

A photograph of Samantha Tavener, an environmental scientist, standing outdoors at Base Mine Lake. She is wearing an orange hard hat, safety glasses, an orange high-visibility vest over a white long-sleeved shirt, and yellow work gloves. She is smiling and looking towards the camera. The background shows a large body of water (Base Mine Lake) surrounded by green hills under a blue sky with light clouds.

07.30.2012 @ Base Mine Lake

Samantha Tavener

ENVIRONMENTAL SCIENTIST

“As part of our reclamation plan, Syncrude is creating an aquatic reclamation area using a technology called water-capped tailings. Basically, we’ve put fine tailings into one of our former mine pits. As the fine tailings settle and slowly densify, pore water from in between the fines moves upwards into the lake water. There, it mixes with additional water that will flow in and out of the lake.

■ *Our stakeholders want the lake to support a variety of aquatic plants and insects.*

Syncrude has spent more than 20 years studying this technology in smaller ponds and through numerous other studies. We will track the progress of the developing aquatic ecosystem and I am very confident about its success.”

SAMANTHA

TAILINGS MANAGEMENT

Performance Overview

- Founding member of the Oil Sands Tailings Consortium to share research and development of tailings management technologies
- Performed commercial-scale demonstration of underwater placement of composite tailings to increase fines capture
- Investing almost \$2 billion on commercial-scale centrifuge plant
- Site preparation begins for \$800 million composite tails plant at Aurora Mine

Our Position

We recognize stakeholders' interest regarding the pace of reclamation and are vigorously pursuing strategies to accelerate our reduction of fluid fine tailings volumes, and dry tailings into a more solid form, which can then be incorporated into our reclaimed landscapes. In addition, we will continue to share knowledge and actively work with industry partners and the scientific community towards further solutions.

Adherence to Mining Association Standards

As a member of the Mining Association of Canada, we adhere to the principles outlined in the Towards Sustainable Mining (TSM) initiative. This includes guidance on managing tailings facilities in a safe and environmentally responsible manner through the entire life cycle – from site selection and design, through construction and operation, to eventual decommissioning and closure. Syncrude's [performance results](#) are reported annually. These are externally verified every three years and reviewed by the TSM Community of Interest Advisory Panel.

What are Tailings?

At Syncrude, tailings are a byproduct of our process to extract bitumen from oil sand. Tailings are composed of a mixture of water, sand, clay, fine solids, residual hydrocarbon and salts – all of which are naturally found in oil sands deposits.

Tailings are placed in large landforms commonly referred to as settling basins or tailings ponds. Tailings ponds serve two uses – one, as the recycled water source for our plants and, two, as a containment area which enables tailings to segregate prior to further dewatering for use in reclamation activities.

The primary tailings management challenge is the long period of time it takes for some solid components to settle. While the sand settles rapidly, clay and fine solids (together called fluid fine tailings or FFT) can take decades to settle on their own.

In the settling process, water rises to the top of the tailings pond and is then reused in the bitumen extraction process. Over 85 percent of the water we use is recycled from our settling basins. The Mildred Lake Settling Basin and Aurora Settling Basin are the main sources of recycled water for our operation.

Tailings also contain bitumen that is not recovered in the extraction process. As the bitumen is released, it floats to the top of the settling basin and can appear as an oily slick on the water surface. Bird deterrents are in place year-round to discourage waterfowl from landing (see discussion in [Biodiversity chapter](#)).

Bitumen is a valuable natural resource and, while recovery is about 90 percent, we are studying new technologies and processes to increase this even further. This will reduce the amount of bitumen lost to tailings (see discussion in [Research and Development chapter](#)).

Tailings Dam Safety

Settling basins are dam structures licensed and regulated through [Alberta Environment](#), Alberta Environment Dam Safety Branch and the [Energy Resources Conservation Board \(ERCB\)](#). Designs comply with Alberta Dam Safety Branch standards, and guidelines of the [Canadian Dam Association \(CDA\)](#) and [Mining Association of Canada](#).

All designs are reviewed by an external Geotechnical Review Board (GRB). CDA guidelines also require a dam safety review to be conducted for each structure by an independent external consultant every five to seven years. In addition, staff conduct formal inspections each quarter and informal inspections throughout the year. Regulators also conduct their own inspections, typically on an annual basis. Procedures are tested in simulations and table top exercises.

Around 3,000 instruments are in place to monitor our tailings structures and up to \$11 million is spent annually on their maintenance and installation.

