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**A Guide to
Audit and Assess
Oil Sands Fluid Fine Tailings
Performance Management**

Canada's Oil Sands Innovation Alliance

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Foreword

It is with pleasure that I present, on behalf of the members of Canada's Oil Sands Innovation Alliance (COSIA), *A Guide to Audit and Assess Oil Sands Fluid Fine Tailings Performance Management*. The Guide complements COSIA's companion publications on fluid fine tailings (FFT) management:

- *Technical Guide for Fluid Fine Tailings Management*¹
- *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*²

The guides are a result of extensive collaboration among COSIA members to develop a suite of documents for FFT management. They specify practices which are consistent with corporate and government policy goals for the progressive reclamation of mine sites on the road to sustainable closure plans.

The purpose of this document is to provide a basis for discussion and facilitate alignment between government and industry on the process for third-party performance audit of FFT management on the individual mine sites. An audit and assessment process is an important component in implementing a *tailings management framework* as called for in the Government of Alberta's *Lower Athabasca Regional Plan*.

FFT management is an evolving field, where each year brings new knowledge to be applied to sustainable solutions. This Guide has been designed to meet the needs of the oil sands mining industry. It encourages and provides a means of monitoring environmentally responsible management of FFT and reporting progress to corporate managers, regulators and stakeholders.

A number of independent industry experts and members of COSIA's Tailings Environmental Priority Area collaborated on and contributed to the guides. We appreciate the insight, expertise, dedication and enthusiasm they brought to the task.

Dan Wicklum,
Chief Executive, COSIA

Preface

In August 2012, COSIA published the *Technical Guide for Fluid Fine Tailings Management*. This document describes the methods being developed and implemented to convert FFT into stable deposits in sustainable mine closure landscapes. It also identifies the key performance measures appropriate for each of the deposit types.

To complement the Technical Guide, in February, 2014 COSIA published *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*. It describes the process to manage and report annual and five year progress to regulators, for control of FFT volumes on each mine site. It provides oil sands mining operators with guidelines for creating FFT management plans. It also requires each operator to submit an annual report comparing predicted versus actual FFT process performance and deposit behaviour.

This third Guide complements the above COSIA documents as well as the other guidance documents listed under “Document Purpose” in Section 1. It describes the independent third-party audit and assessment of FFT plans and performance of operations against those plans, as called for in the above guidelines. Every five years, well-trained, third-party experts will carry out this audit and assessment process. They will verify that plan versus actual performance comparisons are correct, that the performance commitments outlined in the FFT Management Plan have been met and that plans are realistic. An important outcome of this evaluation will be an independent opinion specifying whether or not mitigation measures need to be considered.

Progressive reclamation and mine closure design require the effective integration of several engineering and other applied science disciplines. Ineffective management of FFT can necessitate building additional containment volume, may delay reclamation timing and require a greater amount of FFT treatment at mine completion than was foreseen. The scale of mining, large volumes of FFT accumulation and the technical complexities involved in FFT treatment and measuring deposit performance justify the need for audit and assessment methods focused on these matters within an overall tailings management framework.

The **audit** of the management and organizational framework will determine if the key results are built into the organization from the most senior executive responsible for the mine operation through the technical and operations leaders, and the personnel responsible for planning, executing and reporting of FFT management activities.

The technical **assessment** will determine whether:

- Tailings plans are aligned with the production plan and forecast of fines in ore feed
- FFT treatment processes are being operated in accordance with the production rates and specifications required to accomplish plans
- FFT deposit behaviours are within the range of projections included in plans

- Measurement, monitoring and reporting accurately reflect process performance and deposit behaviour
- Plans have a reasonable probability of attainment
- Contingency actions are necessary to achieve plan goals.

The role of COSIA in ensuring the availability of a pool of multi-disciplined technical experts familiar with both oil sands operations and the audit and assessment process is set out in Section 5.

