Oil Sands Rules, Tools and Capacity: Are we Ready for Upcoming Challenges?

Oil Sands Research and Information Network

University of Alberta

October, 2014

Oil Sands Research and Information Network

The Oil Sands Research and Information Network (OSRIN) is a university-based, independent organization that compiles, interprets and analyses available knowledge about managing the environmental impacts to landscapes and water affected by oil sands mining and gets that knowledge into the hands of those who can use it to drive breakthrough improvements in regulations and practices. OSRIN is a project of the University of Alberta's School of Energy and the Environment (SEE). OSRIN was launched with a start-up grant of $4.5 million from Alberta Environment and a $250,000 grant from the Canada School of Energy and Environment Ltd.

OSRIN provides:

- **Governments** with the independent, objective, and credible information and analysis required to put appropriate regulatory and policy frameworks in place
- **Media, opinion leaders and the general public** with the facts about oil sands development, its environmental and social impacts, and landscape/water reclamation activities – so that public dialogue and policy is informed by solid evidence
- **Industry** with ready access to an integrated view of research that will help them make and execute environmental management plans – a view that crosses disciplines and organizational boundaries

OSRIN recognizes that much research has been done in these areas by a variety of players over 40 years of oil sands development. OSRIN synthesizes this collective knowledge and presents it in a form that allows others to use it to solve pressing problems.

Citation

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Copies of this report may be obtained from OSRIN at osrin@ualberta.ca or through the OSRIN website at http://www.osrin.ualberta.ca/en/OSRINPublications.aspx or directly from the University of Alberta's Education & Research Archive at http://hdl.handle.net/10402/era.17507.

Table of Contents

LIST OF FIGURES

REPORT SUMMARY

Within the next decade we are likely to see some significant tests of the current oil sands regulatory and policy framework, including:

- **Industry-driven:** such as an application for reclamation certificate or an application for release of process-affected water or a request to approve the water-capped fine tailings option
- **Government-driven:** such as the implementation of the tailings management framework or LARP management frameworks or the wetlands policy or AEMERA
- **Environment-driven:** such as a low-flow event in the Athabasca River or a major rainfall/flood event

What other challenges can we foresee?

We know there are various policy initiatives underway that will address some of these challenges but the results are not yet public and the related uncertainty is itself a challenge.

In this Workshop, held October 27, 2014 at the University of Alberta, 48 people from a number of sectors explored our level of readiness to deal with such challenges, based on our existing and planned rules, tools and capacity and identify solutions to address the challenges. Each table was asked to produce a list of potential challenges, categorize them based on a set of criteria and then provide solutions to the most pressing challenges.

About 84% of the challenges identified were expected to occur in the next 5 years; many of the challenges were described as happening right now. A total of 17 challenges were placed in the Parking Lot. Participants indicated we have Low Readiness to address 41% of the challenges; the small number of High readiness challenges is probably a reflection of our tendency to focus on problems rather than things that are going well. Knowledge was the most frequently identified gap while Regulation was least commonly flagged.

Common themes among the 138 challenges include:

- Oil sands process-affected water release – criteria, process, stakeholder acceptability, pit lake viability, treatment options and costs
- Caribou – how to protect the species and its habitat; how to restore habitat
- Aboriginal – what are their desires and needs; how can we accommodate those needs into plans and operational practices
- Greenhouse gas and climate change – management, reduction, impact of regulation
- Climate change adaptation – how do we ensure hydrology and reclamation plans take climate change into account
- Closure and reclamation goals and reclamation certification – end land uses, is perpetual care an option, do we know how reclamation success will be measured

- How can offsets be used to compensate for disturbance
- Communicating with stakeholders – how to provide and explain complex data, how to explain plans, options and constraints
- Economic forces affecting development – access to market, access to resources, price of oil, liability management programs

Some of the key themes were:

- Desire to see clearer roles and responsibilities for government agencies in regulation, monitoring and communication; suggestions for a single *coordinator* for these roles
- Complete and implement all the Lower Athabasca Regional Plan frameworks
- More emphasis on technical- and risk-based decision-making
- More emphasis on *regional* outcomes and solutions
- More emphasis on obtaining, considering and incorporating Aboriginal views in plans and decisions
- Use adaptive management based on forecasts, scenarios, and monitoring
- Need more public, stakeholder and investor communication – share success stories (but acknowledge the problems), identify champions who can take the message out
- Invest in research, knowledge/data management
- Invest in skills training
- Retrieve, preserve and use historical knowledge and corporate memory

ACKNOWLEDGEMENTS

The Oil Sands Research and Information Network (OSRIN), School of Energy and the Environment (SEE), University of Alberta provided funding for this project.

