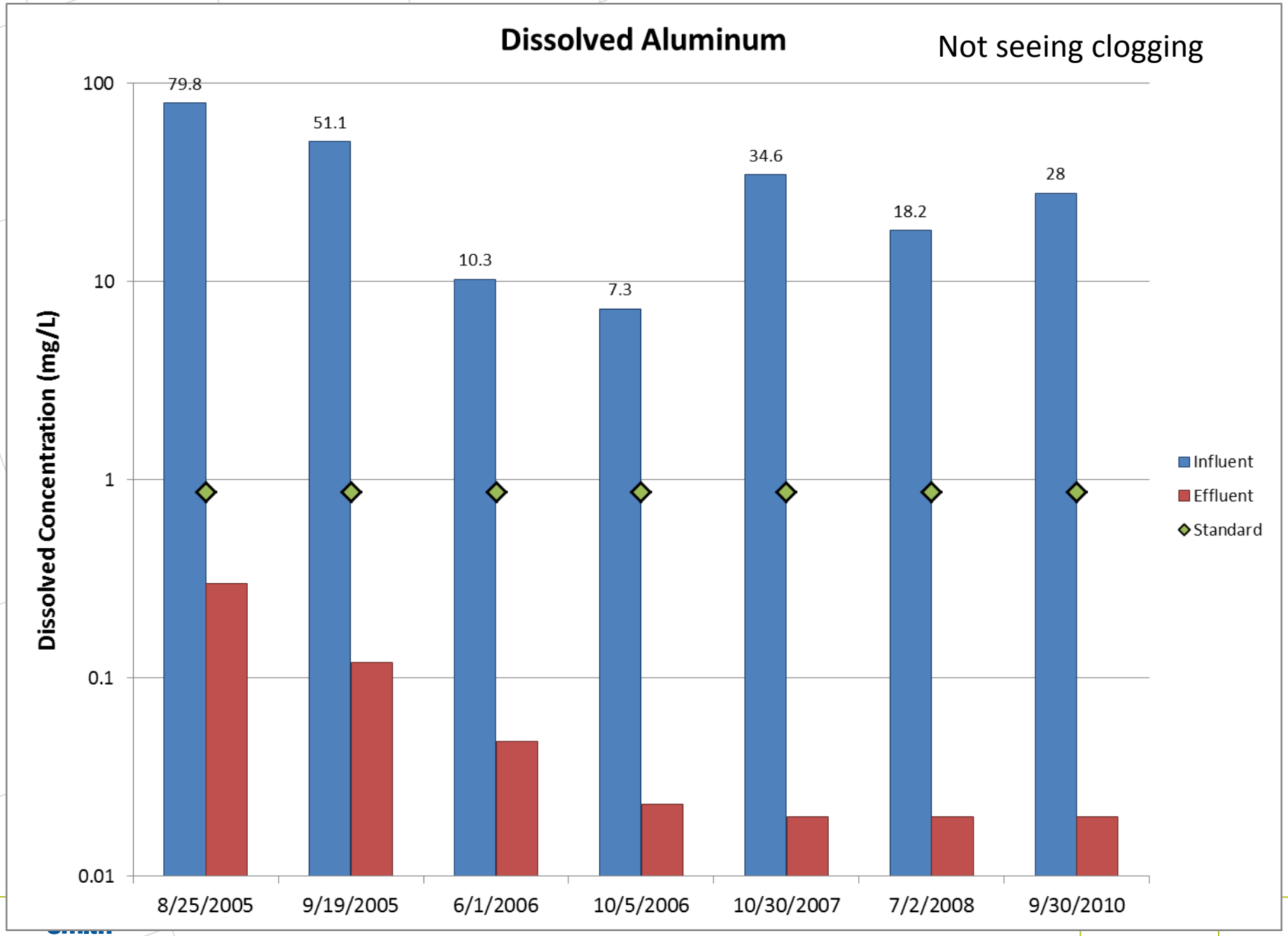
- Since 2006 has been used as a pretreatment
- Effluent from the BCR mixed with untreated leachate
- Raises pH ~2 pH units
- Treated in the water treatment plant (caustic addition)
- Effluent discharged to land application system
- After July, the BCR can handle all of the leachate from the repository except during high rainfall events

