First Permitted Use of Alum in the State

Learning from the Past to Protect the Future at Big Elk Meadows

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Sustaining Watershed Conference
Vail, Colorado
October 5-7, 2010

Lake & Reservoir Management Options

	Pros	Cons
Move Water - Flush - Destratify - Drawdown	Easy Inexpensive No permits	Water/Rights Energy Moves Problem
Oxygen - Aeration - Oxygenation - Mixing	No permits Multiple Benefits	Capital Energy Continuous
Chemicals - Herbicides - Algaecides - Barley	Quick & Easy	Permits Continuous Expensive
Biological - Fish Renovation - Weevils - Grass Carp	Natural & Greener	Slow Uncertain Results

The Past

Alum treatment in Wisconsin during the 1970's,

Horseshoe Lake

Horseshoe Lake, located near Manitowoc, WI became eutrophic from agricultural runoff, and also from the direct drainage of the waste lagoon of a cheese and butter factory during 1963-65. Prior to the dairy discharges, the lake had a sport fishery. Winter fishkills in 1964-66, severe blue-green algal blooms from 1963-69, and nuisance macrophytes curtailed use of the lake. The dairy plant closed in 1965. In 1970 Horseshoe Lake became the first lake in the United States to receive an alum application (Peterson et al. 1973; Table 1).

The Past, Past

4,300,000,000 BCE

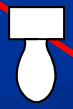
1700 BCE

1243 CE

1458 CE

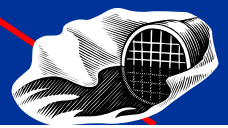
1777 CE

1800's CE



1970 CE

1980's CE



Alum in the U.S.

State	Lakes	Years
MN	30	1990-2003
FL	25*	1987-2005
WA	16	1974-2002
WI	15	1970-2004
MA	8	1978-2003
NJ	6	1993-1998
ME	4	1978-1992
OH, MI, NY,	3	1974-1985
CT, IL, CA, SD, OR	2	1973-2005
NE, MD, VT, NH	1	1984-2003
CO	1	2010

