Ozone Treatment to Address Algal Toxin Concerns

OREGON on the bay
City of Opportunity

ARCADIS

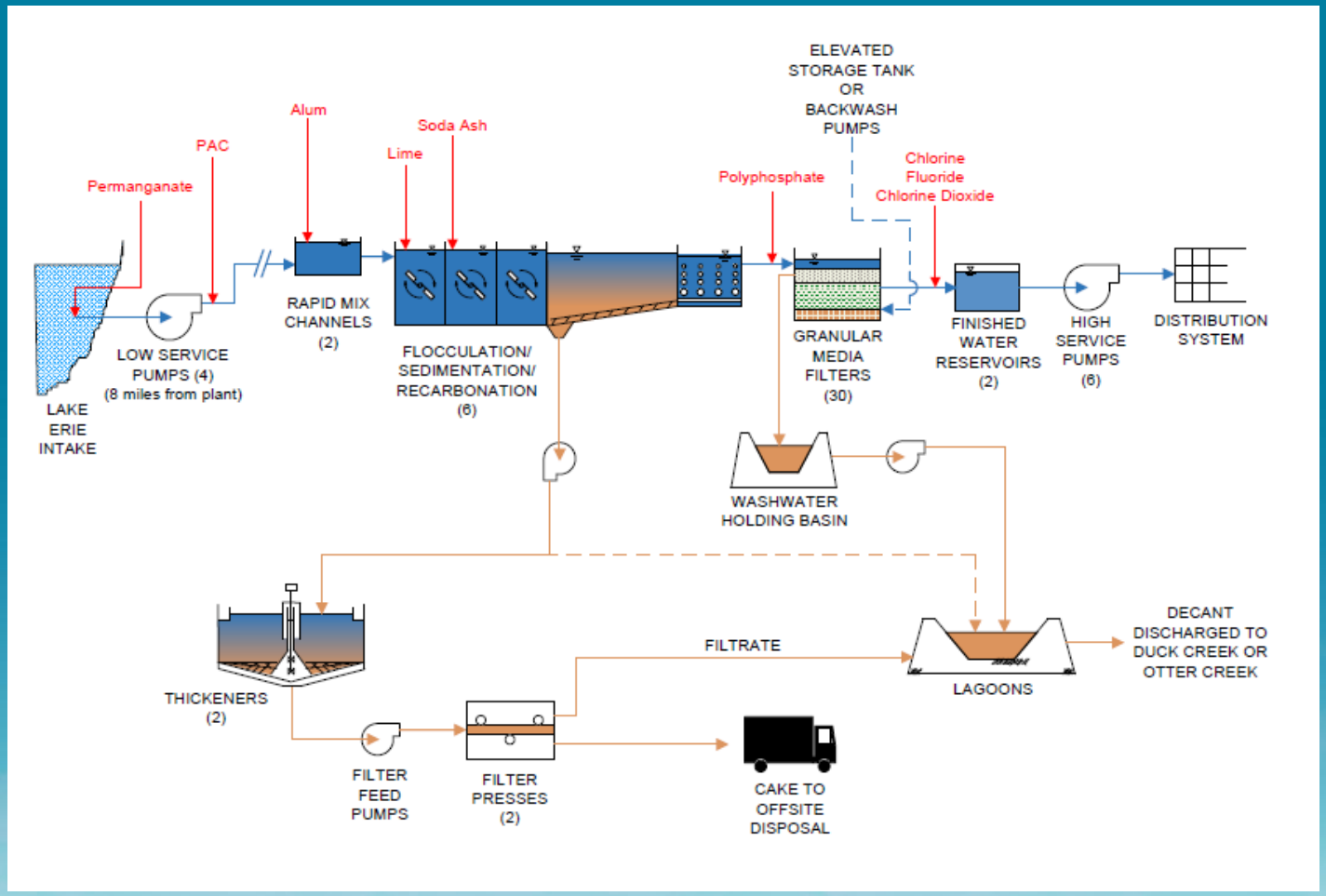
BLACK & VEATCH
Building a world of difference.