OSRIN is grateful for the assistance of the following people in developing the workshop structure and invitation list: Bruce Anderson (Suncor), Carol Jones (Stantec), Gord McKenna (BGC Engineering), Norbert Morgenstern (University of Alberta), and Taras Pojasok (Alberta Environment and Sustainable Resource Development).

1 INTRODUCTION

Within the next decade we are likely to see some significant tests of the current oil sands regulatory and policy framework, including:

- **Industry-driven:** such as an application for reclamation certificate or an application for release of process-affected water or a request to approve the water-capped fine tailings option
- **Government-driven:** such as the implementation of the tailings management framework or LARP management frameworks or the wetlands policy or AEMERA
- **Environment-driven:** such as a low-flow event in the Athabasca River or a major rainfall/flood event

What other challenges can we foresee?

We know there are various policy initiatives underway that will address some of these challenges but the results are not yet public and the related uncertainty is itself a challenge.

In this Workshop, held October 27, 2014 at the University of Alberta, 48 people (Appendix 1) from a number of sectors explored our level of readiness to deal with such challenges, based on our existing and planned rules, tools and capacity and identify solutions to address the challenges. The Workshop agenda is provided in Appendix 2.

Each table was asked to produce a list of potential challenges, categorize them based on a set of criteria and then provide solutions to the most pressing challenges. Guidance was provided on how to approach this task (Appendix 3). The results of their work are provided in sections 3 to 7 of this report.

2 KEYNOTE PRESENTATION – STRATEGIC FORESIGHT

To set the stage for the Workshop discussions we invited Richard Dixon, Chief of Strategic Foresight, Alberta Energy Regulator, to discuss what strategic foresight is and how it can be used. His presentation is provided in Appendix 4.

Key points from the presentation and discussion include:

- Foresight aims to identify potential futures and the key factors that lead to each scenario but it doesn't provide actionable intelligence (tends to result in admiring the problem); Strategic foresight, on the other hand, provides actionable advice to decision-makers
- Strategic foresight is aware of, and interested in, short term events (often called data points or weak signals) but is not unduly influenced by them; instead it focuses on trends and the underlying structures that support the trends

- Scenarios provide a framework for further discussion and for challenging our assumptions about the future. What we think or assume the future will be influences the decisions we make today.
- It is important to look back at earlier scenarios to see what we got right and wrong, and why the outcomes were different than expected so the lessons can be built into the next scenario.
- The Alberta Energy Regulator Strategic Foresight team will be working on 80 different but integrated scenarios over the next few years.

3 LIST OF CHALLENGES

The groups were asked to develop a list of potential challenges that people and organizations involved in oil sands environmental management may be faced within the next ten years. While asked to describe challenges in the form of an **action or event** wherever possible (e.g., Industry submits an application for …), most groups described challenges in the form of an issue (e.g., How do we decide trade-offs regarding resource development vs. ecosystem integrity).

Common themes among the 138 challenges include:

- Oil sands process-affected water release – criteria, process, stakeholder acceptability, pit lake viability, treatment options and costs
- Caribou – how to protect the species and its habitat; how to restore habitat
- Aboriginal – what are their desires and needs; how can we accommodate those needs into plans and operational practices

Figure 1. List of common words found in the challenges.

- Greenhouse gas and climate change – management, reduction, impact of regulation

- Climate change adaptation – how do we ensure hydrology and reclamation plans take climate change into account
- Closure and reclamation goals and reclamation certification – end land uses, is perpetual care an option, do we know how reclamation success will be measured
- How can offsets be used to compensate for disturbance
- Communicating with stakeholders – how to provide and explain complex data, how to explain plans, options and constraints
- Economic forces affecting development – access to market, access to resources, price of oil, liability management programs

4 RANKING THE CHALLENGES

The groups were asked to rank the challenges based on the following categories:

- Timeframe (when is the challenge likely to arise):
  - Within next 5 years (5)[1]
  - Within next 10 years (10)
- Readiness Level (how prepared are we to deal with the challenge):
  - Low (L)
  - Medium (M)
  - High (H)