111

* Stormwater

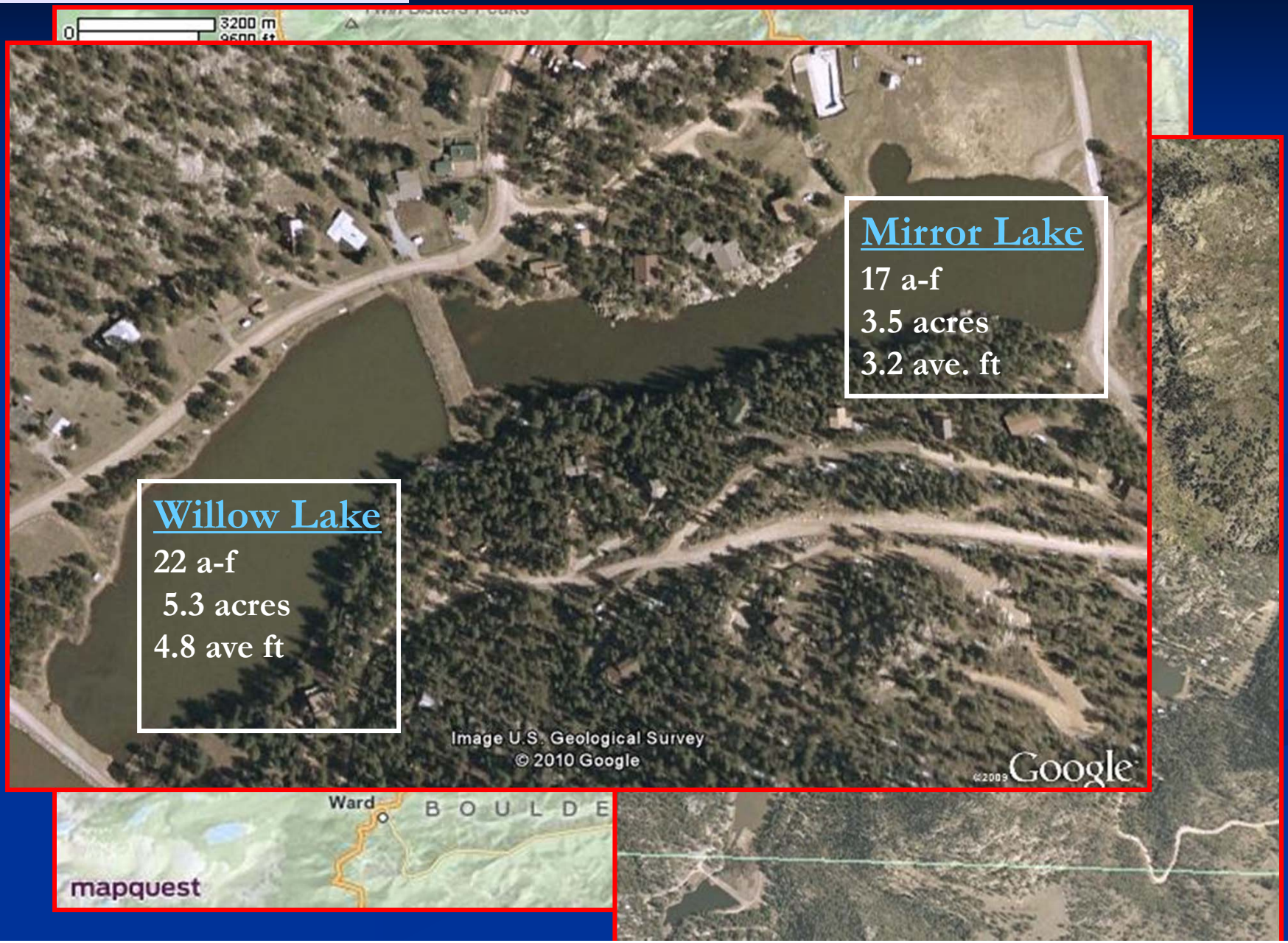
What we have Learned from the Past

- Why Alum Works
- Why Alum doesn't Work
- Higher Doses
- Not a Pesticide
- Shallow vs Deep Lakes
- Inactivation Primary Benefit
- Consequences of Improved Water Clarity
- Multiple Uses

The Present

Willow Lake (July 6, 2010)

The Present


0
3200 m
Mirror Lake
17 a-f
3.5 acres
3.2 ave. ft
Willow Lake
22 a-f
5.3 acres
4.8 ave ft
Image U.S. Geological Survey
© 2010 Google
©2009 Google
Ward
BOULDE
mapquest

The Present

Dosage Determination:

1. Alkalinity
2. Internal Loading Estimate
3. Mobile Phosphorus Estimate

Mirror = 17.6 mg Al/L
Willow = 16.7 mg Al/L

$$Al^{+3} + 3H_2O \longleftrightarrow Al(OH)_{3(s)} + 3H^+$$

(Aluminum Hydroxide)

Floc

Secondary

P Precipitation

Sweeping

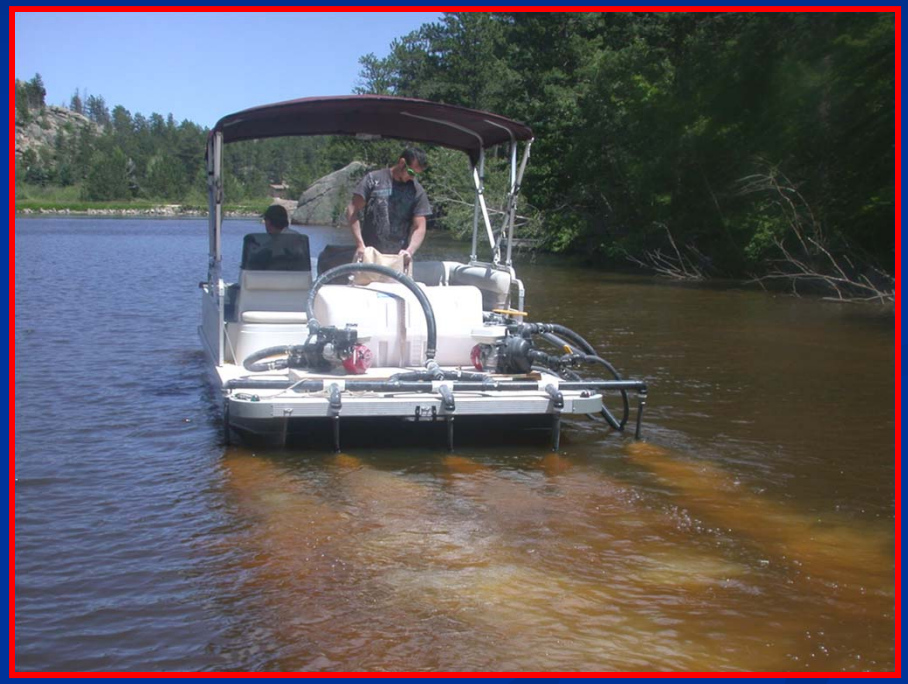
Entrapment

The Present

Buffering:

Calcium Carbonate

Willow = 6,300 lbs
Mirror = 4,850 lbs



The Present

Decisions:

What are the Goals?

