PRACTICAL OUTFALL MINE WATER TREATMENT APPLICATIONS– CHALLENGES AND SOLUTIONS

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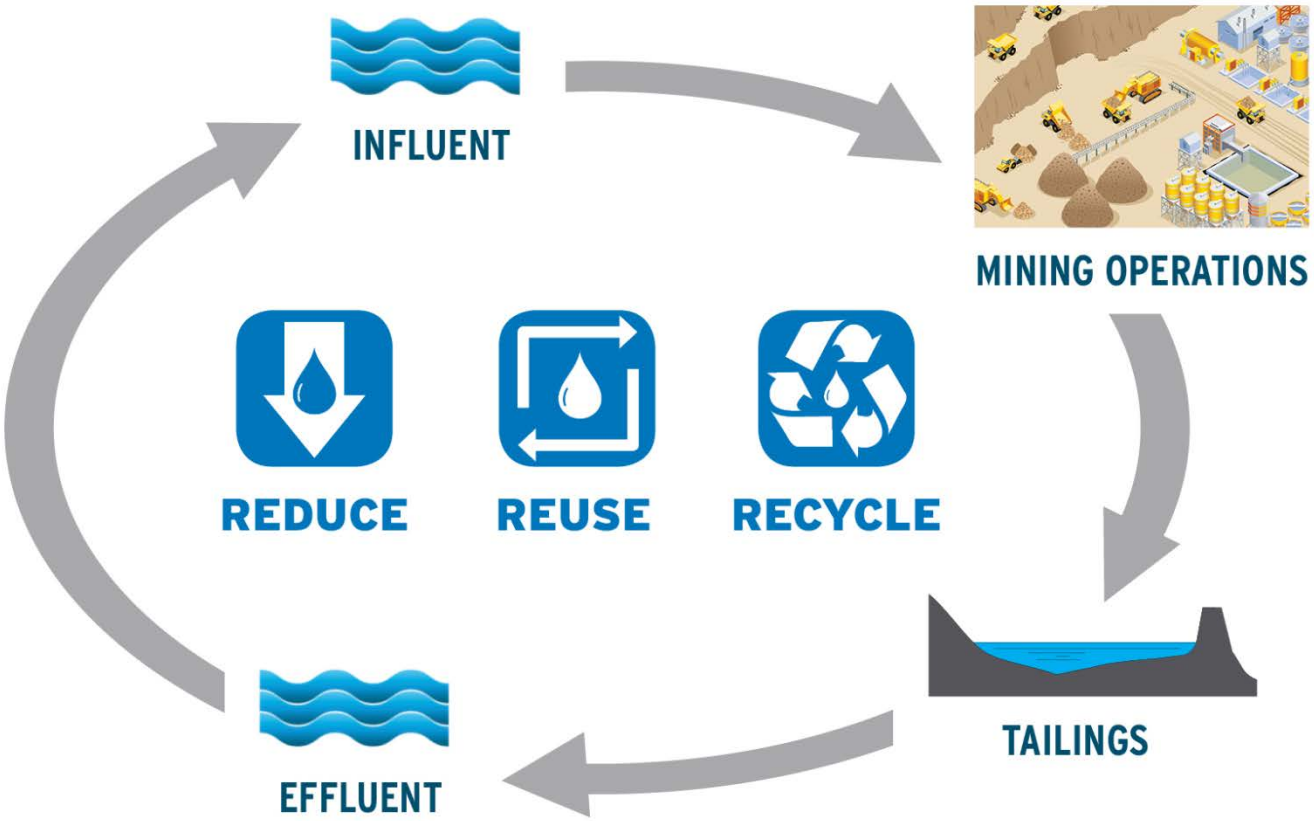
Water is a critical business driver for mining and a shared scarce resource globally