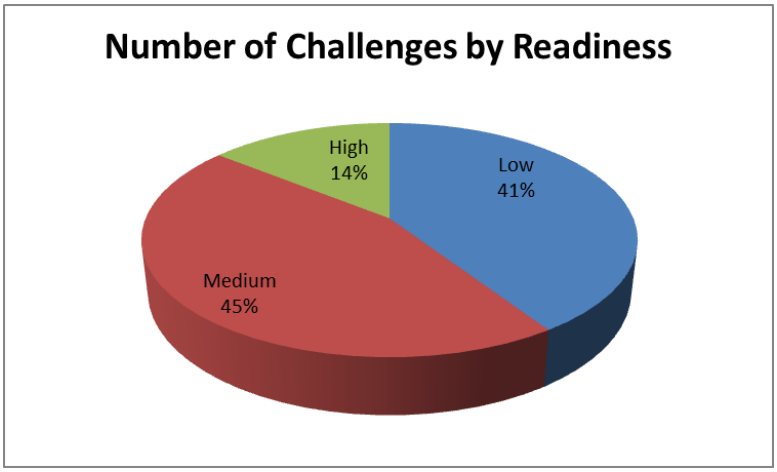

Figure 2. Number of challenges by Readiness Level.

About 84% of the challenges identified were expected to occur in the next 5 years (the first 113 challenges listed in Appendix 6); many of the challenges were described as happening *right now*. A total of 17 challenges were placed in the Parking Lot (Appendix 5). Figure 2 shows that participants indicated we have Low Readiness to address 41% of the challenges (these are listed in Appendix 7); the small number of High readiness challenges is probably a reflection of our tendency to focus on problems rather than things that are going well.

[1] Groups were asked to use the codes in brackets to label their challenges. For example, Table 2 identifies a challenge occurring in the next 5 years, says we are Medium ready to deal with it and that the gap is due to Experience and Knowledge. They label the challenge: 2 – 5 – M – E K

In two instances groups noted that government had low readiness while industry's was high (release criteria for water; dealing with access to market). Most of the discussion on readiness levels focused on government and industry but one group asked if we know the level of readiness in Aboriginal communities to deal with these issues.

5 IDENTIFYING THE GAPS

Groups were asked to assess the gaps that were impacting our ability to address the challenges. The following gap categories were used:

- Regulation (R) – are regulatory tools available to address the challenge (e.g., Acts, Regulations, Codes, Directives, etc.)?
- Policy (P) – is there public guidance on how to proceed?
- Capacity (C) – do we have the people, skills and money to address the challenge? Capacity applies to dealing with the regulatory, environmental and social consequences of the challenge.
- Experience (E) – have we dealt with something similar before or will this require a very different approach?
- Knowledge (K) – do we have the information necessary for decisions and implementation?
- Willingness (W) – are we willing to acknowledge and address the challenge when it arises?

Groups were allowed to identify more than one gap where applicable. By default, High readiness challenges were not expected to have many (or any) gaps.

Figure 3 shows that Knowledge was the most frequently identified gap while Regulation was least commonly flagged.

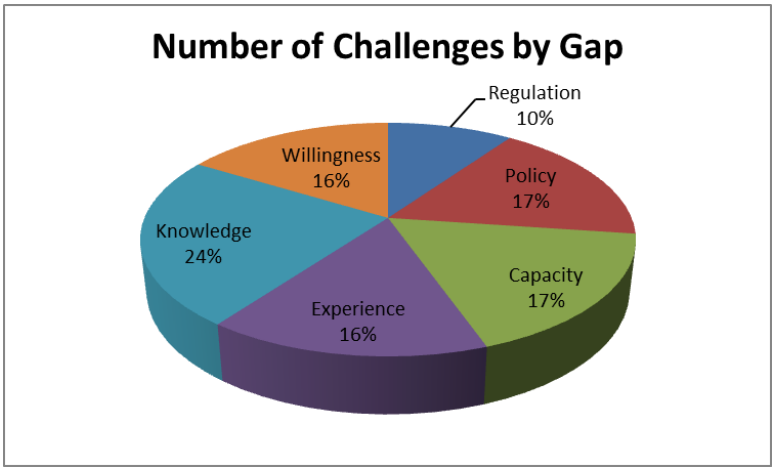

Figure 3. Number of challenges by Gap.

Appendix 6 provides the full listing of ranked challenges and the associated gaps. The challenges associated with each Gap are listed separately in the following Appendices:

- Regulatory gap – Appendix 8
- Policy gap – Appendix 9
- Capacity gap – Appendix 10

- Experience Gap – Appendix 11
- Knowledge gap – Appendix 12
- Willingness gap – Appendix 13

6 IDENTIFYING SOLUTIONS

Groups were asked to identify potential solutions to the gaps, with particular emphasis on the 5-Year, Low readiness challenges (Appendix 14).

