



Managing the Health of an *ex situ* Anoxic Bioreactor

Presented by: Kevin Morris

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The business of sustainability



Arkema Project Background

- The original facility was constructed in 1941 during WWII and operated for 60 years as a chemical manufacturing plant prior to decommissioning in 2003-2004.
- Manufactured chemicals included dichlorodiphenyltrichloroethane (DDT), chlorine, chlorate, ammonium perchlorate (rocket fuel), caustic soda, and hydrochloric acid.



Arkema Project Background

§ Historical site operations resulted in various contaminant releases.

§ Site contaminants of concern (COCs) in soil and groundwater include:

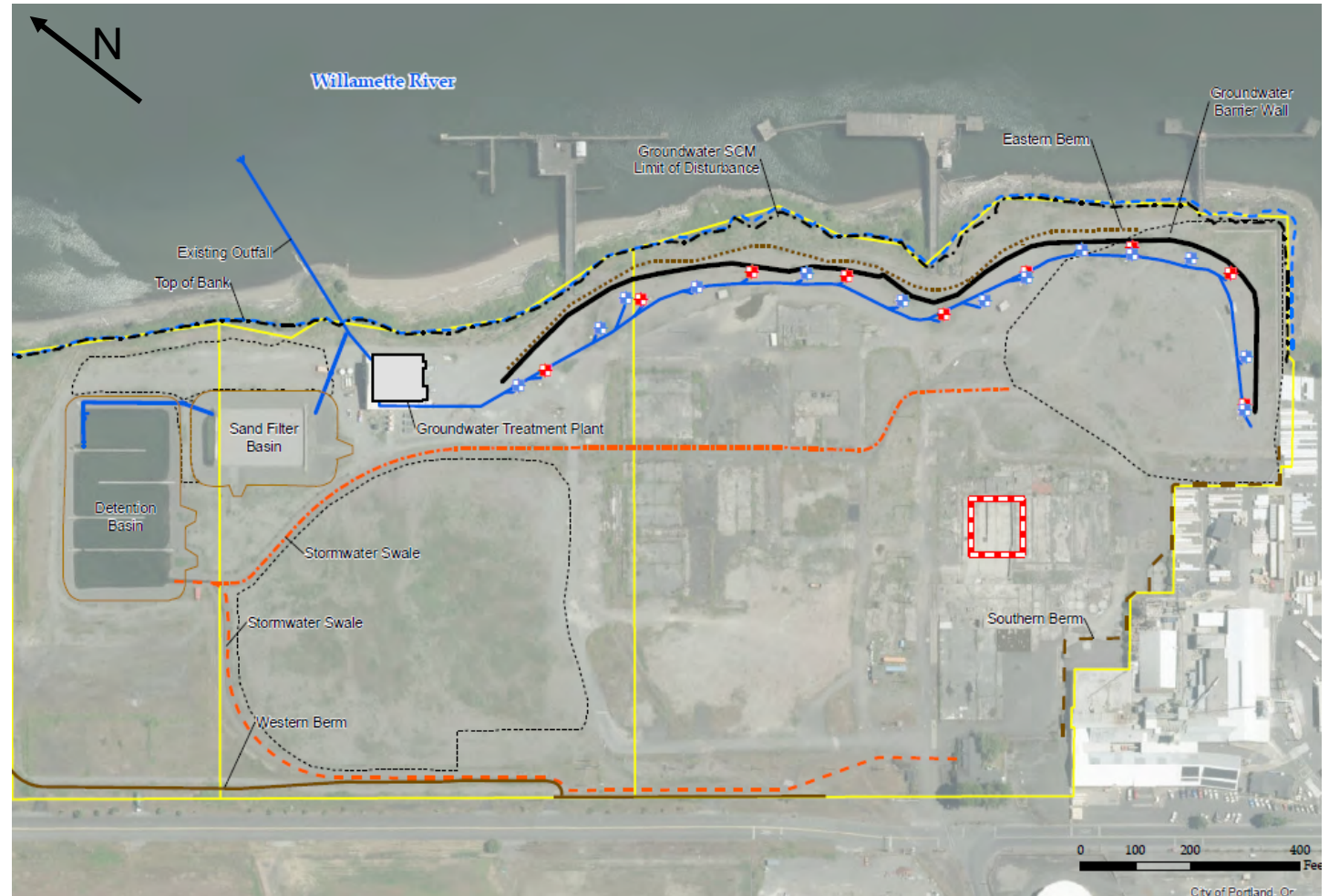
- DDT (processing area shown in red)
- Chlorobenzene
- Perchlorate
- Hexavalent chromium
- Tetrachloroethene
- Chloride
- Metals



