

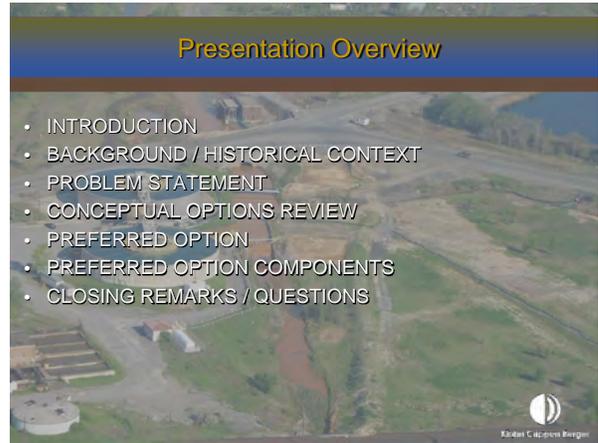
Controlling Surface Water at One of Canada's Largest Base Metals Operations: From Legacy Challenges to Environmental Award Winner



Greg Noack, P.Eng.,
 Associate, Klohn Crippen Berger Ltd., Toronto ON.
Lawrence Clelland, P.Eng.,
 Associate, Klohn Crippen Berger Ltd., Sudbury ON.
Trevor Ross, P.Eng.,
 Chief Engineer, Tailings, Dams & Special Projects
 Vale Canada Limited, Copper Cliff, ON.
Randy Donato, P.Eng.,
 Tailings Engineer, Vale Canada Limited, Copper Cliff, ON.

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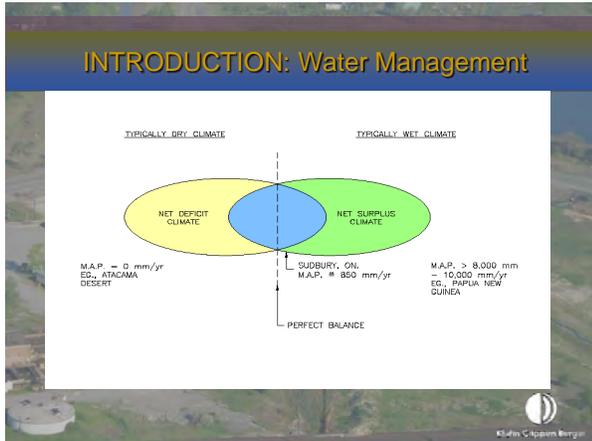
Presentation Overview



- INTRODUCTION
- BACKGROUND / HISTORICAL CONTEXT
- PROBLEM STATEMENT
- CONCEPTUAL OPTIONS REVIEW
- PREFERRED OPTION
- PREFERRED OPTION COMPONENTS
- CLOSING REMARKS / QUESTIONS

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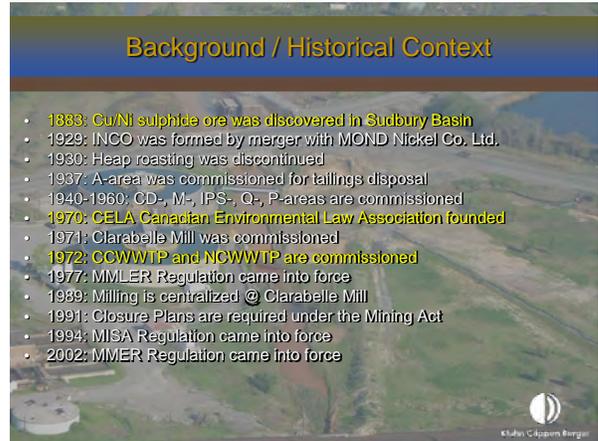
INTRODUCTION: Water Management



TYPICALLY DRY CLIMATE TYPICALLY WET CLIMATE
 NET DEFICIT CLIMATE NET SURPLUS CLIMATE
 M.A.P. = 0 mm/yr SUDBURY, ON. M.A.P. > 8,000 mm
 EG., ATACAMA M.A.P. = 800 mm/yr EG., PAPUA NEW GUINEA
 DESERT
 PERFECT BALANCE