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1 Introduction

1.1 Fluid Fine Tailings Management Objectives

FFT management objectives support the over-arching objectives of sustainable mine closure and progressive reclamation:

1. To eliminate fluid containment dams in the closure landscape.
2. To establish a stable closure landscape, with sustainable and diverse ecosystems, within a reasonable time after cessation of mining.
3. To develop sustainable surface drainage including a functional lake system.
4. To facilitate progressive reclamation (i.e., the reclamation of mine areas, to the extent practical during mine life, to reduce post-closure liability).
5. To optimize full life-cycle costs and minimize life-cycle environmental impacts without compromising reclamation and closure objectives.
6. To understand technical uncertainties and appropriately manage their associated residual risks.

The *Technical Guide for Fluid Fine Tailings Management* described the processes under development for conversion of FFT into stable deposits in a closure landscape, and how the performance and deposit behaviour was to be measured against plans and predictions. The *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments* set out a process for FFT management of the two key performance factors:

- The control of FFT volumes throughout the mine life to closure.
- The performance of processes to create the closure deposits and measurement of deposit behaviour.

A key component of the *Performance Management* process was the requirement for a 5-year audit and assessment by an independent team of audit/assessors.

1.2 Document Purpose

This document provides oil sands mining operators with guidelines for the audit and assessment process consistent with the requirements set out in the *Performance Management* document referenced above. Through this process, the audit and assessment team will:

1. Assess the reasonableness of the relevant plans and reports.
2. Provide an opinion as to whether the mine closure plan is realistic and the progressive management of FFT is on track to the desired closure outcome.

This process will assist the operating companies to meet their commitments to sustainable mine closure and thereby give confidence to government and regulators that appropriate plans are being executed.

There are a number of additional documents that together with this and the above referenced documents make up a comprehensive suite for the management of FFT.

1. The *Oil Sands Tailings Measurement Protocol*³, outlines the measurement methods appropriate to the different FFT deposit types.
2. The Mining Association of Canada (MAC) has produced two documents that provide an overall process framework for tailings management:
 - *A Guide to the Management of Tailings Facilities, Second Edition, 2011*⁴
 - *A Guide to the Audit and Assessment of Tailings Facility Management, 2011*⁵

The MAC Guides deal comprehensively with all aspects of tailings planning, construction and operation. This document builds upon the MAC *Guides* to provide a focus on auditing and assessing the management of FFT volumes consistent with progressive management and closure commitments, including:

- The performance of processes in place to control FFT volumes
 - The predictions of the behaviour of different types of tailings deposits produced from FFT management processes.
3. *De-licensing of Oil Sands Tailings Dams*⁶, sets out the criteria for the critical mine closure step of decommissioning the containment dams used to clarify and store process water and store FFT.
 4. Two documents needed to complete the suite of supporting documents for FFT management are works in progress at the time of issuance of this Guide:
 - *Mine Financial Security Program – Application to Tailings* (CAPP)
 - *Tailings Water Effluent Release Standard* (In progress: MAC/COSIA)

1.3 Planning and Review Process

Figure 1 is taken from *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*. It highlights the point in the planning cycle where the third-party audit and assessment process is conducted. The assessment process ensures that reporting of the prior five-year period is accurate and that plans going forward are realistic, achievable, and have appropriate resources in place to execute them.

