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# An Alternative Approach to Decommissioning and Risk Management of a Historical Cooling Pond and Phosphogypsum Stacks

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# Introduction

## Nutrien Fort Saskatchewan Nitrogen Operations (FNO)

- Annual Production: Over 1M tonnes of nitrogen-based fertilizers
- Neighboring Sherritt Facility produced phosphate-based fertilizers from 1965-1991
- Phosphogypsum - byproduct of phosphate fertilizer production and is stored in stacks ~**6 million tonnes**
- In 1996, Nutrien inherited stacks and associated phosphate cooling ponds
- Alternative uses possible but not economical so Nutrien examined ways to abandon in place





# Background

- Two gypsum stacks previously decommissioned
- Two remaining gypsum stacks (32 acres) and phos cooling ponds (18 acres)
- COCs in soil and groundwater are sulphate, phosphate, nitrate/ammonia and some metals

## Primary objectives of the decommissioning:

- Reduce risk to human and ecological receptors
- Improve aesthetics of the area





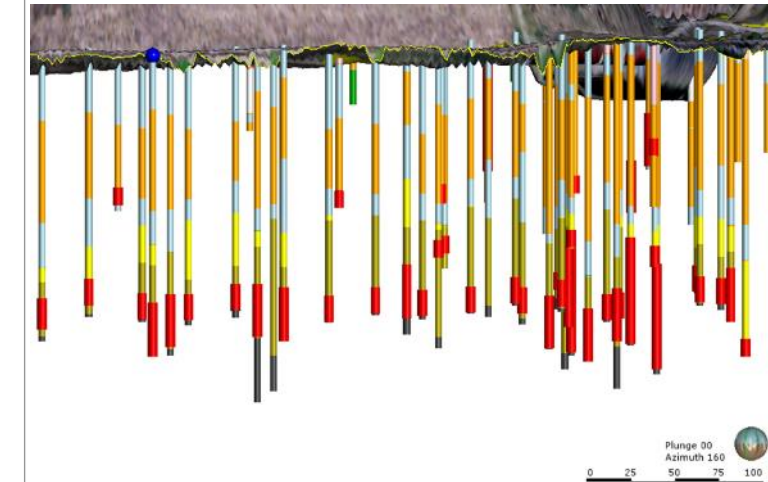
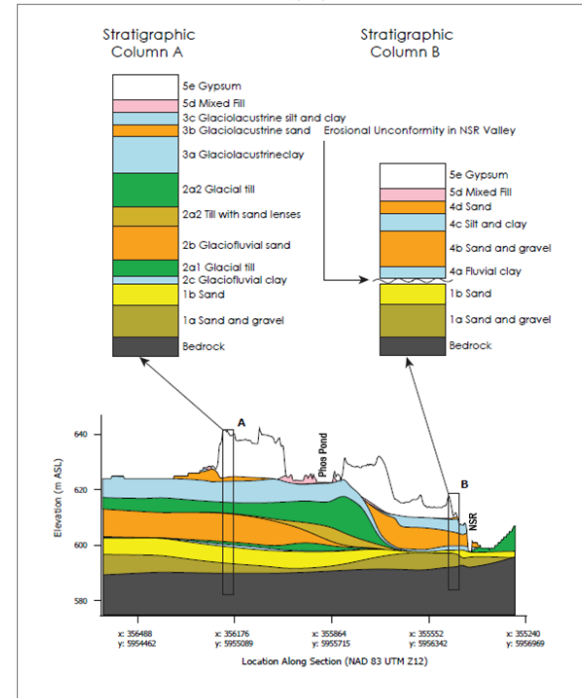
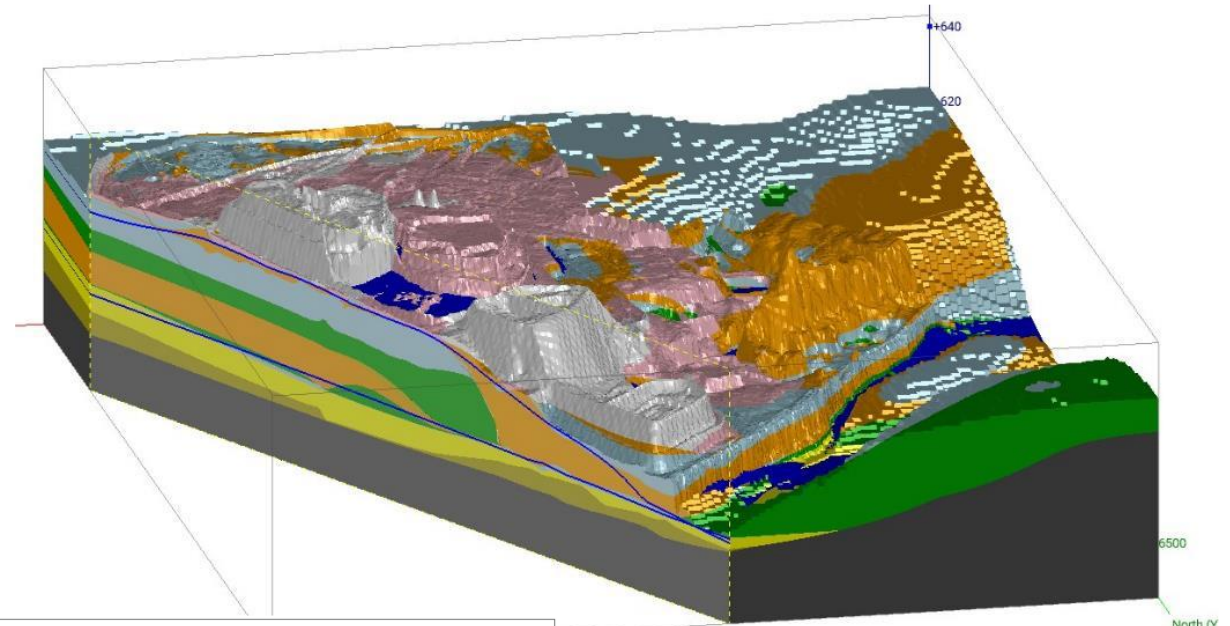
# 3D Conceptual Site Model