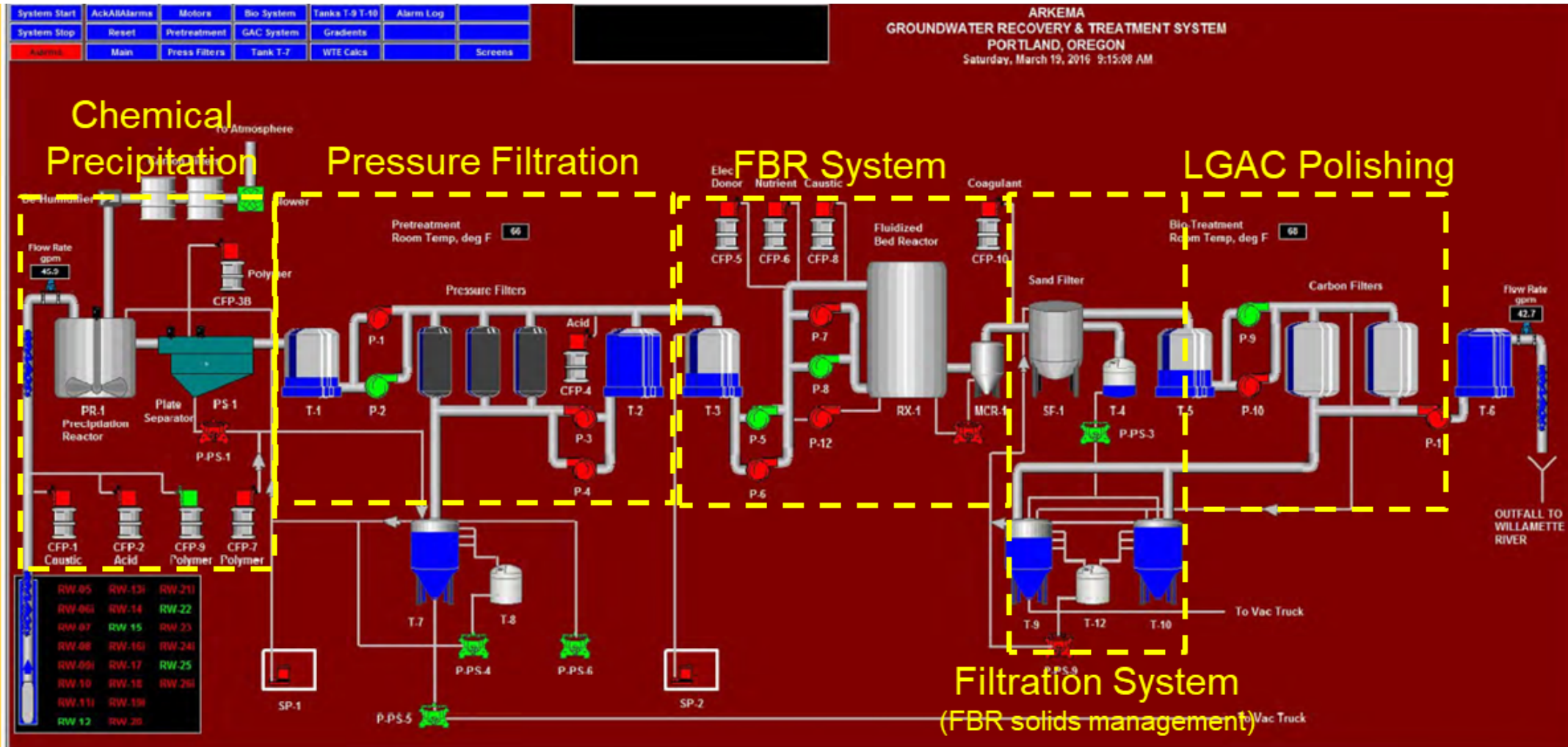
Arkema Project Background

Work completed to date includes:

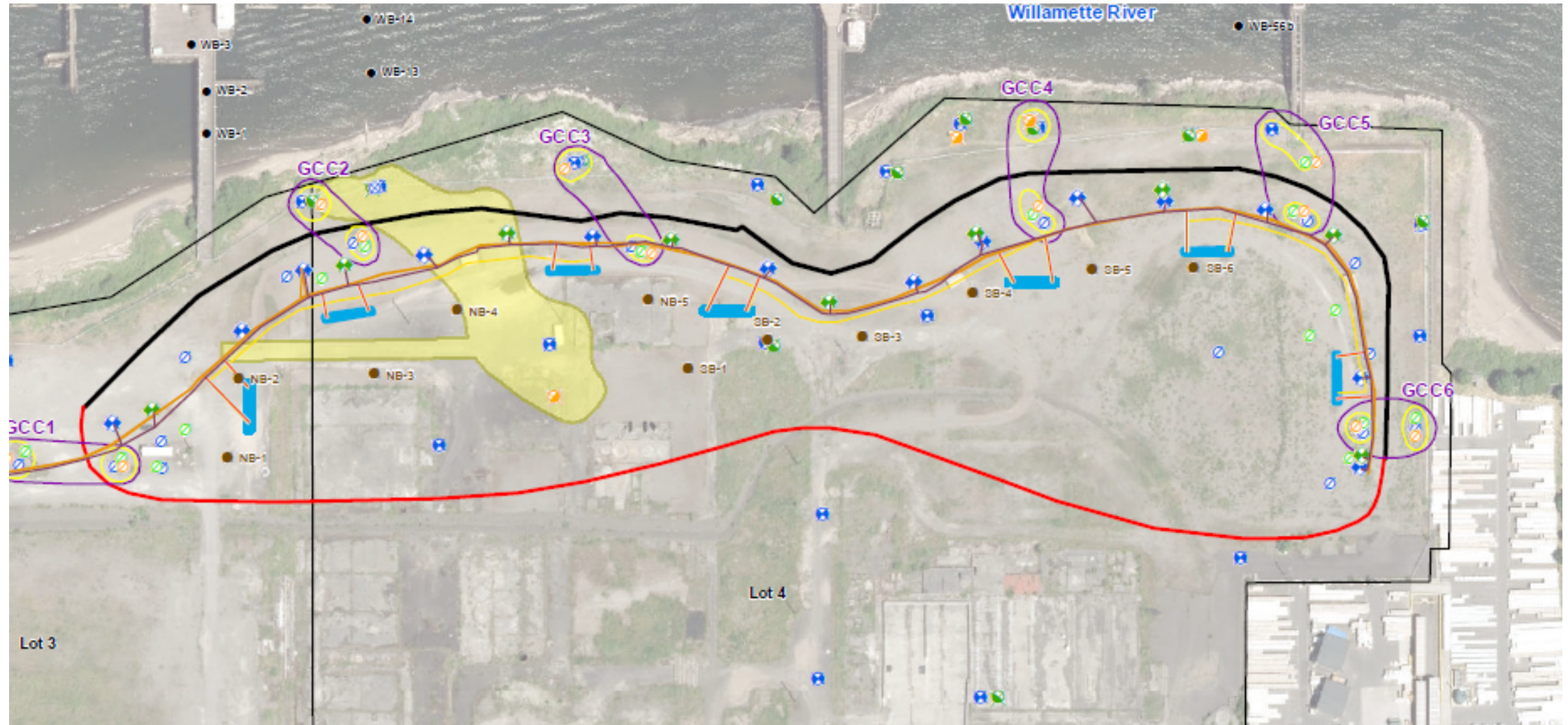
- Remedial investigation
- Hot spot soil removal (DDT, MCB)
- Soil vapor extraction
- In situ chemical injection (1.5MM gal) to reduce hex chrome in groundwater
- Soil capping
- Groundwater source control measure (groundwater barrier wall, extraction, and treatment system)