Some of the key themes were:

- Desire to see clearer roles and responsibilities for government agencies in regulation, monitoring and communication; suggestions for a single *coordinator* for these roles
- Complete and implement all the Lower Athabasca Regional Plan frameworks
- More emphasis on technical- and risk-based decision-making
- More emphasis on *regional* outcomes and solutions
- More emphasis on obtaining, considering and incorporating Aboriginal views in plans and decisions
- Use adaptive management based on forecasts, scenarios, and monitoring
- Need more public, stakeholder and investor communication – share success stories (but acknowledge the problems), identify champions who can take the message out
- Invest in research, knowledge/data management
- Invest in skills training
- Retrieve, preserve and use historical knowledge and corporate memory

Figure 4. List of common words found in the solutions.

7 SUGGESTED READING

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APPENDIX 1: List of Workshop Attendees

Name and Organization		Name and Organization	
Terry Abel	CAPP	Stacy MacDonald	AER
James Agate	CNRL	Pat Marriott	AER
Angela Alambets	WaterSMART	Gord McKenna	BGC
Bruce Anderson	Suncor	Norbert Morgenstern	UofA
David Anderson	Cenovus	Richard Nelson	AIEES
Caroline Bampfylde	ESRD	Lori Neufeld	Imperial
Lynne Barlow	Syncrude	Mike Norton	NRCan
Judy Bennett	AMEC	Taras Pojasok	ESRD
Brian Brassard	ESRD	Brett Purdy	AI-EES
Richard Dixon	AER	Tanya Richens	Suncor
Sara Dorow	UofA	Andy Ridge	ESRD
Sarah Ficko	UofA	Sheila Risbud	Teck
Greg Goss	UofA	Neil Sandstrom	Teck
John Gulley	Golder	Jim Schieck	ABMI
Kelvin Hirsch	NRCan / CFS	Tim Shopik	Matrix
Chris Holly	Energy	Shauna Sigurdson	CEAA
Martin Jalkotzy	Golder	Kem Singh	ESRD
Dallas Johnson	ESRD	Christina Small	AITF
Carol Jones	Stantec	Daniel Stuckless	Fort McKay
Kim Kasperski	NRCan / Devon	Kim Sturgess	WaterSmart
Mark Kavanagh	AUC	Adam Sweet	EEDC
Angela Kupper	BGC	Steve Tuttle	CNRL
Lianne Lefsrud	U Michigan	Prasad Valupadas	AEMERA
Ron Lewko	Syncrude	Ward Wilson	UofA

APPENDIX 2: Workshop Agenda

0900 – 0915	Welcome, Safety Moment, Workshop Goals and Structure
0915 – 0945	Strategic Foresight – What is it and how can we use it? Richard Dixon, Chief of Strategic Foresight, Alberta Energy Regulator
0945 – 1030	Group Session 1: Brainstorming List of Challenges
1030 – 1045	Coffee
1045 – 1115	Group Presentations – Three Challenges
1115 – 1200	Group Session 2: Ranking the Challenges Timeframe – (5) Next 5 Years or (10) Next 10 Years (Parking Lot for longer term challenges) Readiness Level – (L) Low; (M) Medium; or (H) High
1200 – 1245	Lunch (provided)
1245 – 1330	Group Session 3: Identifying the Gaps Source of the Readiness Gap – (R) Regulation; (P) Policy; (C) Capacity; (E) Experience; (K) Knowledge; or (W) Willingness
1330 – 1345	Groups Post Ranked Challenges on Master Chart
1345 – 1410	Plenary and Coffee – View and discuss challenges
1410 – 1450	Group Session 4: Identifying Solutions Starting with the 5-Year, Low Readiness Challenges Groups will discuss and recommend solutions to Gaps
1450 – 1520	Group Presentations – Three Challenge Solutions
1520 – 1545	Plenary Discussion
1545 – 1600	Closing Remarks and Next Steps

APPENDIX 3: Workshop Guidance

Within the next decade we are likely to see some significant tests of the current oil sands regulatory and policy framework. Each table is asked to produce a list of potential challenges, categorize them based on the criteria described below and then provide solutions to the most pressing challenges.

You will document the challenges and ranking codes on sticky notes which we will post on the wall during a plenary/coffee session so you can see what others have come up with.

Task 1: List the Challenges

You will develop a list of potential challenges that people and organizations involved in oil sands environmental management may be faced within the *next ten years*. Please approach this task as a brainstorming session and do not spend time discussing or debating the challenges – this will occur in the next stages.

Challenges are to be described in the form of an *action or event* wherever possible. Groups are encouraged to consider that in some cases a particular challenge can actually be expressed as two challenges: e.g., X occurs or X doesn't occur.

Note that while *you* may know that a rule, tool and/or capacity exists or is currently being developed to address a challenge others may not – these perceived challenges represent an opportunity for communication and education.