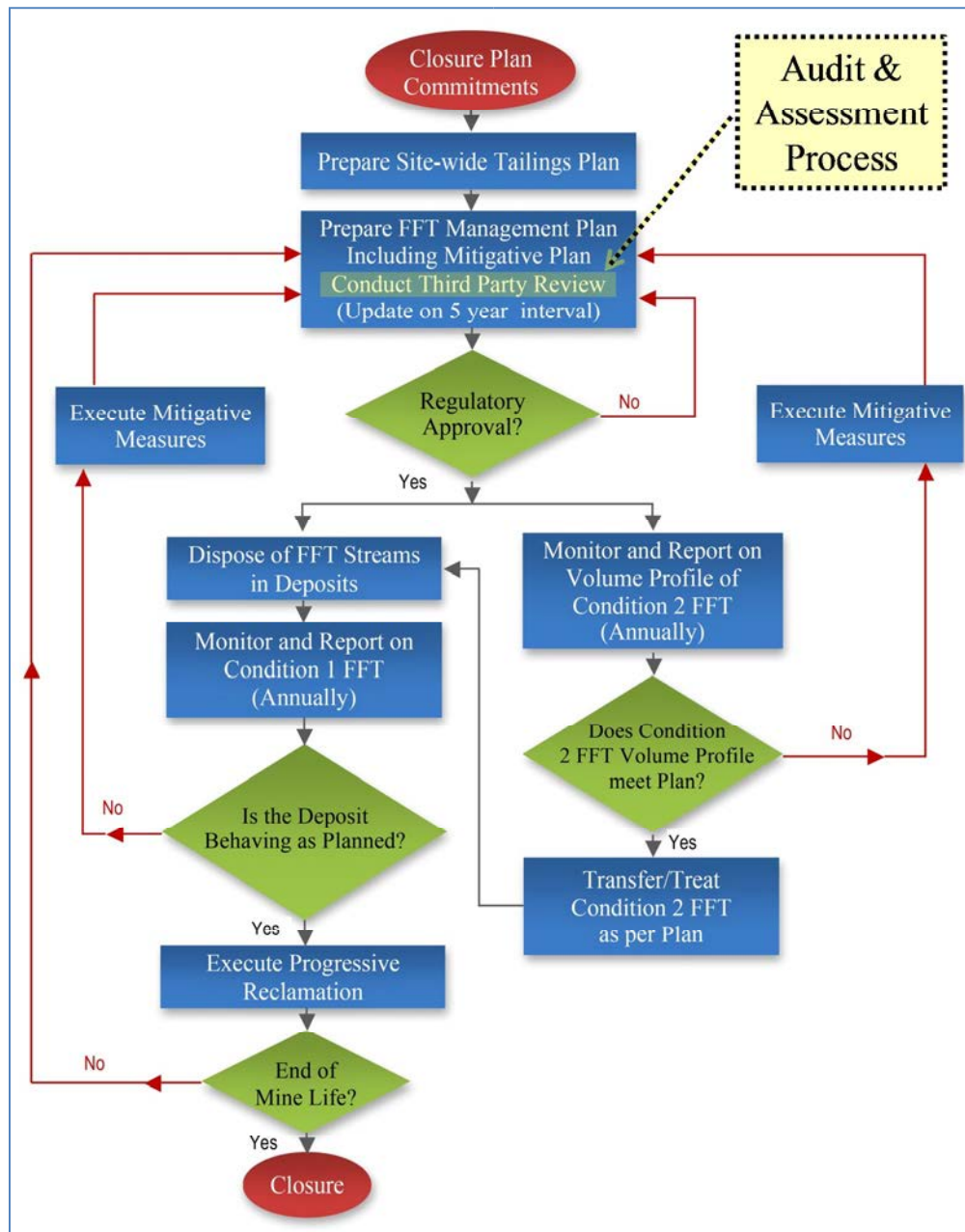


Figure 1 Tailings Performance Management Process

2 Audit of Management Framework

The Audit and Assessment process will ensure there is agreement among the various plans the organization has in place that underpin FFT management, and confirm that the organizational commitment, understanding and capability are in place to execute the plans.

2.1 Congruence of Plans & Budget

The first audit step is to ensure that the FFT operating plans and budgets are consistent with the commitments outlined in the five-year site-wide plans, which include:

- Mine plan
- Tailings disposal and containment plan
- FFT management plan
- Water management plan
- Reclamation plan
- Closure plan
- Budget plan and approval cycles

The intent is to verify that plans, budgets and financial approvals are in harmony through a review of the planning documentation and interviews with key personnel who are responsible for the above-listed plans, executing the associated FFT management projects and for related operational activities.

2.2 Organization and Alignment of Objectives

The second audit step is to ensure that organizational commitment, understanding and capabilities are in place to ensure that FFT management objectives are met:

- Does the responsible corporate officer have an understanding of and commitment to fulfill the plans?
- Are the organization's resources (numbers, skills, knowledge, and experience) in place to execute the plans?
- Is there comprehensive communication and delegation of tasks to meet the plan requirements?
- Are the organization's key result areas aligned with successful execution of the FFT management plan?