SCM Treatment Train



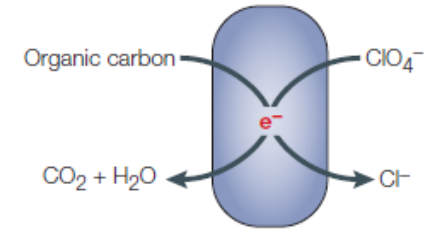
Conceptual Design



Microbial Perchlorate Reduction

Perchlorate reducing bacteria

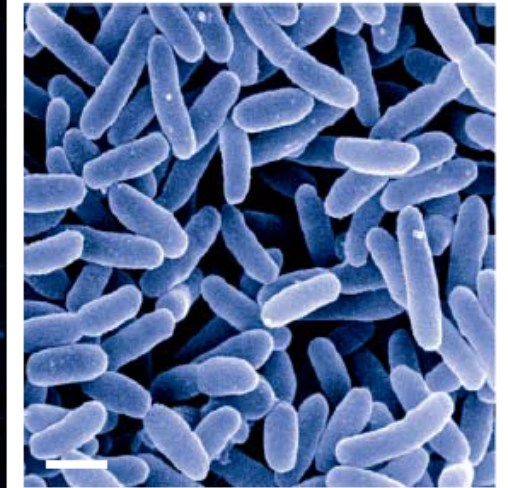
- Oxidize organic carbon
- CO_2 , H_2O , and Cl^- are produced
- Bacteria are diverse



Dechlorospirillum strain WD



Dechloromonas strain RCB



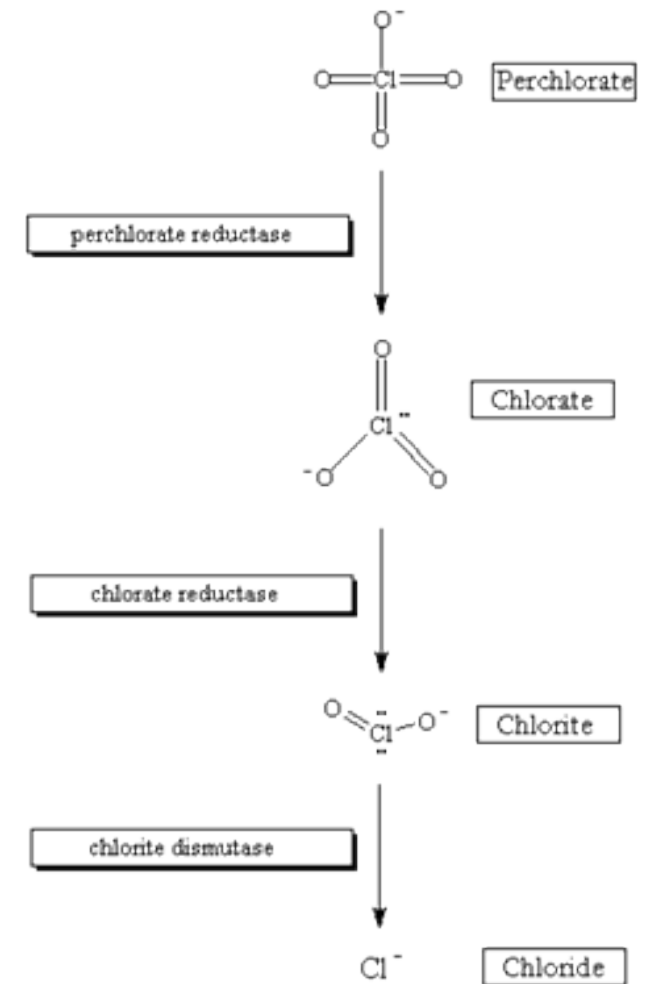
Microbial Perchlorate Reduction: Rocket-Fueled Metabolism
John D. Coates and Laurie A. Achenbach
Nature Reviews, Microbiology, Volume 2, July 2004