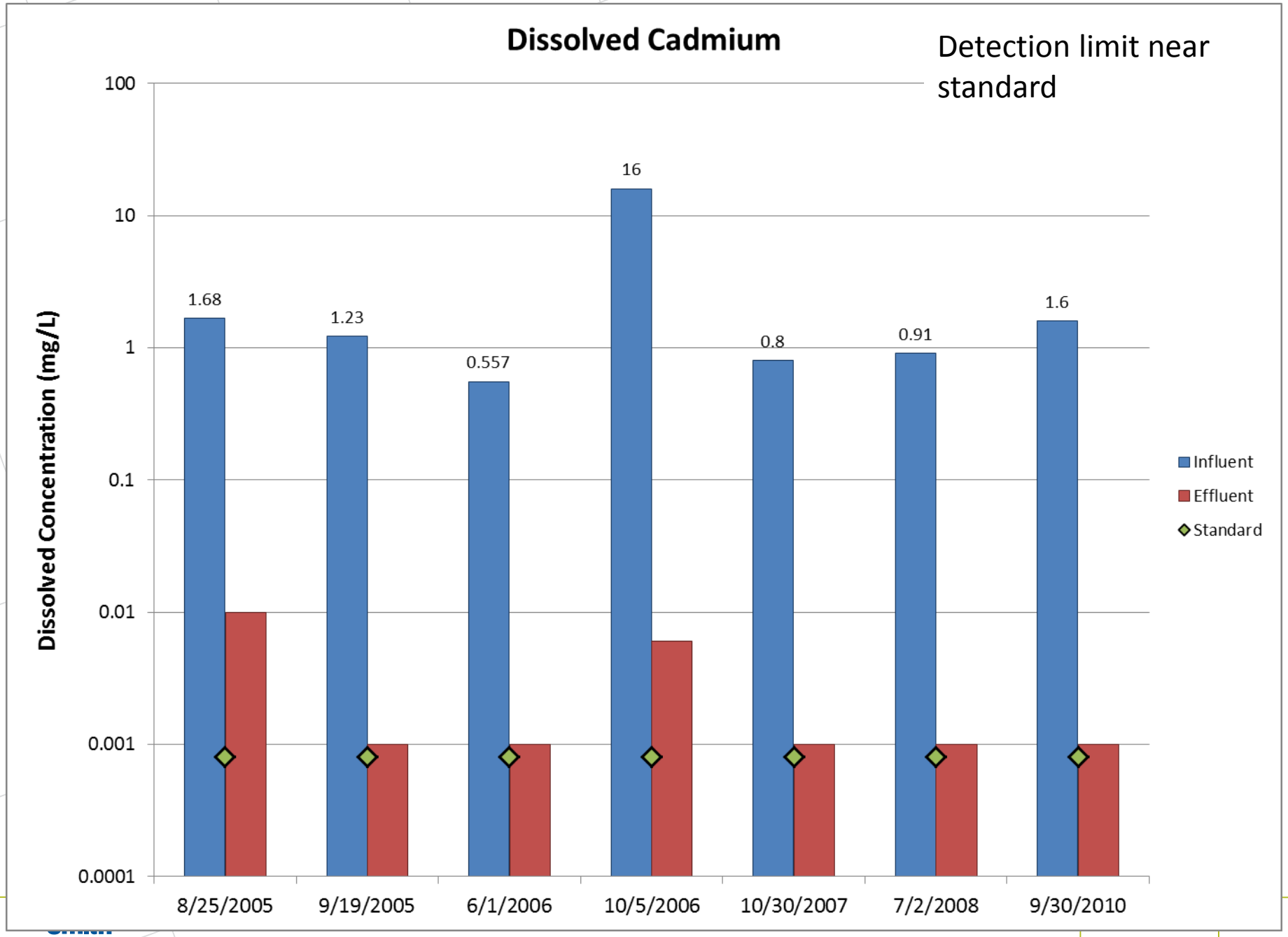
Luttrell Land Application Disposal (LAD) System