3 Assessment of FFT Processes and Deposits

3.1 Introduction

The assessment process will determine if the performance during the prior period has been consistent with plans and commitments made for that period, and if the plans for the next 5-year period are realistic (given past performance) to meet closure and progressive reclamation objectives.

3.2 Prior Period Performance

3.2.1 General

For each of the plan elements the following questions will be addressed:

- Have the objectives of the plan for the previous 5-year period been achieved?
- Have the deposit performance and behaviour been accurately measured and reported?
- Have FFT inventories been appropriately measured and reported?
- Have the appropriate contingency plans or adaptive management adjustments been incorporated into the updated plan?

3.2.2 FFT Deposit Management Processes

For each of the FFT management processes and deposits:

- Have the deposit placement and location been executed consistent with plans?
- Have the production projection targets for the deposits (on-line time, tonnage forecasts, etc.) been achieved?
- Have quality criteria (segregation, SFR, etc.) for the type of deposit been met or exceeded?
- Are the mitigation measures in progress likely to achieve the required results?
- Is the landform/terrain progression within the range of planning parameters for mine closure?

3.2.3 FFT Volume Management

- Do the measured FFT volume and the trend of the measured volume indicate that FFT and process water volumes will remain within the ranges planned for containment, consistent with progressive reclamation commitments?
- Is there a need for contingency actions based on the performance and trend?

(See Section 4.1 in *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*)

3.2.4 Deposit Behaviour Assessment

The different deposit types, their critical behaviour factors and performance measures are set out in Section 3.3.1 of the *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*. Where slowly -consolidating (clay-rich) deposits are concerned, deposit behaviour is essentially the rate of dewatering (solids content increase, deposit settlement, pore pressure dissipation and strength gain). Consolidation timelines are critical to planning progressive reclamation and predicting closure time requirements. The key questions for these deposits are:

- How does the actual deposit behaviour compare with the predicted (modelled) deposit behaviour?
- Is the deposit behaviour adequate to meet closure objectives or are contingency actions required to accelerate dewatering?
- Is there a need for contingency actions based on the performance and trend?

3.2.5 Other Factors

- Have any other unanticipated factors become known that could disrupt plans or commitments for progressive reclamation and mine closure?

3.3 5-Year Plan

The 5-year plan will normally include processes in operation for the prior period and may include processes new to the organization.

- In all respects, is the plan consistent with a sustainable closure plan and with commitments for progressive reclamation on the road to closure?
- Have any contingency requirements arising from prior years' performance and current trends been included in the plan?
- Given what is known (or not known) about FFT management processes, is the plan achievable?
- Are contingency actions "implementation ready" to the degree necessary?
- Considering the findings of the Audit and coming demands, does the organization have adequate staff and capabilities required to execute the 5year plan?

4 Assessment Team Composition and Qualifications

Managing FFT to achieve a sustainable mine closure landscape is an integrated process involving many engineering and other applied science disciplines. The audit process must confirm the commitment of senior executives to the management of FFT. This commitment must be reflected through the delegation of tasks, authorities and the organization's key result areas, so that all processes are coherently aligned with the commitments to progressive reclamation and mine closure.

Due to the complexity and multi-disciplinary integration requirements, the assessment component does not lend itself to a strict formulaic approach. The composition and experience of the audit and assessment team will be critical to assessing site-specific plans and the related operations. The members will generally be senior practitioners with in-depth knowledge gained through professional practice or management of relevant disciplines. As a whole, the team must be familiar with the disciplines outlined below and of equal importance, understand how the different facets integrate and interact with the overall site planning for mining, tailings management, water management and closure:

- Planning (mine pits, production, overburden, infrastructure, site layout)
- Tailings planning
- Geotechnical properties and consolidation behaviour of tailings deposits
- FFT management processes (thickening, etc.)
- Geology and hydrogeology
- Landform design, terrestrial reclamation and surface hydrology
- Limnology
- Environmental assessment including risk assessment
- Closure plan integration
- Regulatory processes
- Technology development from research and development to commercial operation
- Integration of disciplines to achieve progressive management to a sustainable closure
- Other knowledge related to unique aspects of the particular site.