- Producers face many water challenges
  - Regulatory landscape
  - Limited discharge options
  - Public perception
  - Environmental stewardship
  - Water shortages, variable water quality
- Economic climate drives the need to increase efficiencies and reduce total cost of operation without major capital expenditure
- Producers need solutions that
  - Are adaptable
  - Function in harsh and variable environments
  - Utilize available water (sea, waste, etc)
  - Are compatible with process applications

Mineral processing is water intensive – detailed understanding of all water flows and interactions is needed



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Total Plant Approach to Water – Areas of Impact

- Seawater and slurry pipeline corrosion control
- Raw water treatment
- RO membrane treatment

- Process water scale control
- Flotation optimization
- Boiler and cooling water treatment

- Tailings management
- Water reuse/recycle
- Dust control

- Mine influenced waters treatment
  - Metals removal
  - Sulfate reduction
  - Suspended solids
- Mine dewatering

Poor effluent treatment = negative environmental impact and substantial penalties for exceedances

Increasing scrutiny from regulatory agencies for multiple outlet parameters

- More and more sites needing active discharge treatment in Appalachian coal areas
- Challenging applications - steep runoffs, highly variable flows and limited holding volume/time
- Onsite/Bench testing critical for effective program development
  - Feedpoint optimization critical
  - Options to improve residence time
  - Flocculant addition can improve settling
  - Ongoing monitoring and analytical testing
  - Flexible program for continued success
- Nalco has treatment solutions which have been proven effective for NPDES outlet parameters

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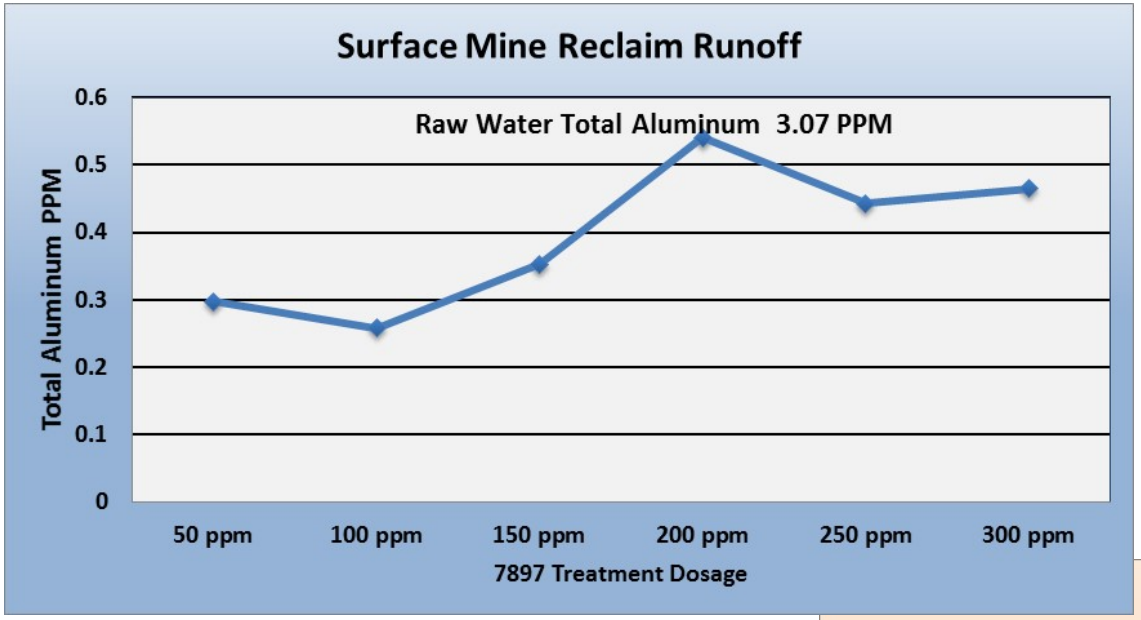
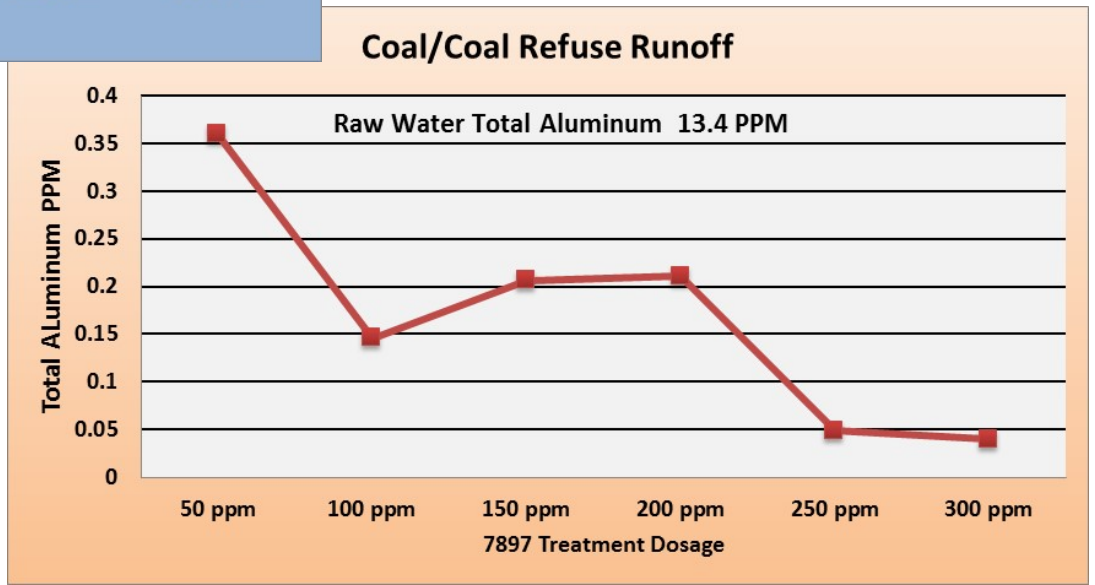
Properly developed treatment programs able to meet discharge limits in most applications