Task 2: Rank the Challenges

You are asked to rank the challenges based on the following categories:

- Timeframe (when is the challenge likely to arise):
  - Within next 5 years (5)
  - Within next 10 years (10)
- Readiness Level (how prepared are we to deal with the challenge):
  - Low (L)
  - Medium (M)
  - High (H)

The following guidance will help rank the challenges:

- Strive for a consensus ranking where possible, otherwise go with the "most common ranking" but note what the main differences of opinion were
- The "within next 10 years" category is most likely going to be for challenges that are expected to arise in years 6 to 10, but can also be used to house challenges where the timeframe is uncertain (but within 10 years)

- Low readiness means we would struggle to handle the event appropriately or in a timely manner; High readiness means we feel we have the authority, tools and capacity to deal with the event (or will have by the time the event occurs); Medium readiness is for everything in between these two levels of confidence
- When considering Readiness, "we" means all sectors – government (includes the Alberta Energy Regulator for this assessment), industry, consultants, stakeholders, Aboriginal communities, and knowledge creators/providers – as we all have a role to play in ensuring effective environmental management of the oil sands.
- Place challenges that are expected to occur at some time in the future (but after 10 years) into a Parking Lot so we don't lose them.

Task 3: Identify the Gaps

You are asked to assess where the gaps are that are impacting our ability to address the challenges. Please use the following gap categories:

- Regulation (R) – are regulatory tools available to address the challenge (e.g., Acts, Regulations, Codes, Directives, etc.)?
- Policy (P) – is there public guidance on how to proceed?
- Capacity (C) – do we have the people, skills and money to address the challenge? Capacity applies to dealing with the regulatory, environmental and social consequences of the challenge.
- Experience (E) – have we dealt with something similar before or will this require a very different approach?
- Knowledge (K) – do we have the information necessary for decisions and implementation?
- Willingness (W) – are we willing to acknowledge and address the challenge when it arises?

You may identify more than one gap where applicable. By default, High readiness challenges are not expected to have many (or any) gaps.

Task 4: Identify Solutions

In this session you will identify potential solutions to the gaps. To ensure the key challenges are addressed we want you to tackle the 5-Year, Low readiness challenges first, and then as time permits the 10-Year, Low Readiness challenges, and then the 5-Year and 10-Year Medium readiness challenges.

Filling out the Challenge Sheets

Each Table will have a pad of sticky notes.

Put one challenge on each sticky note

At the TOP of the sticky note place the following Code for the Challenge

Table # – Time – Readiness – Gap(s)

For example, Table 2 identifies a challenge occurring in the next 5 years, says we are Medium ready to deal with it and that the gap is due to Experience and Knowledge. They write at the top of the sticky note

2 – 5 – M – E K

Under the Code write out the challenge

When appropriate, under the Challenge and on the next page write out the solutions

For Parking Lot items just write Table # – P at the top and then the Challenge

APPENDIX 4: Strategic Foresight: What is it and How Can we Use it?

Workshop PowerPoint presentation delivered by Richard Dixon, Chief of Strategic Foresight, Alberta Energy Regulator.

Strategic Foresight
What is it and how can we use it?

OSRIN – The Final Workshop
October 27th, 2014

Richard Dixon
Chief of Strategic Foresight
Alberta Energy Regulator

What is Foresight?

- Also known as future studies or futurology
  - Modern origins: HG Wells, 1901
- Usually split into:
  - Academic / Institutional (e.g. WFS, …)
  - Government / Military (e.g. Rand, intelligence, …)
- What is missing?
  - Corporations – especially energy
    - Often propriety knowledge and information, more often a branch of economics
- Example: Forecasting vs. Scenarios (Gov't budget)

What makes it "Strategic"?

- Strategic does not describe a type of foresight but what you do with the foresight
  - create strategies that incorporate the insights that foresight methodologies and tools bring.
    - Example: Business Cases are developed with a single view of what the future might be (often ideal or hoped for)
  - Suncor's Voyageur project

Strategic Foresight

- Is the ability to create and maintain a high-quality, coherent and functional forward view and to use the insights arising in organizationally useful ways e.g. to reach new markets, to guide policy, to reinvent companies, to launch strategic alliances.
  - Richard Slaughter, Strategic Foresight

Some Foresight Tools

Framing	stakeholder analysis, integral (meta-method) issue analysis, critical futures
Scanning	environmental scanning, content analysis, leading/lagging indicators, text mining, trend tracking
Forecasting	bellwether analysis, cross impact analysis, Delphi, emerging issue analysis, framework forecasting, gaming/simulation, historical analogy/pattern recognition, morphological box/field anomaly relaxation, scenarios (2x2, incasting, Manoa, etc), statistical modeling (time series), systems analysis, technology forecasting (TRIZ, roadmapping, patent analysis, etc), trend analysis
Visioning	causal layered analysis, futures wheel, implications analysis, appreciative inquiry, backcasting, creative imagery, visualization, Futures Search
Planning	decision modeling, risk analysis, strategic planning, technology assessment
Acting	action research, change management, coaching, consulting, issues management