3D CSM constructed to synthesize historical data to improve understanding of the hydrogeology and support environmental management activities

## The 3D CSM integrated:

- 715 borehole and CPT logs
- Well completion details
- Groundwater levels
- Groundwater chemistry
- Groundwater recovery system as-built information

3D CSM used to guide monitoring, remediation, and risk management including support for the decommissioning of the phosphate ponds and gypsum stacks





# Risk

## Hazard or Source

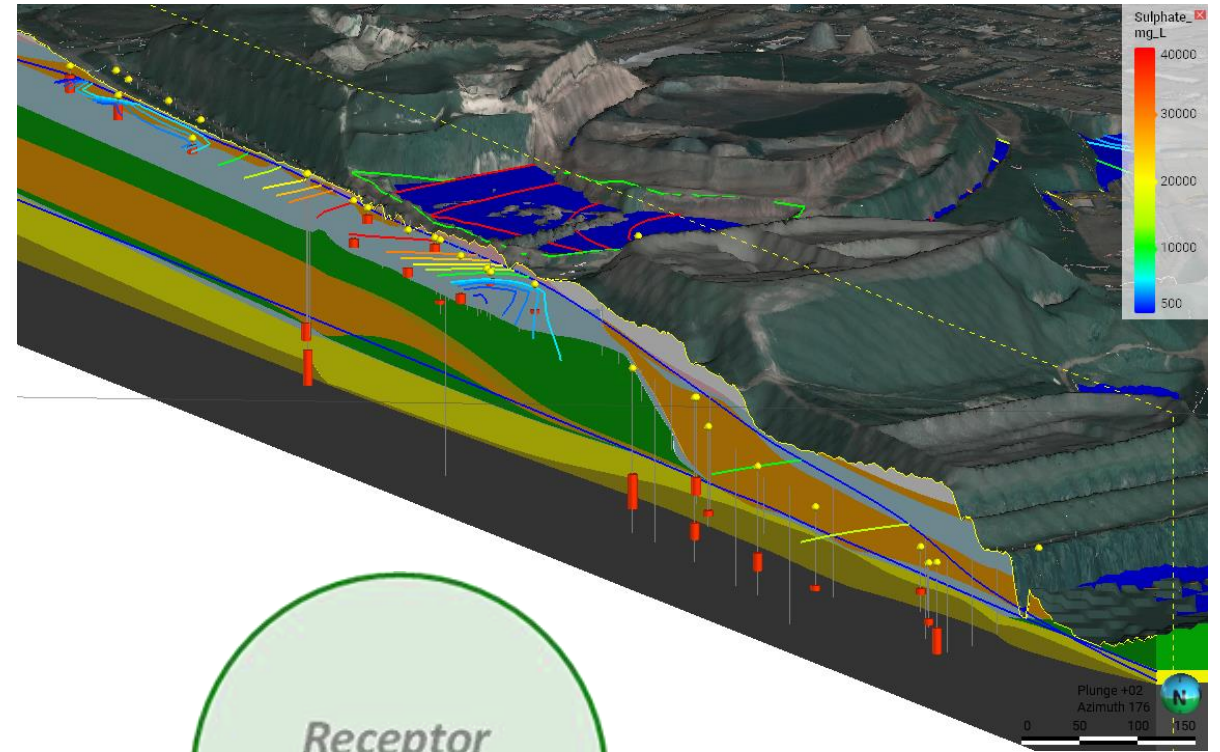
- Gypsum stack and phos pond COCs in soil and groundwater
- Source has been well characterized and delineated over the past 40 years