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7897 “Fish Friendly” Raw vs. Treated

Raw:

Client:	NALCO an ECOLAB COMPANY	**Collection Date:**	6/2/2015 12:00:00 AM
Project:		**Date Received:**	6/4/2015
Lab ID:	1506677-09A	**Matrix:**	Liquid
Client Sample ID:	RAW WATER	**Site ID:**	

Analysis	Result	MDL	PQL	MCL	Qual	Units	Date Analyzed	NELAP
METALS BY ICP			**Method: EPA 200.7 Rev. 4.4 (1994)**				**Analyst: CGW**	
Aluminum	0.270	NA	0.100	NA		mg/L	6/12/2015 4:02 PM	PA/VA

Treated @ 25 ppm

Client:	NALCO an ECOLAB COMPANY	**Collection Date:**	6/2/2015 12:00:00 AM
Project:		**Date Received:**	6/4/2015
Lab ID:	1506677-01A	**Matrix:**	Liquid
Client Sample ID:	7897 25 PPM	**Site ID:**	

Analysis	Result	MDL	PQL	MCL	Qual	Units	Date Analyzed	NELAP
METALS BY ICP			**Method: EPA 200.7 Rev. 4.4 (1994)**				**Analyst: CGW**	
Aluminum	0.033	NA	0.100	NA	J	mg/L	6/12/2015 3:31 PM	PA/VA

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Common problems seen in the region include iron and turbidity

- Site out of compliance with iron and turbidity
- Staining creek below – had to pay for cleaning
- Nalco Water program with pH adjustment, coagulant and flocculant
- Iron solids dropped out and all NPDES guidelines met
- Annual savings from optimized program >$250,000