Microbial Perchlorate Reduction, Cont'd

Fluidized Bed Anoxic Bioreactor

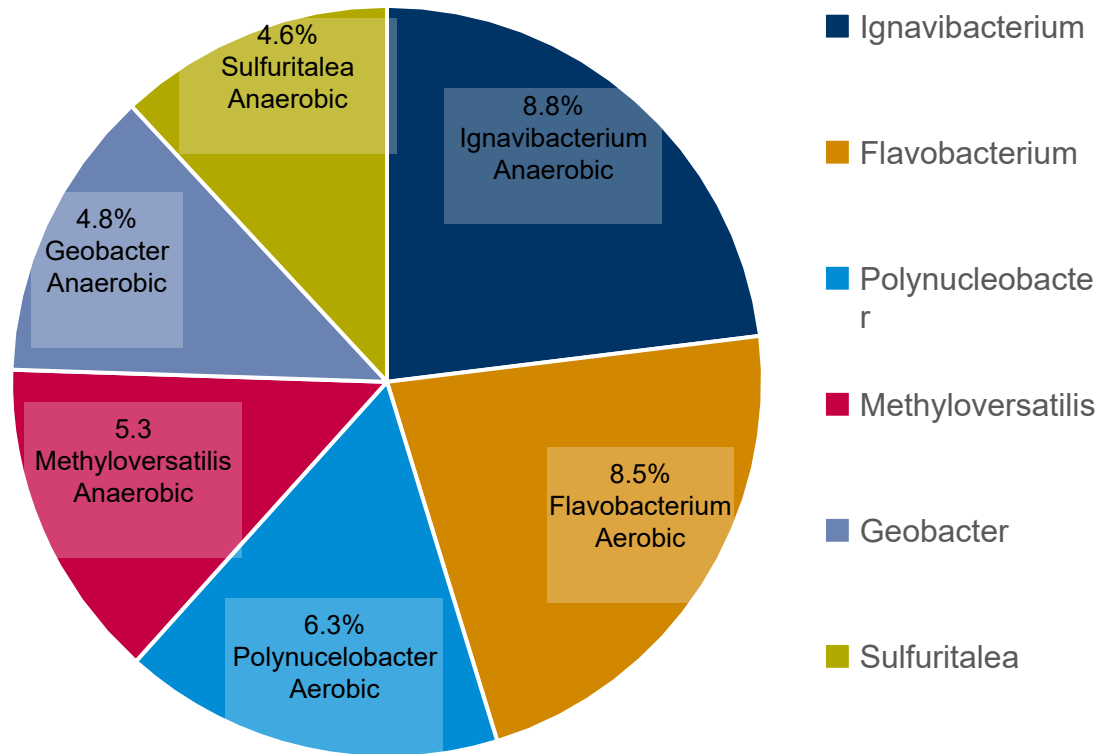
- Fluidized activated carbon
- Electron donor (acetate)
- Nitrogen (urea)
- Phosphorous