## Potential Receptors

- On-site workers and ecological receptors
- Off-site landowners (human and ecological receptors)
- Groundwater users
- Surface water (Ross Creek and NSR) (human and ecological receptors)

## Pathways

- Soil contact and windborne soil
- Groundwater flow offsite





# Risk Management Plan

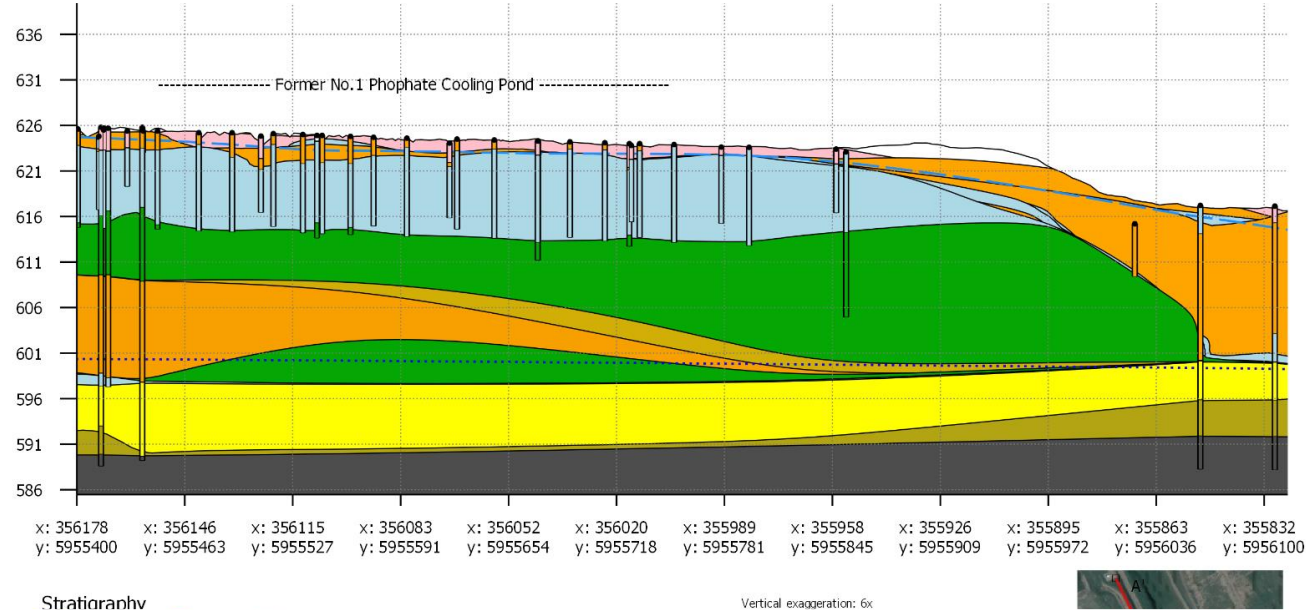
AEPA required a RMP to support the decommissioning plan

## Source Control

- Controls to limit exposure - HSE policies and groundwater interceptor systems
- Decommissioning plan includes augmenting existing controls - toe ditch and interceptor pond
- Backfilling, grading and phytocapping to reduce groundwater mounding, flow, and potential for off-site migration