Interceptor ditches and sumps collect and pump seepage or precipitation run-off back into the pond. We also maintain a network of surface water sampling points and groundwater monitoring wells to ensure tailings water does not impact local watercourses. For example, there are 170 wells throughout the Mildred Lake mine site area monitoring environmental compliance.

Transforming Tailings into Reclaimed Landscapes

We believe our multi-pronged approach to tailings management will enable us to meet the long-term intent of the [Energy Resources and Conservation Board \(ERCB\) Directive 074](#). This Directive, established in 2009, specifies performance criteria for the reduction of fluid tailings and the formation of trafficable deposits. Our submission was one of the first to be approved by the ERCB.

As we work towards achieving our plan, three technologies are now being deployed: water capping, composite tails and centrifuging. At the same time, we continue to research additional methods while also participating in the Oil Sands Tailings Consortium, which exchanges findings amongst industry operators.

Water Capping

[Water capping](#) involves the placement of a layer of water over a deposit of fluid fine tails to form a lake. Syncrude began researching this technology in the 1980s and has demonstrated its viability through laboratory testing and eleven test ponds of various sizes. Results have shown these lakes will evolve into natural ecosystems and, over time, support healthy communities of aquatic plants, animals and fish.

We are commissioning the industry's first commercial-scale demonstration of water-capped end pit lake technology in late 2012. It will be used to evaluate the large-scale viability of water capped tailings as a remediation strategy for both fluid fine tailings and oil sands process-affected water. It will be monitored intensively for about 20 years following commissioning to demonstrate that the lake is developing into a viable ecosystem and to prove that this technology can be used on other oil sands leases. It is anticipated that long-term monitoring will continue after this demonstration period is complete.



Eleven test ponds were utilized over the last two decades to research the water capping method.



The industry's first demonstration of the water capping technology will be commissioned in the former West Mine area in late 2012.

Composite Tails

Composite Tails (CT) combines fluid fine tails with gypsum and sand as tailings are deposited in a mined-out area. This mixture causes the tailings to settle more quickly and release water. CT is then capped with sand and soil, enabling the development of landscapes that support grass, trees and wetlands. This technology is now being used at the Mildred Lake site and will be implemented at the Aurora North Mine starting in 2013.

CT is being used to reclaim our former East Mine. Placement began in 2000 and was complete in 2011. Sand capping to established closure drainage is ongoing. A [54-hectare fen wetland](#) research project is already under construction at the northwest end of this area. Soil and woody debris have been placed and locally-collected seeds spread throughout the area. Vegetation planting on the fen will be complete in 2012-13, at which time active research will begin on hydrology, wetland and terrestrial plant response, and climate conditions. A 65-hectare area directly east of the fen project will be permanently reclaimed in 2015.

Fens are an important type of peat land found in the boreal forest. This large-scale reconstruction effort is the first of its kind in the world and underscores our commitment to return the land we disturb to a condition similar to that prior to disturbance.

We are also working to improve CT deposition and increase fines captured through a technique which places CT under a layer of water in the mined-out area. Sand is then added and the water later pumped out and recycled. This leaves a landform base which can be capped with soil, and reclaimed. Results from a commercial-scale test are being evaluated.



A 54-hectare fen wetland research project is under construction at the northwest end of our former East Mine area. Composite tailings was used to fill up the mine pit and form the landscape foundation.

Centrifuged Tails

We have successfully piloted the [use of centrifuges](#) to remove the water in fluid fine tails. This technology produces a soft, clay-rich material that can be used as the landform foundation in oil sands reclamation areas. We are planning to implement this technology in two stages – a commercial-scale demonstration plant beginning operations in 2012 and a \$1.9 billion full-scale commercial plant in 2015.



A commercial-scale demonstration of using centrifuges to dewater fluid fine tailings will begin operations in 2012.

The Quest for New Solutions

We are currently researching a number of additional technologies, which could be used to supplement existing remediation methods and reduce bitumen in tailings ponds. These include:

Accelerated Dewatering

Also referred to as rim ditching, [accelerated dewatering](#) is based on methods used in the Florida phosphate industry. It involves depositing fine tailings in a shallow containment structure and removing the water from the surface as it is released. Initial tests have shown a reduction in FFT volume by 50 percent in three to five years. Further study continues on a larger scale.



Accelerated dewatering field demonstration, 2009.

Overburden Mixing

This method proposes mixing fluid fine tails with overburden and placing the resulting material into mined-out pit areas for incorporation into reclamation landscapes. Research is underway to better understand water absorption into the overburden clays.

CO₂ Addition

Microbes living in our tailings ponds have reduced fluid fine tails volume by more than 25 percent over the past 15 years through bio-densification. Syncrude researchers are now studying how to mimic microbial activity and replicate this process through the direct addition of CO₂ into fluid fine tails.