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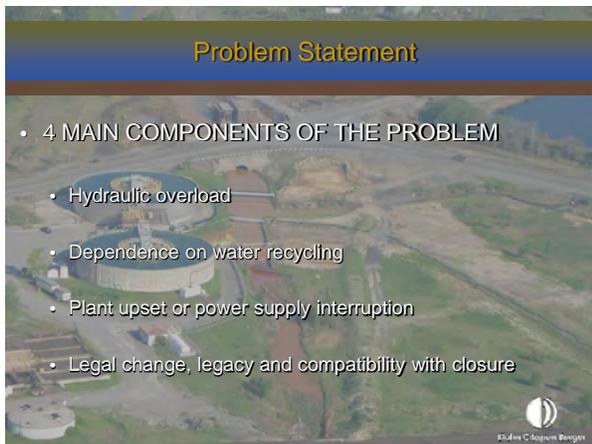
Background / Historical Context



- 1883: Cu/Ni sulphide ore was discovered in Sudbury Basin
- 1929: INCO was formed by merger with MOND Nickel Co. Ltd.
- 1930: Heap roasting was discontinued
- 1937: A-area was commissioned for tailings disposal
- 1940-1960: CD-, M-, IPS-, Q-, P-areas are commissioned
- 1970: CELA Canadian Environmental Law Association founded
- 1971: Clarabelle Mill was commissioned
- 1972: CCWWTP and NCWWTP are commissioned
- 1977: MILLER Regulation came into force
- 1989: Milling is centralized @ Clarabelle Mill
- 1991: Closure Plans are required under the Mining Act
- 1994: MISA Regulation came into force
- 2002: MMER Regulation came into force

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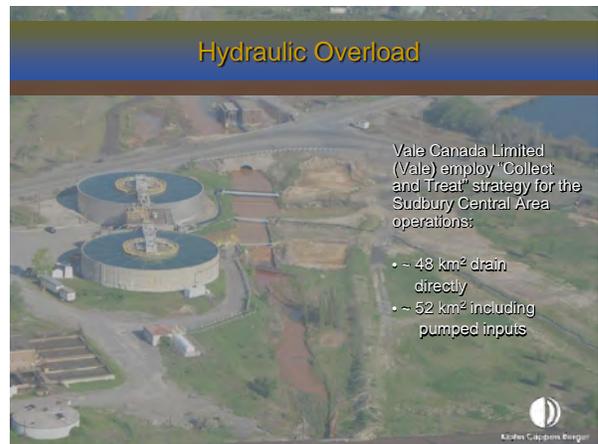
Problem Statement



- 4 MAIN COMPONENTS OF THE PROBLEM
 - Hydraulic overload
 - Dependence on water recycling
 - Plant upset or power supply interruption
 - Legal change, legacy and compatibility with closure

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Hydraulic Overload



Vale Canada Limited (Vale) employ "Collect and Treat" strategy for the Sudbury Central Area operations:

- ~ 48 km² drain directly
- ~ 52 km² including pumped inputs

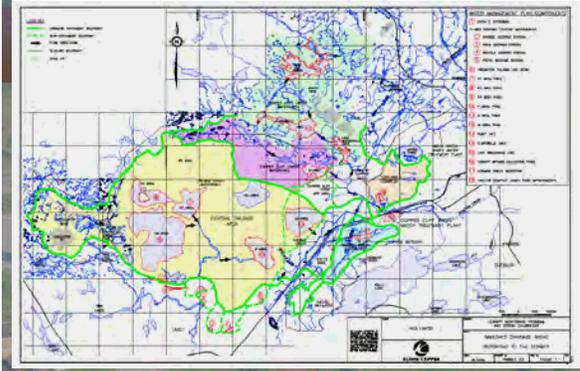
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Hydraulic Overload



Q: What does about 52,000,000 m² look like?