Cities requested assistance in evaluating treatment for HAB

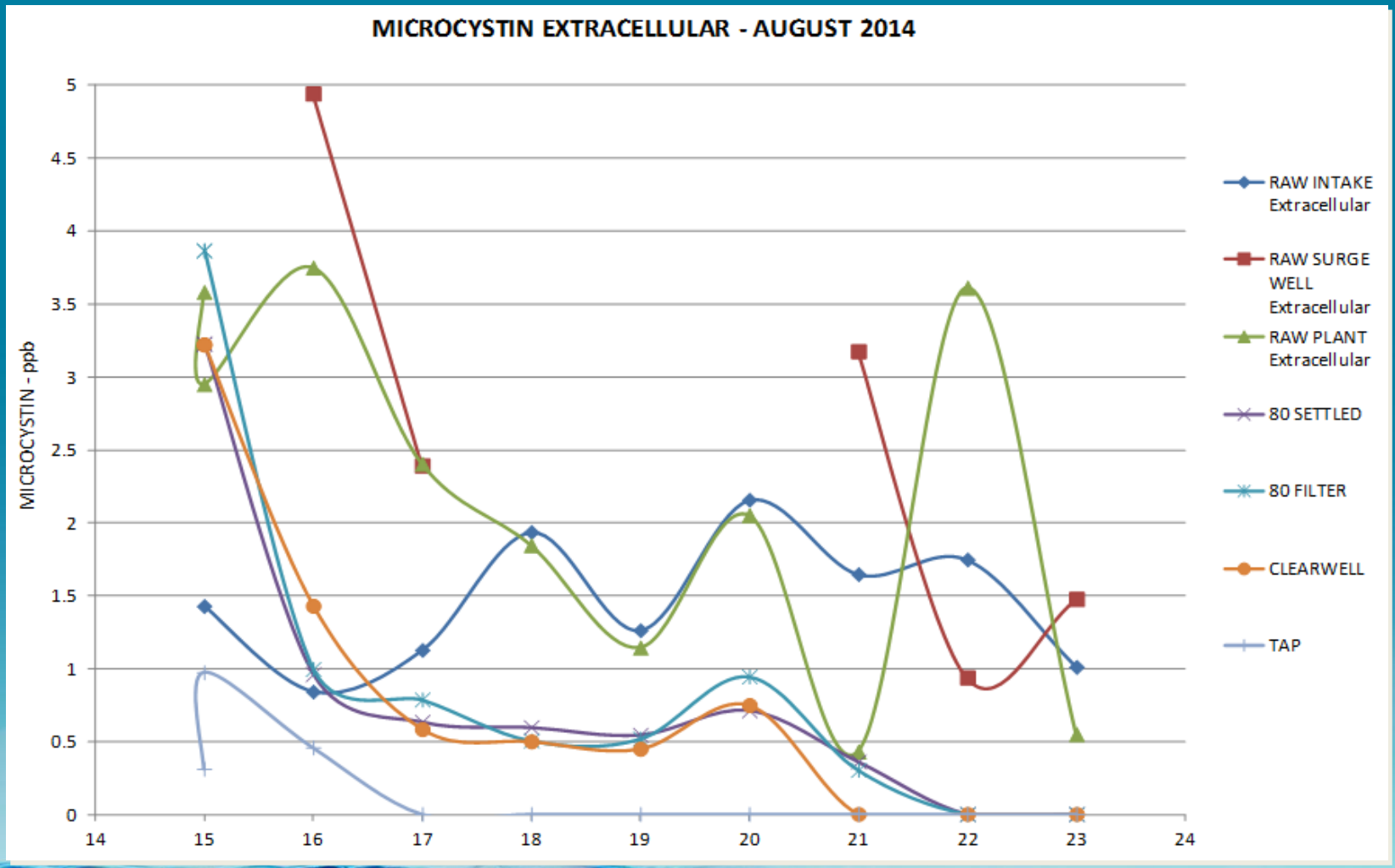
- Toledo looked at ozone, GAC, and upgrades to existing potassium permanganate and PAC feed systems

Focus here will be on the ozone evaluation, but I want to touch briefly on PAC testing results during the discussion

Toledo Treatment Process Schematic



Microcystin Removal through Current Treatment at the Collins Park WTP



Blue Ribbon Panel

- Nine members with national standing from academia, technical, government, and regulatory sectors
- Best practices in water treatment and the effective treatment of algae
- Ozonation recommended as treatment barrier for algal bacteria
- Implementation in next 3 years

Ozone Evaluation Scope

- Review historical water quality data
- Conduct ozone bench testing of raw and settled water
- Review bromate formation potential
- Establish ozone equipment sizing
- Establish requirements for ozone contacting approach