Thickened Tails

Under evaluation for over a decade, this technology accelerates the settling of the fluid fine tailings by adding an organic thickening agent after bitumen extraction. The released water is still warm and can be recycled immediately back into the process. The thickened tailings are transferred directly to a mined-out area and deposited on a thin slope which allows excess water to drain and be recovered. Reclamation can then follow. This technology could reduce energy needs, speed up reclamation and result in smaller tailings ponds.

Bitumen Removal from Tailings Streams

Our extraction process recovers around 90 percent of the bitumen in the oil sand. The remaining bitumen is lost to the tailings stream and enters the settling basin. Recovery of this bitumen represents a significant economic opportunity and addresses key stakeholder and environmental concerns regarding potential risks to waterfowl. Bitumen recovered from either the tailings stream directly or from existing tailings areas would then be processed into crude oil product.

Collaboration Key to Advancements

We work collaboratively with other operators through the [Oil Sands Tailings Consortium \(OSTC\)](#) which was established in 2010. Through this group, we are sharing the results from our past efforts and cooperating on research and development activities going forward. This initiative foregoes intellectual property rights on technologies and makes \$400 million of past industry research available to all parties. It will be managed through the [Canadian Oil Sands Innovation Alliance \(COSIA\)](#).

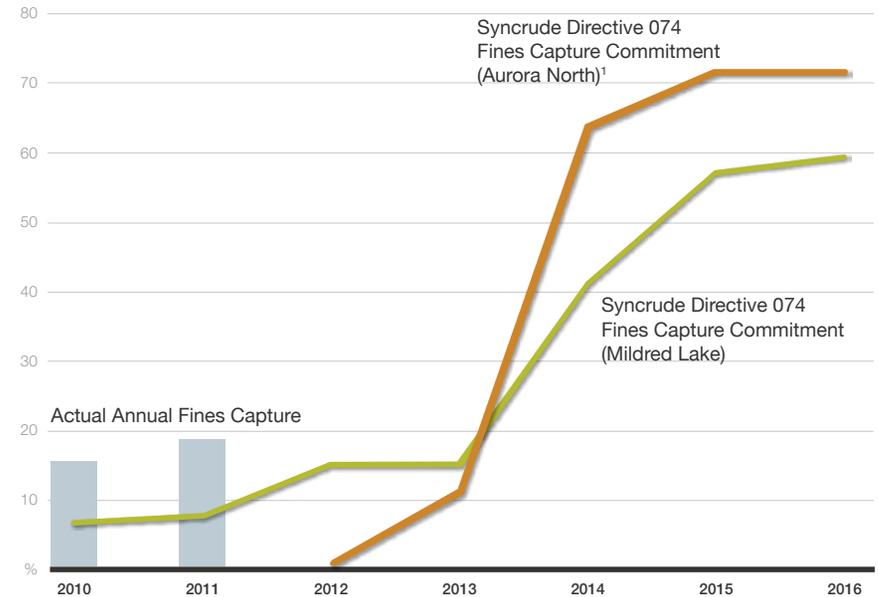
Directive 074 Commitment

As of 2015, Syncrude expects to meet the conditions outlined in the Energy Resources and Conservation Board (ERCB) Directive 074 which requires a minimum 50 percent tailings fines capture. The ERCB approved our plan in 2010, allowing us to construct facilities and implement the proven technologies necessary to ensure full compliance by 2015.

We surpassed our fines capture targets during the reporting period, achieving 15.7 versus 7.2 percent in 2010 (Q3 and Q4 only as per Directive) and 18.8 versus 8.2 percent for 2011 (full calendar year), for the Mildred Lake site. Fines capture at the Aurora mine operation commences in 2013 with the start-up of a commercial-scale composite tailings facility.

We are investing significant capital and resources to attain future targets, and are committed to the long-term intent of the Directive.

Fines Capture



¹ Fines capture at the Aurora Mine operation commences in 2013 with the start-up of a commercial-scale composite tailings facility.

*Graph reflects actual fines capture at Syncrude's Mildred Lake site against regulatory approval related to Directive 074, which requires operators to reduce fluid fine tailings. Syncrude's tailings management plan was approved by regulators in 2010. The first quarterly fines capture report was as of Q3 2010, per Appendix B of ERCB Directive 074. The Directive also requires Dedicated Disposal Areas (DDAs) to be formed in a manner that ensures trafficable deposits. The performance criteria are based on the strength of the deposit. Syncrude will incorporate this performance data into future reporting.