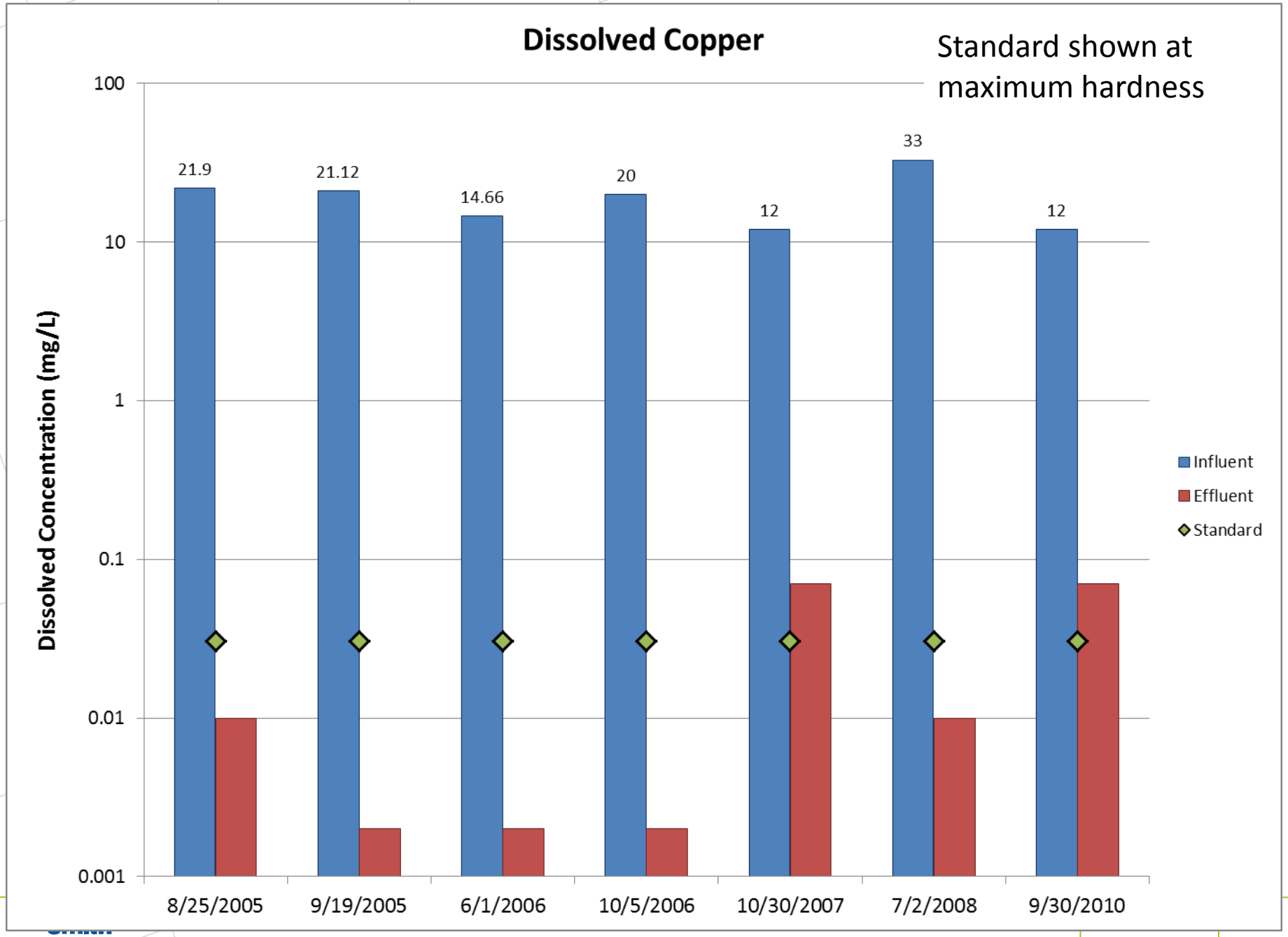
- Treated leachate sprayed over a large forested area to allow the soils to attenuate metals before the water reaches groundwater or a stream
- Data over about 10 years of operation indicate that there is very large metals loading capacity in the LAD soils; no buildup of metals in the soils has been observed
- LAD requires pumping equipment to operate