- Solids removal

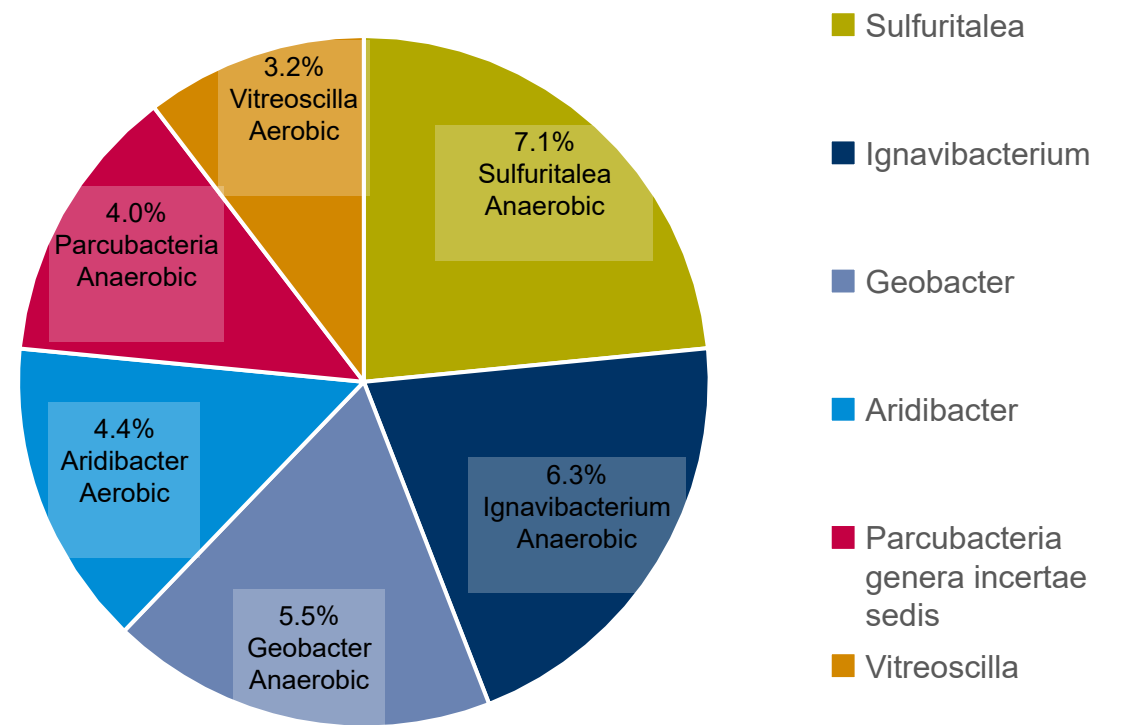


Microbial Population Health

FBR-CARB 2018 Top Genera

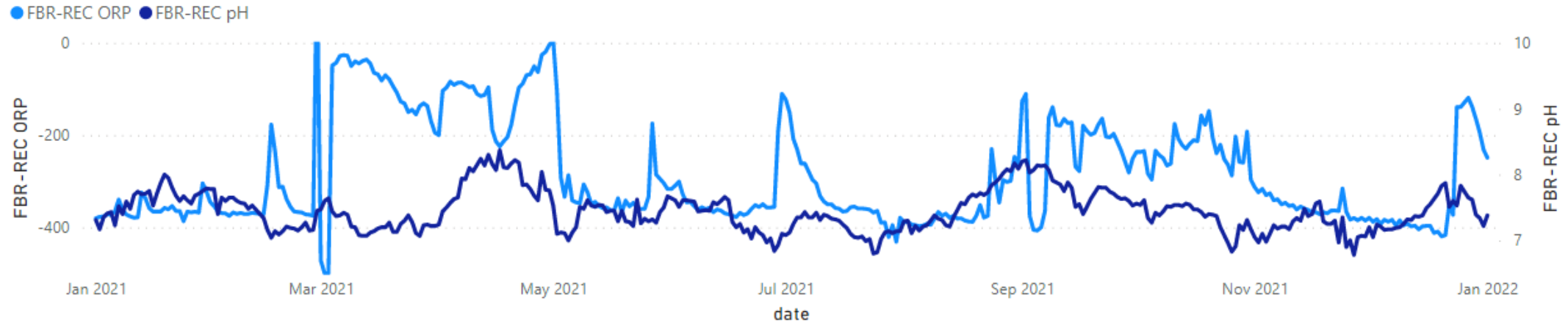


FBR-CARB 2021 Top Genera



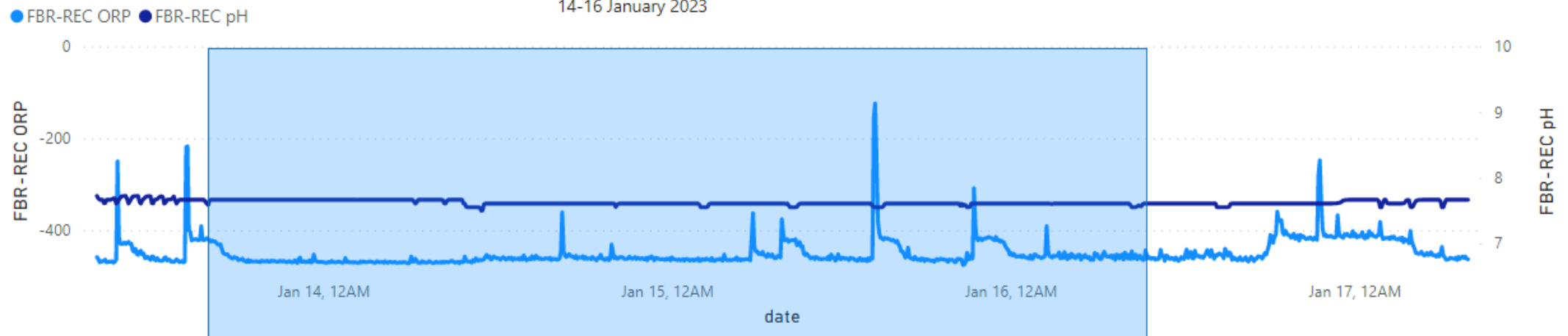
Microbial Population Health

FBR-REC ORP and FBR-REC pH by date

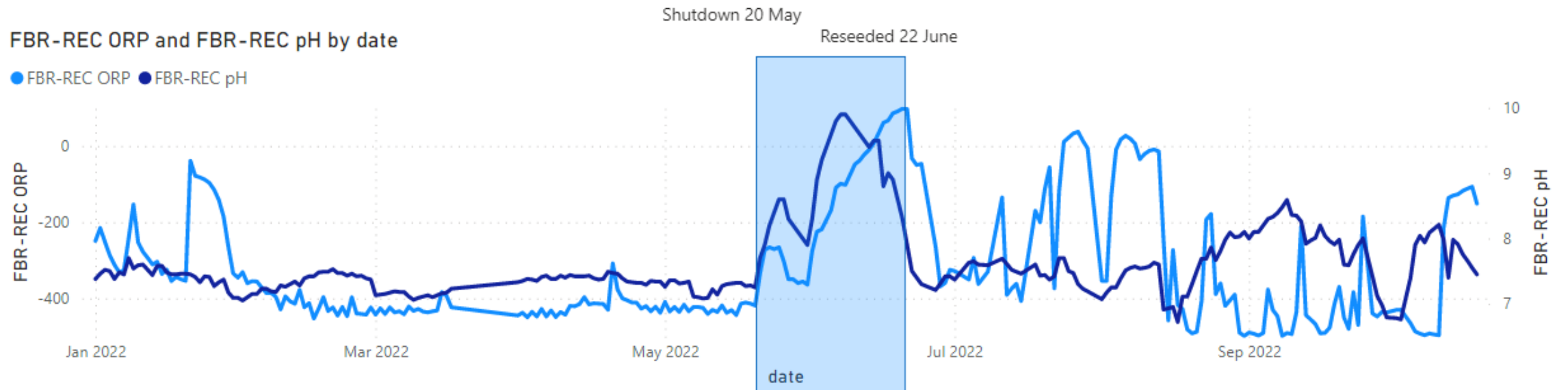


FBR-REC ORP and FBR-REC pH by date

Planned shutdown, FBR recirculation
14-16 January 2023