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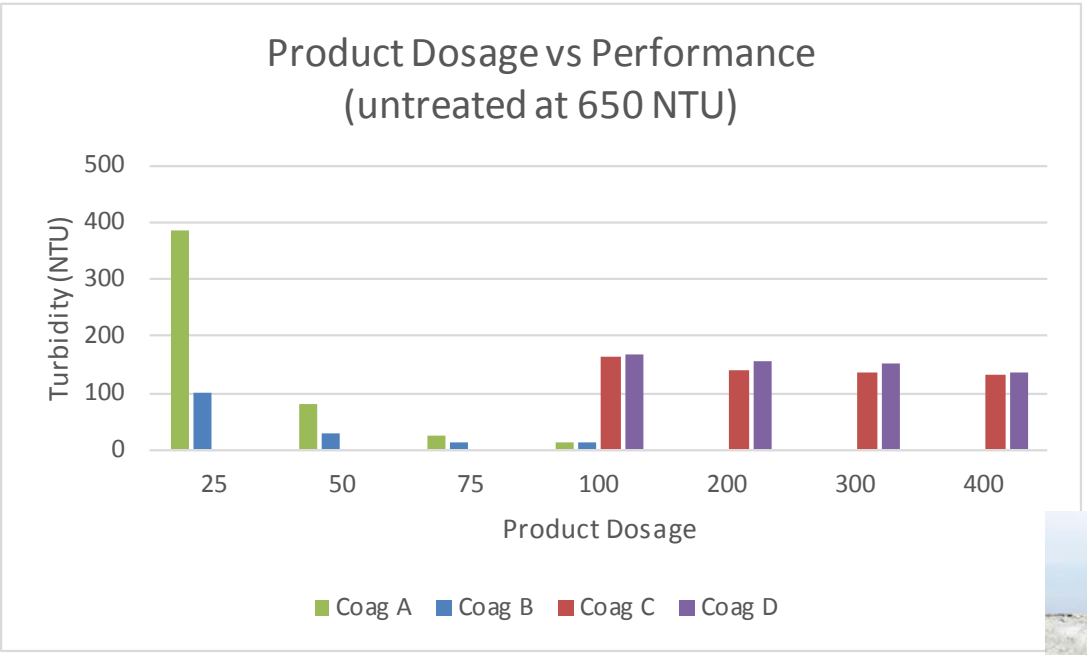
Treatment program cost and effectiveness can vary widely



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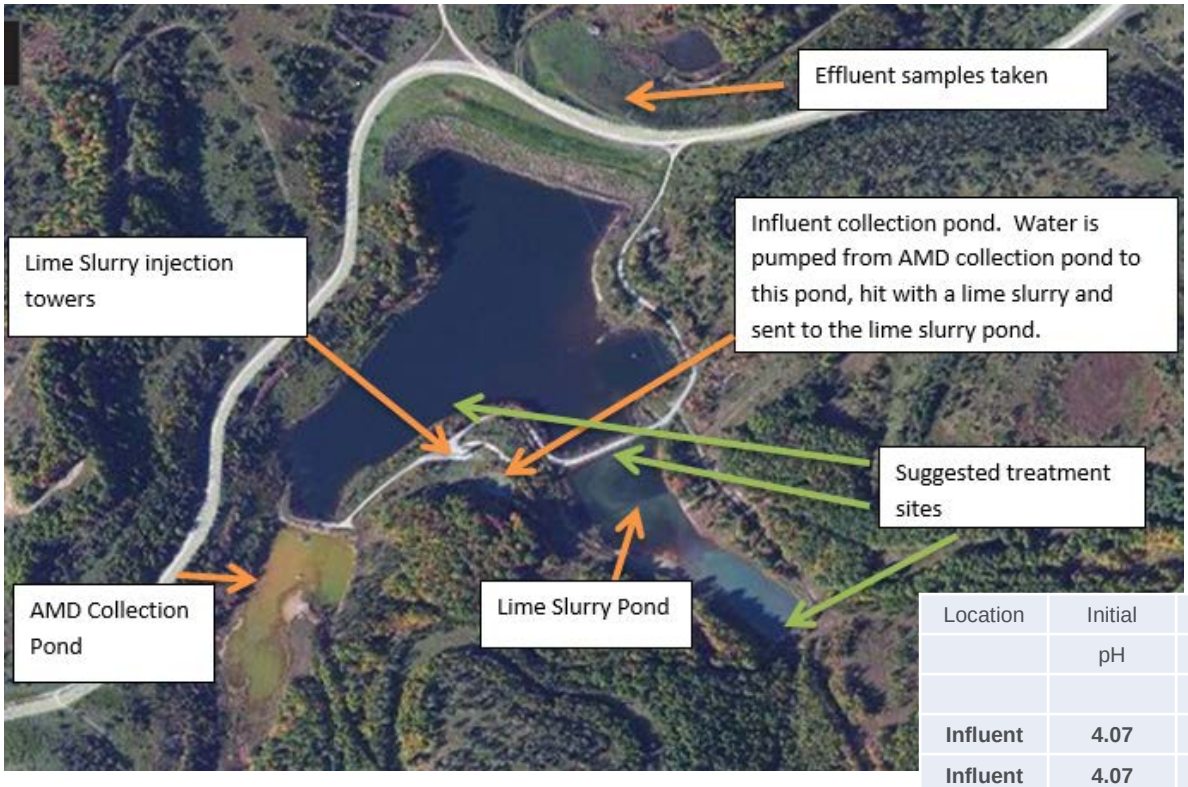
Alternatives to pH adjustment for metals removal