Ozone Evaluation Scope (cont)

- Review hydraulics
- Develop conceptual layouts for facilities
- Develop plant facility arrangement
- Establish cost opinions


2015 HAB
Season

HAB Treatment Alternatives and Considerations

- Intermediate Improvements
- Ozone
- GAC

Intermediate Improvements

Intake Crib/Pump Station

- Increase $KMNO_4$ feed capability to 6.5 mg/L
- Increase PAC feed to 40 mg/L
- Install storage silo for 175,000 pounds of dry PAC

Treatment Plant

- Add capability to feed up to 6 mg/L of PAC at 3rd pass flocculation
- Install two new 45,000 PAC storage silo and feed systems

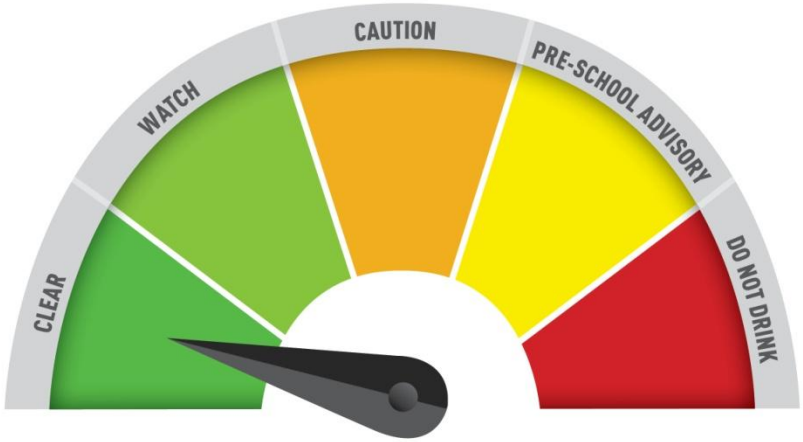
Early Warning System

- Sampling Probe in Water Intake
  - 2 hour traveling time to pumping station (low service)
- Sampling Probe at Low Service Pump Station
  - 4 hours travel time to Collins Park WTP
- Test Parameters
  - pH
  - Blue Green-Algae
  - Chlorophyll
- Data reported every 10 min.

Toledo Water Dashboard

Water Quality

Toledo tests raw and treated water regularly for the presence of toxins, including microcystin created by algae blooms. See scale below for the current status of drinking water quality according to Ohio EPA guidelines.



- **CLEAR** – Non-detect in the intake crib in Lake Erie and non-detect in tap water.
- **WATCH** – Detect in the intake crib in Lake Erie and non-detect in tap water.
- **CAUTION** – Microcystin has been detected in tap water, but test results do not indicate the need to issue an advisory. Additional testing and sampling is underway and water treatment has been accelerated.
- **PRE-SCHOOL ADVISORY** – DO NOT DRINK for children five and younger. Tap water tests greater than 0.3 ppb and not exceeding 1.6 ppb.
- **DO NOT DRINK** – DO NOT DRINK. Tap water tests greater than 1.6 ppb.

Toledo Ozone System Design Parameters

- Two 11,000 gallon LOX tanks
- Three oxygen vaporizers (184 SCFM)
- Three 1200 ppd ozone generator Units (2 duty, 1 standby)
- Side stream injection flow 400 - 900 gpm

Ozone System Alternatives

Settle Water Flume Contactor

- Flow Rate 160 MGD
- Firm Dosage 1.8 mg/L
- 3 Generators
- 4 Contactor
- Retention Time : 4 min. new & 6 min existing flume
- Probable Cost: $29,000,000

External Settled Water Ozone Contactor

- Flow Rate 160 MGD
- Firm Dosage 1.8 mg/L
- 3 Generators
- 4 Contactors
- Retention Time; 10 min in new contactor
- Probable Cost: $40,000,000

Annual O&M Costs

	SETTLED WATER FLUME CONTACTOR	EXTERNAL SETTLED WATER OZONE CONTACTOR
Electricity, $/yr	$124,000	$136,000
LOX, $/yr	$86,000	$86,000
Cooling Water	$1,000	$1,000
LOX Leasing Fee ($3,000/month)	$36,000	$36,000
Staff Salary	$82,000	$82,000
Estimated Annual Operating Cost, $/yr	**$329,000**	**$341,000**
Annual Maintenance @2%, $/yr	**$82,000**	**$82,000**

Questions?