A: About 80% of the land base of Manhattan NY

Hydraulic Overload



Hydraulic Overload



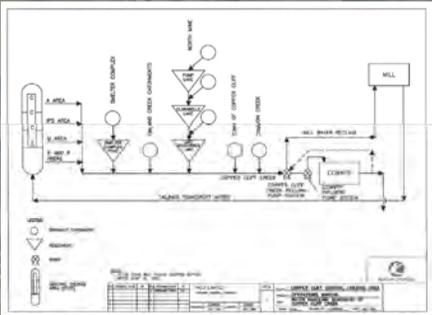
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Hydraulic Overload




Dependence on Water Recycling




Problem Statement Continued...

Plant Upset or Power Interruption:

- Need a way to capture and return non-compliant effluent

Legal Change and Compatibility with Closure

- Need a modular or "expandable" solution



Step 1 - Conceptual Options Review: 1998-1999

Conceptual options for whole basin included:

1. Pumping and storage in inactive underground workings
2. Pumping and storage in new surface reservoirs
3. Reservoir attenuation upstream of the Plant
4. Reservoir storage downstream of the Plant
5. **Combination of upstream and downstream reservoirs**
6. Plant capacity upgrades and smaller attenuating reservoirs
7. Plant capacity upgrades and no attenuating reservoirs

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Step 2 - Central Tailings Seepage Stations: 1999-2000

P-Area Seepage Station Improvement Project involved storage and pumping improvements:

- Whissel Dam (North) Seepage Pond
- Whissel Dam (South) Seepage Pond
- Rock Dam Seepage Pond
- Mikkola Dam Seepage Pond
- Pistol Dam Seepage Pond

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Step 2 - Seepage Stations Improvements: 1999-2000

Rock Dam Seepage Station

Pistol Dam Seepage Station

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Step 3 - Tailings Pond Operational Changes: 2002

OM&S Manual and Filling Plan allow 27km² to be controlled with minimal capital improvement

Active Areas (R1, R2, R3 and R4)

- Incorporates sufficient freeboard into annual dam raising plans
- Defines operating water levels and levels that trigger water release to manage overtopping risk

R4 Area and No. 3 Seepage Station

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Step 3 - Tailings Pond Operation Changes: 2002

Old Stack Areas (CD, Q, M1, M, P, IPS)

OMS defines N.O.W.L., EDF H.W.L., IDF H.W.L. and interventions required to manage overtopping risk

P-Area

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Step 4- Uncontrolled Area Improvements: 2002

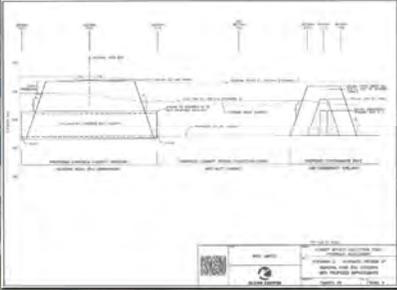
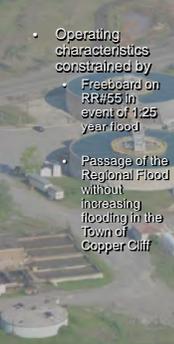
> 8 km² catchment

- Finland Creek
- Common Creek
- Town of Copper Cliff
- South part of Smelter Complex

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Step 4 – Bypass Collection Pond: 2002

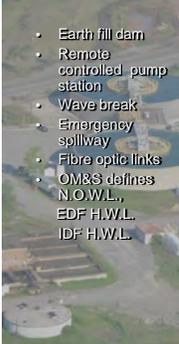
- Operating characteristics constrained by
 - Freeboard on RR#55 in event of 125 year flood
 - Passage of the Regional Flood without increasing flooding in the Town of Copper Cliff