Polaroid: the Strategic Conversation

IF THEY ONLY KNEW

"fun, futuristic stuff without many actionable implications"
Polaroid Executive

Sub Primes: Testing Assumptions

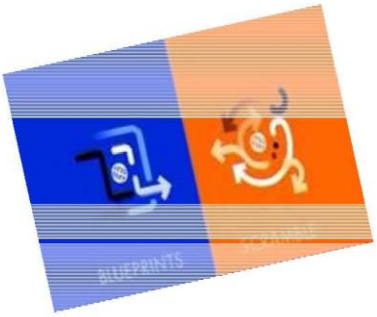
IF THEY ONLY KNEW

Wabamun: Testing Policy Effectiveness

IF THEY ONLY KNEW

Shell – How they knew what to do

- Describe long-term plausible futures, opens strategic conversations
- Reveal and confront assumptions, widen perspectives, test policies
- Define roles and directions for decisions on strategies and policies



- **Carbon Constrained World**
- **No more easy oil**
- **More energy**

Work of a Futurist

- Make an organization work smarter and more efficient
- Offer discipline and structure to help the organization intentionally anticipate the future
- Align business interests with anticipated futures

Four Forces of Change

- Resources : energy use and concentration
  - Stone Age > Agrarian > Industrial > Digital
- Technology: convert resources into goods, etc
- Demographics: needs & abilities of the population
- Governance
  - Rules =law and markets; structure = government

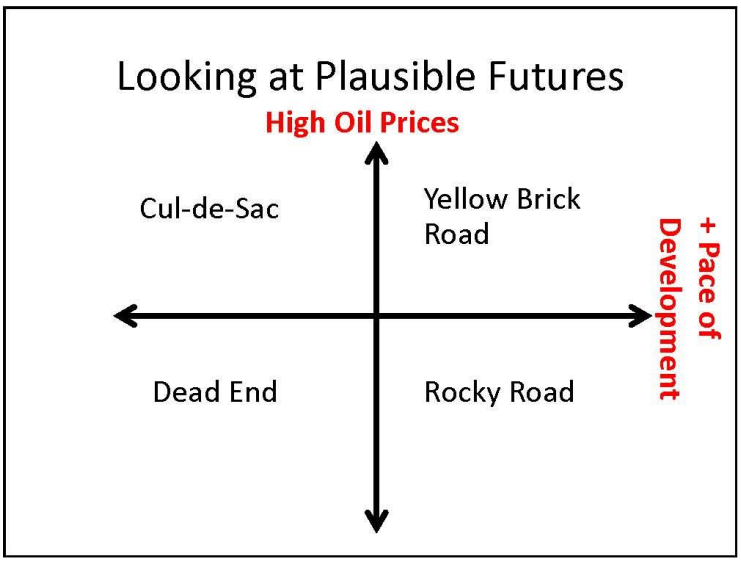
A Strategic Way To Look At The World

Best or Focal Questions

- It stumps you
- It is philosophical
  - Seeking understanding of why something does or doesn't work
- It is very specific
- It focuses on what, not how

Know the Drivers

- From the four Forces of Change
- Evaluate for
  - Impact
  - Likelihood
  - Certainty (Forecasting vs Scenarios)
- Concentrate on the drivers with highest impacts & likelihood and then which are the most uncertain to forecast


Looking at Plausible Futures
High Oil Prices
Cul-de-Sac
Yellow Brick Road
Dead End
Rocky Road
+ Pace of Development

APPENDIX 5: Challenges Placed in the Parking Lot

Some groups identified challenges that they felt were important but would occur at some point after the 10 year window that was the focus of the Workshop. I some cases the groups identified the Readiness Level and gaps associated with the challenges.