- NALMET™ 1691 – Heavy Metals Removal Technology
- Polymeric sulfide based precipitant
- Works at lower pH – avoiding caustic addition and pH compliance issues
- Simple one step process
- Often can remove aluminum and manganese without any pH adjustment

Lime treatment programs can be effectively augmented with additional treatment when needed



Location	Initial pH	Final pH	Product Dose	Mn (mg/L)	Al (mg/L)	% Alum Reduction
Influent	**4.07**	**Baseline**	**Baseline**	**18.5**	**16.2**	**0.00%**
Influent	**4.07**	**7.2**	**25**	**15.5**	**0.744**	**95.41%**
Influent	4.07	7.2	50	15.2	0.697	95.70%
Influent	4.07	7.2	75	14.9	0.792	95.11%
Influent	4.07	7.2	100	8.5	0.668	95.88%
Effluent	**7.2**	**7.2**	**25**	**0.64**	**0.703**	**95.66%**
Effluent	7.2	7.2	50	0.62	0.554	96.58%
Effluent	7.2	7.2	75	0.6	0.567	96.50%
Effluent	7.2	7.2	100	0.59	0.592	96.35%

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WaterShed™ Tailings Management increases water recovery and facilitates water reuse

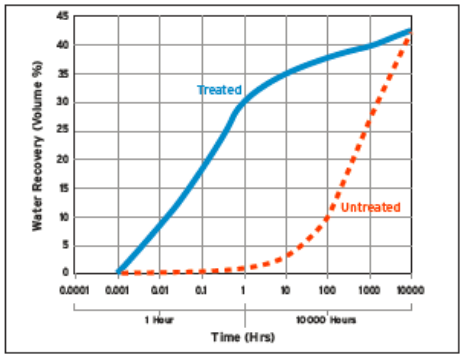
- Additives bind the solids within tailings slurries at discharge
- Improves tailings storage capacity and decant water quality
- Dramatically reduced rehabilitation time, often from years if untreated to weeks
- Local application – shut down three belt presses which paid for cost of program and saved $25k/day transportation cost

WATER
Operation losing 750m3/hr of water to tailings achieved >70% water recovery

EARTH
Coal plant tailings pond capacity extended from 8 to 15 mtpy

PRODUCTIVITY
Improved tailings utilization allowed sand & gravel plant to continue operation

Water Recovery



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Questions/Comments?

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