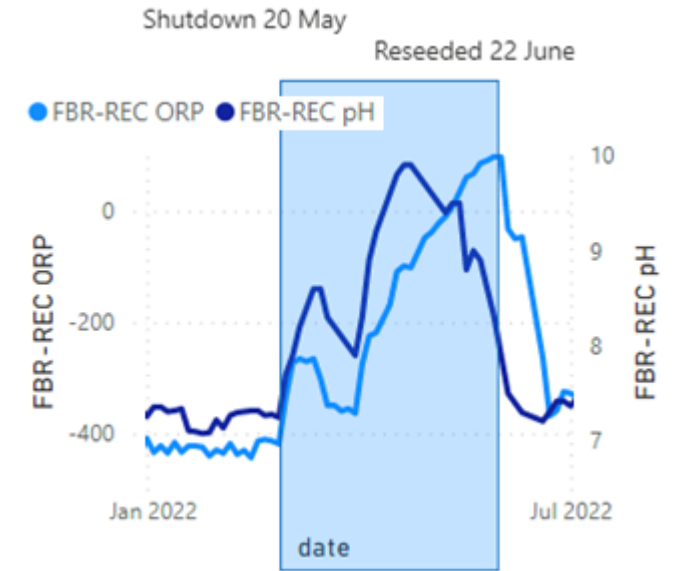
Microbial Population Health



Microbial Population Health

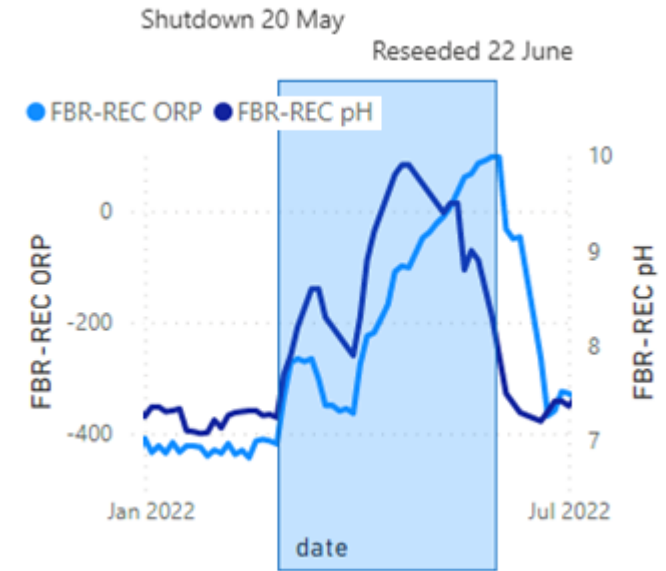
Changes in Observed Chemistry

- Decline in population
- No demand for dissolved oxygen
- Release of basic nitrogen



Lessons Learned

- Complex environment
- Learn what bad health looks like
- Fluctuations in ORP and pH are normal
- ORP and pH measurement is robust





Thank you!

Brendan Robinson

Partner

Brendan.Robinson@erm.com

Portland, Oregon

Sarah Seekins

Partner

Sarah.Seekins@erm.com

Denver, Colorado

Kevin Morris

Associate Partner

Kevin.Morris@erm.com

Philadelphia, Pennsylvania

Josh Hancock

Senior Project Manager

Josh.Hancock@erm.com

Portland, Oregon

Andrew Gardner

Project Manager

Andrew.Gardner@erm.com

Portland, Oregon

Josh Hyrman

Project Engineer

Josh.Hyrman@erm.com

Portland, Oregon