## Monitoring

- Effectiveness of controls verified through groundwater and cap monitoring program
- Monitoring program updated with additional wells in footprint of the gypsum stack and nested in former Phos Cooling Pond





# Decommissioning

## Planning and Site prep

- Proximity agreements
- Removal and disposal of pond inventory

## Backfilling and grading (Summer 2022)

- Grading and surface water management plan prepared to meet objectives of RMP and minimize cut/fill while also improving aesthetics
- **375,000 m<sup>3</sup> of phosphogypsum** moved to fill the ponds and regrade the stacks
- **32,000 m<sup>3</sup> of topsoil** imported and admixed

Traditional capping would have upwards of 200,000 m<sup>3</sup> of imported material

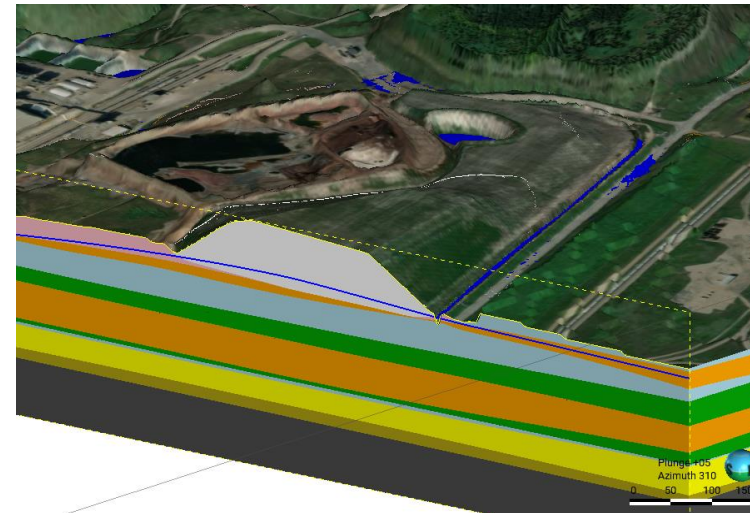
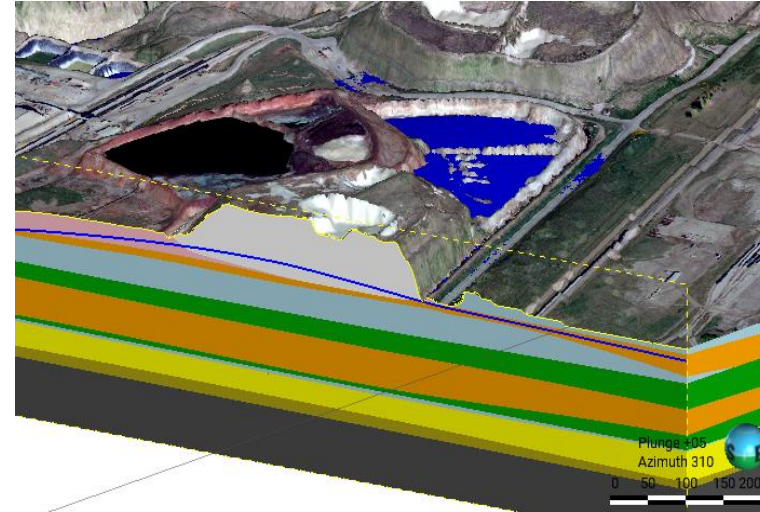




# Decommissioning

## Key aspects of decommissioning plan related to the RMP:

- Recontouring for positive drainage and short-term capture of runoff (drainage minimized when cap is established)
- Cutoff trench along 119<sup>th</sup> street to intercept groundwater before migrating offsite and replace groundwater interceptor
- Pond to intercept groundwater flow from the neighboring metals tailings pond
- Continued operation of the River Road Interceptor
- Conveyance and disposal of the intercepted groundwater







# Phytocapping History

Phytocap – uses fast growing vegetation as a barrier to infiltration

Examples around the world, but Nutrien began experimenting at a local scale in 2005 and made key findings on establishment and performance

1,000 willow and hybrid poplar were planted successfully during the first trials and results indicated **15 cm of topsoil** admixed with gypsum provided optimal growth while limiting groundwater recharge

The concept was expanded to two of the gypsum stacks **44,000 trees** were planted between 2016 and 2022 with approximately 90% survival





# Phytocapping

Trials and masters projects completed at FNO in partnership with the UofA since 2005