The list of longer-term challenges is provided below:

Remove barriers (legal liabilities) limiting collaboration on integrated development and closure and management of cumulative effects
Low – Policy/Regulation/Willingness/Capacity/

Play-based regulation (new approach for regulating development; relationship to long term certification)

Dam de-licensing – keep water in the landscape in a structure; tailings; pit lake; water quality – closure plan for tailings water release; no policy for release – no release not realistic
Low (but high priority) – Knowledge/Experience/Willingness

Biodiversity on reclaimed land – how to establish it, how to measure it (criteria); impacts of climate change on species planted now
Low – Knowledge

Climate change adaptation – for wetland reclamation and terrestrial reclamation; what should we be targeting?
Low – Knowledge/Experience/Regulation/Policy/Willingness

Economics of development (not a high-margin activity, Mine Financial Security Program)

Unexpected source of alternative energy (e.g., nuclear fusion)
Low – Knowledge/Experience

If no longer gasoline for vehicles is the industry still viable
Low – Knowledge/Experience/Willingness

Technology for extraction – solvent (paraffinic technologies); clean coal (see switch from Polaroid cameras to digital for impact); financial barriers
High

Pace of development has a structure constraining it
Low – Policy/Willingness

Is technology facilitating the regional markets for energy (creates local jobs; effect on environmental regulations)

If industry comes to a halt, how do we deal with environmental disturbance all at once (liability, ability to manage and reclaim)

Ability for industry to manage the complexity (technical, technology, social interpretation)

How do we manage impacts (don't oversell the lack of impacts from the development)

Public perception about safety of post-mine landscape
Low – Capacity/Experience/Knowledge/Willingness

What controls people's behaviour – economics or social values? (where is the challenge point)

Will cultural diversity in Alberta facilitate change (opportunity, youth and different viewpoints; regulatory; government reaction)

APPENDIX 6: List of Challenges and Solutions

The table below provides the full list of ranked challenges identified, along with their associated Timeframes, Readiness Level, Gap(s) and Solutions. Some editing has been done for clarity.

The list has been sorted by Timeframe (5 year first) and then by Readiness level within each Timeframe.

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
Competition from other "unconventional" energy sources (economic pricing and competition for labour and materials)	Planning based on strategic foresight	★		★				★	★			

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			
Mine Financial Security Program vulnerable to price crashes for resources (relies on another operator coming along; what if they don't?)	Identify scenarios where this might occur and develop solutions	★		★				★		★		
Developing acceptable (demonstrated) reclamation forecasting models	Internal work by operators already; need a joint effort to cooperate and collaborate to calibrate (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency and/or Canada's Oil Sands Innovation Alliance?)	★		★					★		★	
How do we communicate effectively about complex data?	An arms-length organization; independence of experts; issuing of the data; taking the *story* to the people; have to communicate bad stories too; being first interpreter of the data; government to evaluate the data in the short term to be effective	★		★					★	★		
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are we ready to meet the expectations for environmental management given recent court decisions and treaty rights?	Biodiversity, cumulative effects, regional planning and management	★		★			★	★				

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★
What does resource disparity across the country mean for Canada?		★		★				★				
Changing industry's position that numbers are self-evident (i.e., correct)		★		★					★		★	
How do we fill information voids (how can oil sands get better information out)?		★		★					★	★	★	
Data information communication (access, availability, interpretation; what is role of data?; concept is to have free available data but not ready to do this; need to understand multiple needs and design systems to support these; need to sort out functionality vs. science)		★		★					★	★	★	
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Managing expectations/information of gap between Environmental Impact Assessment predictions and reality (feedback model)	Move from assessing cumulative effects to managing effects; adopt an adaptive management system; identify willingness to change pace of development and spatial/land impact of development; tie reporting to EIA environmental, social and health predictions; continue consultation during construction inspections	★		★							★	★
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	
Providing public information on intended treated tailings water discharge	Better characterization of the effects of tailings (e.g., naphthenic acids); develop risk-related standards for release; utilize existing communication tools (e.g., Oil Sands Information Portal); engagement, education; build trust first; open dialogue to understand expectations	★		★			★					★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Pipelines are not approved (how will this impact environmental disturbance and impacts, for example from using more trains)	Build more refineries; identify cost-benefits of all options; address the fundamental concern about GHGs, ecological and social issues; educate	★		★								★
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Access to market (BC and Energy East pipelines; next US president; key for development; barrier to growth and environment; safety - rail vs. pipeline; positive decisions = dollars gained = investments in environmental protection; accelerated investments) Low readiness for government but high for industry	East-West National - market share and partnerships (share the wealth); establish treaty land claim rights for BC Aboriginals North-South International - political change in government direction (energy security to replace Venezuelan oil); pipeline tariffs to States being crossed; make oil *clean* comparable to conventional oil; have others speak on behalf of industry and government	★		★		★						★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Reclamation of wetlands/peatlands	Use wetland offset payments for higher-value wetland reclamation research; better planning using well-informed tools (include all available data); develop economic tool to determine costs of reclaiming wetlands	★		★						★	★	
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★
Access to energy resources (restrictions on development)	Gauge public opinion through engagement on trade-offs and develop a response (policy) accordingly	★		★				★				
What if capital funding dries up for oil sands projects?	Change royalties to incent development; develop an easily understood story that resonates with investors - less defensive, more comprehensive story-telling about how we are developing the resource with wisdom and integrity	★		★				★				