It is envisaged that a team of three to four people, familiar with the disciplines appropriate to the site in question, would conduct the assessment. The team members must also be trained in how to conduct the audit and assessment process.

In selecting a third-party audit/assessment team for any particular mine site, it will be important that the members, collectively, possess the range of disciplines and experience necessary to the task, while at the same time being autonomous from the organization whose mine they are assessing. Members of the audit and assessment team must not have been engaged in developing the plans being

assessed nor **currently** contracted to a geotechnical review or advisory board of the site operating company. In general, the team will be made up of Professional Engineers and other professionals with appropriate technical and management experience in the relevant disciplines or management thereof. In some cases, it may be useful to involve experts with relevant experience from other mining fields to provide an outside perspective and to assist in the growth of the pool of qualified individuals.

Given the importance of the audit and assessment process to the integrity of tailings management planning and performance, it is recommended that each company advise and seek comment from the Alberta Energy Regulator of their auditors/assessors selection prior to execution of the audit and assessment.

5 COSIA Role

Owing to the unique technical issues involved in management of FFT, it will be essential to have available a pool of multi-disciplined technical professionals familiar with the planning and operation of oil sands mines and the processes deployed for management of FFT. The industry representatives best qualified to nominate, review, and maintain a list of qualified individuals to undertake the work outlined in this Guide are the operators' representatives on the COSIA Tailings EPA. Using their experience and that of others within their organizations (e.g., those responsible for reclamation and closure plans), they will nominate individuals and collectively approve the list of qualified auditors/assessors. Individual operating companies will select a third-party audit team best suited for assessing their site from the list. Each company will also be responsible for providing funding and logistical support for the auditors/assessors in the execution of their work.

To support the operators' responsibilities, COSIA will:

1. Re-issue updated versions of this document as necessary in recognition that such practices and standards are adopted and refined through use.
2. Sponsor a short training program for those who wish to act as auditors and assessors of FFT management plans. This program could be offered in conjunction with oil sands tailings conferences in addition to specific sessions conducted for the purpose.
3. Liaise with MAC and others as necessary to ensure coherence with other related guidance documents.

The most recent version of this document and associated references are available through COSIA.

www.cosia.ca

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1. Alexander Hyndman, P.Eng., Principal Consultant, Magnus Limited.
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It was reviewed by:

1. A CAPP committee established to liaise with government on tailings management including representatives from the COSIA Tailings Environmental Priority Area.
2. Jim Dilay, former board member of the ERCB with extensive experience as panel member or chair in review and decisions on oil sands mining projects.
3. Terry Abel, formerly with the Alberta Energy Regulator and the ERCB with responsibility for oil sands project reviews and approvals.

Related Guidance Documents

The following documents complement this Guide in managing oil sands fluid fine tailings.

Published Guides:

- ¹ OSTC/COSIA (Oil Sands Tailings Consortium) 2012. *Technical Guide for Fluid Fine Tailings Management*. www.cosia.ca
- ² COSIA 2014a. *Guidelines for Performance Management of Oil Sands Fluid Fine Tailings Deposits to Meet Closure Commitments*. www.cosia.ca
- ³ COSIA (Canada's Oil Sands Innovation Alliance) 2014b. *Oil Sands Tailings Measurement Protocol*. Report to COSIA by Thurber Engineering Ltd. and Barr Engineering.
- ⁴ MAC 2011a. *A Guide to the Management of Tailings Facilities, Second Edition*.
- ⁵ MAC 2011b. *A Guide to the Audit and Assessment of Tailings Facility Management*.
- ⁶ Oil Sands Tailings Dam Committee 2014c. *De-Licensing of Oil Sands Tailings Dams- Technical Guidance Document*. (Available on the University of Alberta website at <http://hdl.handle.net/10402/era.38332>)

Documents in development:

CAPP: *Mine Financial Security Program – Application to-Tailings*.

MAC/COSIA: *Tailings Water Effluent Release Standard*.