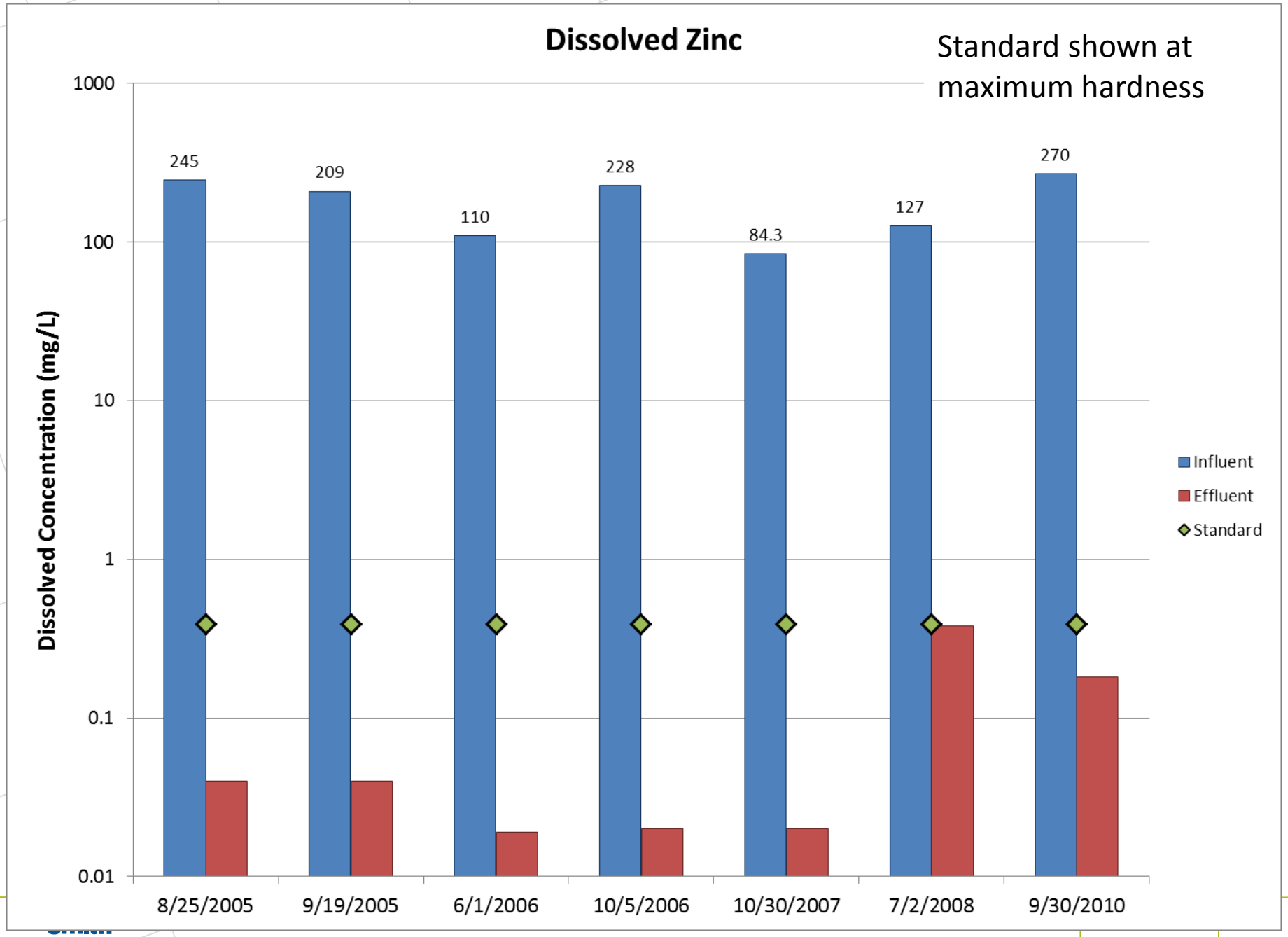
Luttrell BCR Performance

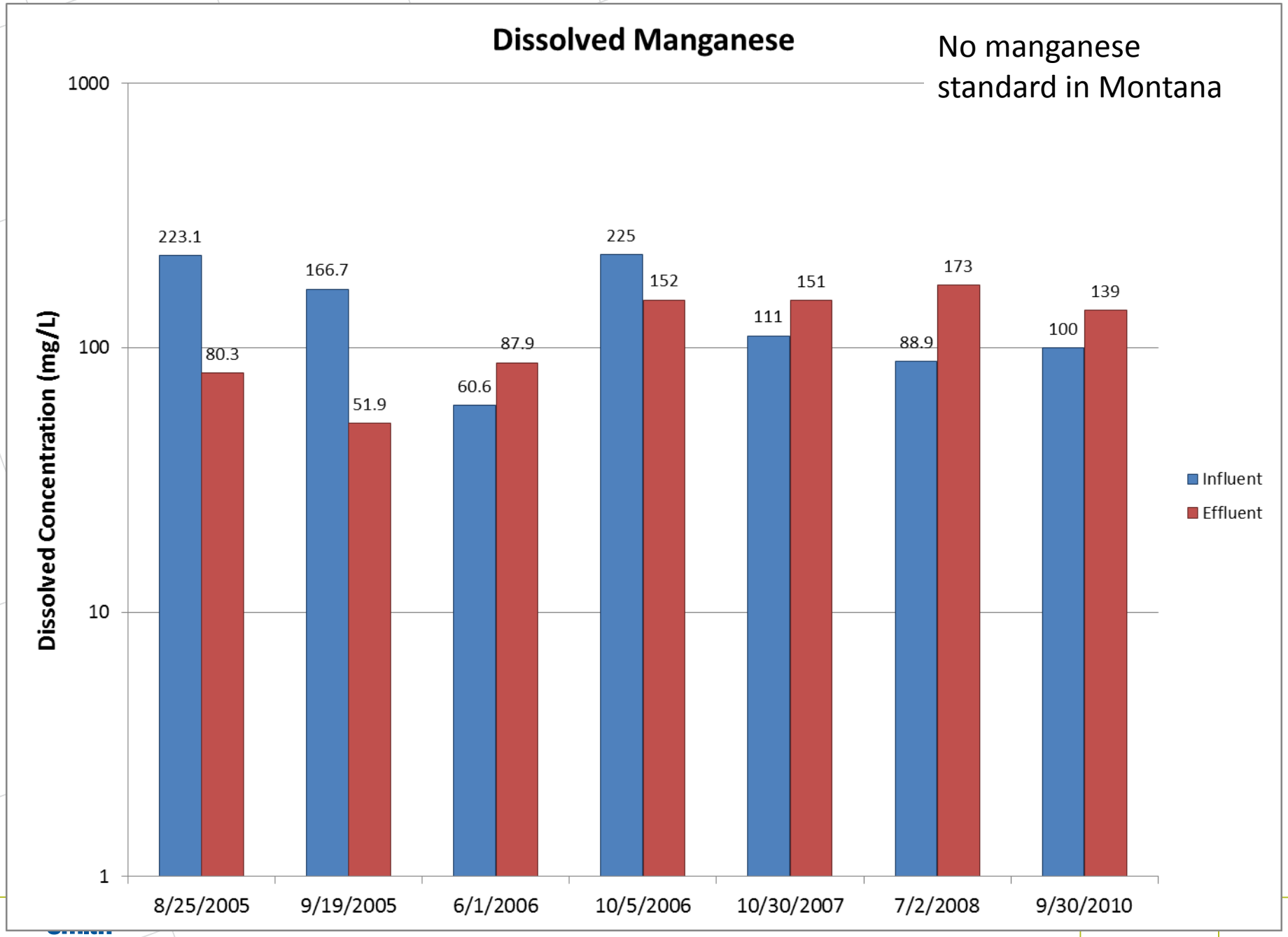
- Generally been monitored seasonally
- 2006 was monitored biweekly
- Data indicates consistent >98% removal for key metals
  - Cadmium, copper, lead, zinc are near surface water quality standards
  - Arsenic removal is also good, but influent is variable
  - Manganese is not removed
- Hydraulics - small pipes retrofitted with large pipes and valves due to initial clogging
- No additions to the initial substrate