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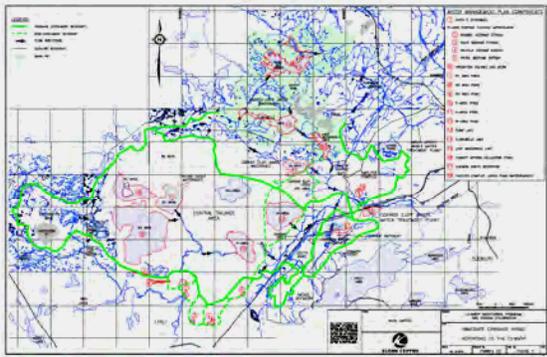
Step 4- Bypass Collection Pond: 2001-2002

- Earth fill dam
- Remote controlled pump station
- Wave break
- Emergency spillway
- Fibre optic links
- O&M's defines N.O.W.L., EDF H.W.L., IDF H.W.L.

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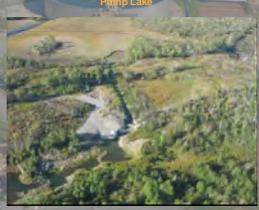
Step 5 - North Mine Lake Improvements: 2004-2008



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Step 5 - North Mine Lake Improvements: 2004-2008

Pump Lake, Clarabelle Lake and Lady MacDonald Lake
 New dams, remote controlled decants and emergency spillways
 Decants are monitored/manipulated at CCWWTP by fibre optic links
 OMS defines N.O.W.L., EDF H.W.L., IDF H.W.L. to manage overtopping risk




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Lady MacDonald Lake




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Step 5 - North Mine Lake Improvements: 2004-2008

Lady MacDonald Dam
 -Was originally a fresh water supply dam for Copper Cliff in the early 1900's
 -Was rehabilitated and raised in the 1980's to improve control of mine water inputs and discharge to the CCWWTP

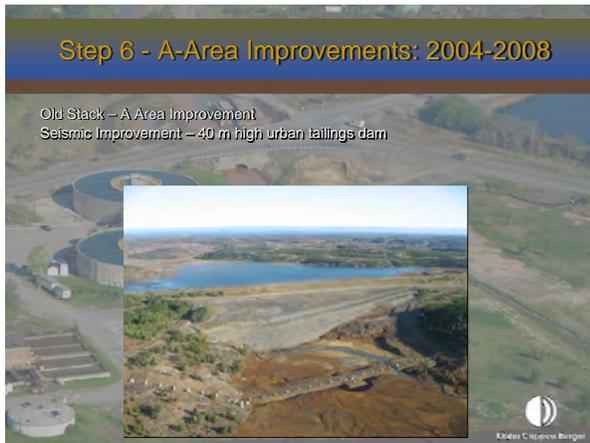
Lady MacDonald Dam




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Step 6 - A-Area Improvements: 2004-2008

Old Stack – A Area Improvement
Seismic Improvement – 40 m high urban tailings dam



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Step 6 - A-Area Improvements: 2004-2008

Old Stack – A Area Dam - Background

- Originally built in the 1930s as a pipeline support embankment
- Subsequently used for tailings storage in the 1937-1958
- About 40 years later, the need to store water and increased seismic criteria in Ontario led to a Stability & Emergency Spillway Improvement Project

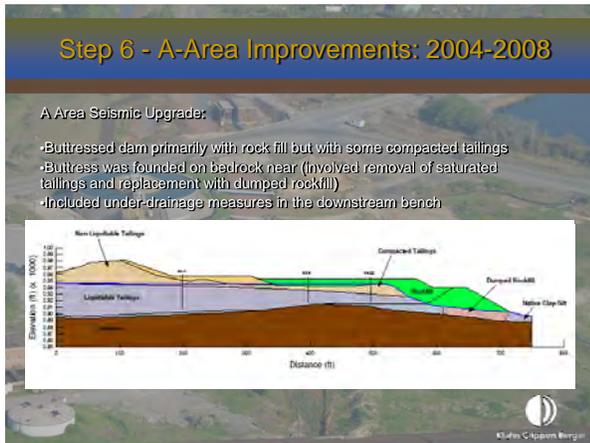


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Step 6 - A-Area Improvements: 2004-2008