Kravchinsky masters thesis

- used sap flow measurements, soil moisture, matric potential, weather stations and empirical models
- showed net flux of water is upwards and limited percolation beyond the root zone (limited groundwater recharge)
- **Net evaporative loss** (evapotranspiration > precipitation)

Based on previous research and success, **26,100 hybrid poplar trees** were planted on the 50-acre decommissioned area in June 2023





# Phytocapping the Phos Pond and Gypsum Stack

## Primary benefit:

Provide source control with additional benefits beyond what traditional capping can provide

## Secondary benefits:

- Improving aesthetics
- Wildlife habitat of the area
- Carbon sequestration
- Reduced maintenance
- Sustainability

## Traditional caps:

- More soil to import
- Expensive
- More maintenance
- Limited lifespan





# Ongoing Monitoring

## Groundwater Monitoring

- Monitoring interior and perimeter of the decommissioned area
- 21 “Perimeter” monitoring wells
- 19 “Operational” monitoring wells
- Nested installations to determine vertical gradients and flow
- Monitoring performance of the River Road Interceptor system

## Cap Monitoring

- Monitoring growth and health of the trees and condition of the cap





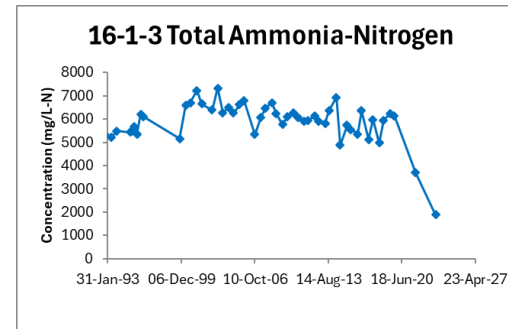
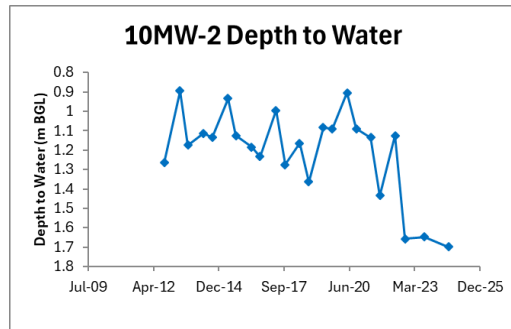
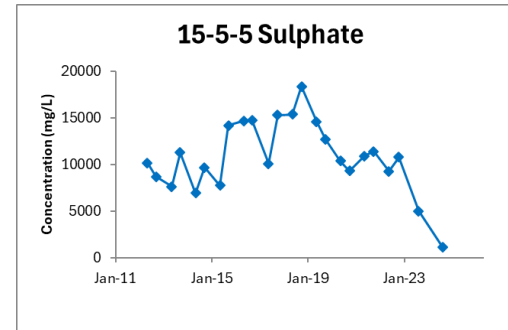
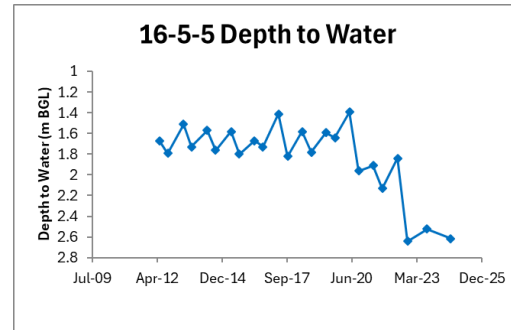
# Key Metrics

Monitoring program is looking for reduced groundwater levels and flow along with improvements in water quality

Trend analysis with expected trends toward decreased concentrations (NO3, NH3, SO4, PO4, As, Co, Cu, and Ni)

**Water levels have decreased by up to 70 cm near the cutoff trench**

Increasing trends trigger additional groundwater management actions





# Challenges and Contingencies

## Establishment of cover

- Heat/drought made the establishment of a cover crop difficult
- Dust – with poor initial establishment of cover, dust became a concern
- Runoff – erosion was a concern prior to establishment of the cover

## Delay in groundwater effects

- Slow groundwater flow takes years to see results
- first major milestone for assessment of the success of the RMP will be at 5-Years post decommissioning

## Contingency plan:

- Additional groundwater recovery
- Reliance on the River Road Interceptor



# Thank you, Questions?

## Acknowledgments

Connie Nichol - Nutrien

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