What kind of Alum and Buffer?

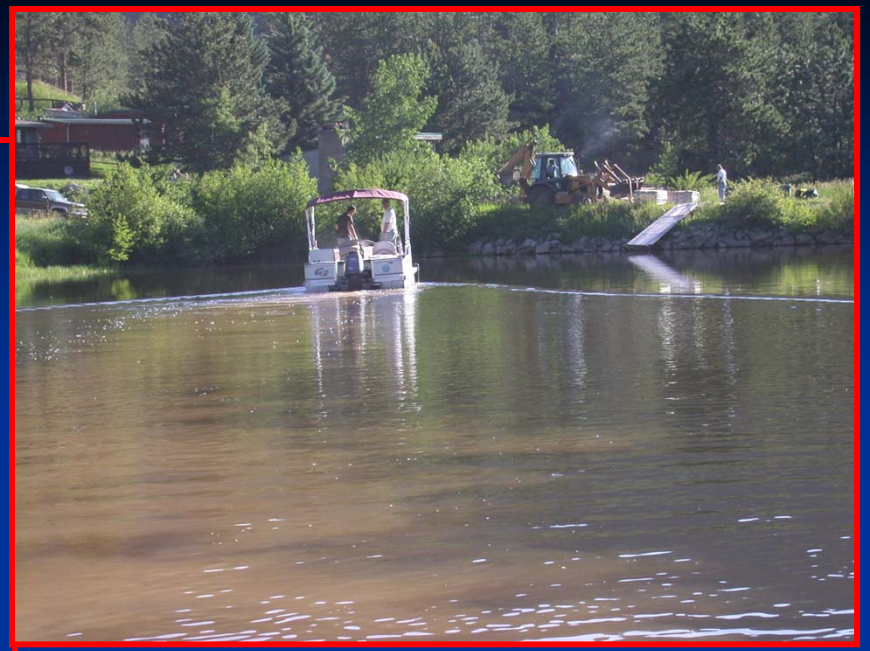
Liquid vs Powder?

Drinking Water Issues?

Who will Apply Chemicals?

How to Apply Both?

Purchase and Delivery?



$$Al^{+3} + H_xPO_4^{x-3} \longleftrightarrow AlPO_{4(s)} + H^+$$

(Aluminum Phosphate)
Insoluble

Primary

P Inactivation

The Present

Monitoring:

Pre (Sediments & Water)

During (pH, Nutrients)

Post (Sediments & Water)

Long-term Monitoring

The Future

Did the treatment reduce sediment P release?

YES

Did the treatment lower the P concentration in the photic zone?

YES

Did we kill anything?

NO

Are the lakes less green?

YES

How long did the reductions last?

??

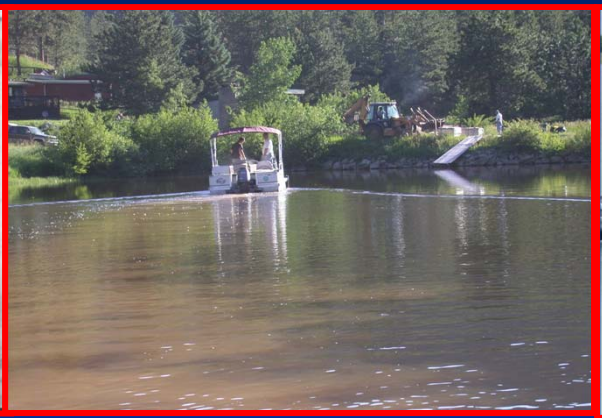
Will external loads bury the alum?

??

The Future

Past

Present



Future

- Will alum be used in Colorado by a few or by many?
- Will nutrient criteria development increase demand?
- Integration with other Management Tools?
- Watershed applications?

Questions and Comments