Dissolved Aluminum
Not seeing clogging
Dissolved Concentration (mg/L)
100
10
1
0.1
0.01
79.8
51.1
10.3
7.3
34.6
18.2
28
8/25/2005
9/19/2005
6/1/2006
10/5/2006
10/30/2007
7/2/2008
9/30/2010
Influent
Effluent
Standard


Dissolved Cadmium
Detection limit near standard
Dissolved Concentration (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
1.68
1.23
0.557
16
0.8
0.91
1.6
8/25/2005
9/19/2005
6/1/2006
10/5/2006
10/30/2007
7/2/2008
9/30/2010
Influent
Effluent
Standard


Dissolved Copper
Standard shown at maximum hardness
Dissolved Concentration (mg/L)
100
10
1
0.1
0.01
0.001
21.9
21.12
14.66
20
12
33
12
8/25/2005
9/19/2005
6/1/2006
10/5/2006
10/30/2007
7/2/2008
9/30/2010
Influent
Effluent
Standard


Dissolved Zinc
Standard shown at maximum hardness
Dissolved Concentration (mg/L)
1000
100
10
1
0.1
0.01
245
209
110
228
84.3
127
270
8/25/2005
9/19/2005
6/1/2006
10/5/2006
10/30/2007
7/2/2008
9/30/2010
Influent
Effluent
Standard


Dissolved Manganese
No manganese standard in Montana
Dissolved Concentration (mg/L)
1000
100
10
1
223.1
80.3
166.7
51.9
60.6
87.9
225
152
111
151
88.9
173
100
139
8/25/2005
9/19/2005
6/1/2006
10/5/2006
10/30/2007
7/2/2008
9/30/2010
Influent
Effluent

Future Leachate Management

- Long term goal is to rely solely on BCR (perhaps enlarged) to treat all leachate water; difficulty is storing leachate water over the winter and handling the large quantity of water in the spring
- Data indicate that for most parameters BCR can generally meet standards for LAD discharge, but not consistently for direct surface water discharge
- Aeration step necessary prior to discharge, manganese removal

Luttrell Repository Prior to Highwall Layback 2010

- Vertical sidewalls
- Waste surface drains to north, water percolates to leachate system
- Storm water directed north to drain system

Luttrell Repository Reconfiguration, 2011-2012

- Allow for all snow load and storm water to drain off of the winter cover to the south without entering the leachate system

Final base grading of Cell 5 expansion to north and west

Winter Cover Installation - 2012

- Heavy duty 20-mil Durascrim winter cover over cells 2 – 5
- Life expectancy for Durascrim is 20 years
- All seams sewn and sand bags every 15 feet
- For future waste placement, peel back and open up a small area of winter cover, starting at north end of repository

Completed Winter Cover - 2012

Rainstorm on Winter Cover

Cover will significantly reduce the volume of leachate generated

Upcoming Work

- Confirm post-winter cover leachate volume decrease
- Intensive monitoring of the BCR in 2013 to obtain more robust performance dataset for stakeholders
- Then hopefully…
  - Modify BCR for continuous operation in freezing conditions
  - Add necessary aeration/polishing steps
  - Expand and allow for gravity flow
  - Decommission active water treatment plant