A Area Seismic Upgrade:

- Buttressed dam primarily with rock fill but with some compacted tailings
- Buttress was founded on bedrock near (involved removal of saturated tailings and replacement with dumped rockfill)
- Included under-drainage measures in the downstream bench



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Step 6 - A-Area Improvements: 2004-2008

A Area Improvement

- Seismic upgrade
- EDF storage
- New low flow decant
- Fibre optic links
- New emergency spillway
- Tunnel widening to safely pass a PMF
- Stilling basin improvement



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Step 7 - Common Creek Improvements: 2006-2007

- Sheet pile cut-off to prevent rail line subsidence
- Remote controlled decant
- Emergency spillway
- Fibre optic links
- OM&S defines N.O.W.L., EDF H.W.L., IDF H.W.L.

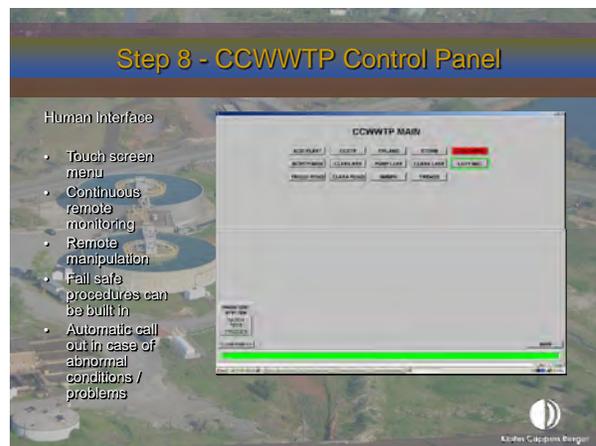


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Step 8 - CCWWTP Control Panel

Human Interface

- Touch screen menu
- Continuous remote monitoring
- Remote manipulation
- Fall safe procedures can be built in
- Automatic call out in case of abnormal conditions / problems



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Step 8 - CCWWTP Control Panel

Human Interface

- Water level
- Reservoir freeboard
- Gate control
- Gate motor statistics
- Building temperature
- Trending
- Integrated with CCWWTP control systems

The screenshot displays a control interface for the Nolin Reservoir. It includes sections for 'FALL SAFE GATE', 'HYDRAULIC MOTOR', and 'RESERVOIR FREEBOARD'. A central diagram shows a cross-section of the reservoir with a gate and motor. The interface also features a 'BUILDING TEMP IN CELSIUS (C) 25.1' and 'NOLIN TRIM LEVEL IN METERS (M) 17.8'. A status bar at the bottom indicates 'NOLIN TRIM LEVEL IN METERS (M) 17.8'.

WMS Project - System Overview

Gaining Real-time Control of Surface Water and Treatment.

The diagram illustrates the WMS Project system architecture. It is divided into three main sections: 'Control System', 'Principal Components', and 'Benefits'. The 'Control System' section lists various software and hardware components. The 'Principal Components' section shows a network of interconnected devices and sensors. The 'Benefits' section lists the advantages of the system, such as improved operational efficiency and reduced environmental impact.

WMS Project: System Performance to Date

- Eliminated seasonal bypasses for more than a decade
- Prevented plant overload during a flash flood in July 2009
- Won an environmental award in 2009 from Consulting Engineers Ontario

The collage consists of four images: a flooded area with a car, a flooded area with a large black object, a red car parked in a flooded area, and a group of men in suits holding an award certificate.

Closing Remarks

Remote controlled reservoir network may seem elaborate

- Operationally superior
- Makes clear economic sense for closure (200 years)
- A modern solution to a legacy challenge

The aerial view shows a large reservoir network with multiple interconnected basins and a central treatment facility. The surrounding area is a mix of green fields and industrial structures.

Thank you for your attention

QUESTIONS?

The aerial view shows a large industrial facility with several tall smokestacks and a complex network of pipes and structures. The facility is situated in a valley with hills in the background.