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Impact on project economics of cumulative policies (fisheries, caribou, wetlands)	Policy development must not occur in silos and must include an assessment of existing policy and the cumulative impact; review policy to address conflicts; consider provincial and federal regulations/policies; undertake Government of Alberta review of policies for synergies and conflicts	★		★				★				★
Access to market (infrastructure)	Communicate successes; be transparent on risks; engage stakeholders effectively	★		★					★			★
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Uncertainty on the assumptions about costs associated with closure for tailings (includes understanding engineering feasibility of closure plans)		★		★			★			★	★	
Shifting regulatory regime (new frameworks, monitoring, resources, accountability)		★			★				★	★	★	
Social licence to operate (market and resource access, approvals; GHGs/climate change now a global issue; strategic alignment)		★			★		★				★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Change in interaction between Aboriginal communities and Government of Alberta and federal government and industry		★			★							
Liberation of trace metals from in-situ sites (into groundwater)		★			★							
Implementing policy requirements (tailings, wetlands, caribou; development of policies with little guidance for implementation; lack of stakeholder input in policy development)		★			★							
Verifying liability estimates for oil sands sites (Alberta Energy Regulator capacity; Mine Financial Security Program qualifying environmental trusts)		★			★							
Ensuring greater breadth of participation in decision-making		★			★							
Alberta Energy Regulator's Licensee Liability Rating system will fail (due to increasing in-situ development)		★			★							
Reliability of sustainable water supply		★			★							
Sulphur disposal (where in the final landscape)		★			★							
Reclaiming caribou habitat (preventing caribou population extinction)		★			★							
Develop standards and processes for reclamation certification		★			★							

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Opening the discussion on long-term use of the land (agreeing on cost-benefit of long term impacts; identifying balance between social acceptance and environmental decision-making)		★			★							
Cheap, credible monitoring technologies needed for the long term (certainty of monitoring programs getting baselines)		★			★						★	
Technical processes of dealing with fine tailings (some being tested but uncertain economics, performance, general application)		★			★			★	★		★	
Labour force costs and availability uncertainties		★			★				★			
Enhancing regional collaboration on solutions (risk management, culture; examples - Canada's Oil Sands Innovation Alliance, Oil Sands Leadership Initiative)		★			★							★
Release water quality (criteria for release; treating will create other waste streams so how to handle them; federal involvement)		★			★			★			★	
Will oil sands end pit lakes work as expected and be socially acceptable?		★			★			★	★	★	★	
Capacity of regulators to process what needs to be processed (enough resources and appropriate focus on what matters)		★			★				★			

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Deteriorating quality of resource (ore) leads to higher fines content (best sources already exploited; harder and harder to extract a barrel of oil)		★			★			★			★	
Resolving the "Duty of the Crown to Consult" issues (First Nation positions vs. government positions may not be resolved until big constitutional Supreme Court decision)		★			★			★	★			★
Maintaining a sustainable, effective, successful multistakeholder forum to move regional issues forward (in coordination with other technical groups doing research and monitoring)		★			★				★			★
Demographics - loss of experience, knowledge, talent (knowledge transfer)		★			★				★			
Vulnerability of government decisions to legal challenges (when is a decision a decision?)(is accommodation an option?)		★			★			★				★
Flexibility and adaptability of regulations to deal with new technologies, legacies of the past, differences between sites (outcomes-based vs. prescriptive)		★			★		★	★				
Challenges of policy implementation (defining deliverables, capacity to deliver)		★			★				★			
No more (added) access to markets due to limits on new pipelines rail and tankers	Strategic foresight and adaptive management	★			★				★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Deteriorating infrastructure adds costs and uncertainty, and harms reputation (e.g., pipeline breaks)	Needs to be incorporated into industry financial planning	★			★				★			★
Cost of production (labour, materials, transport) exceeds economic return (oil price)	Strategic foresight and adaptive management; enhance understanding of cumulative economic impact of policy decisions	★			★			★				
Challenge of agreeing on the "facts" in an open information age		★			★			★	★	★	★	
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★
How would we meet federal and/or provincial GHG emission restrictions?		★			★			★	★			
How can we meet environmental management expectations and still be economically viable?		★			★			★	★			
Need Lower Athabasca Regional Plan and frameworks implemented to define end results		★			★		★	★			★	
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
Identifying effective treatment technology and communicating viability for intended treated tailings water release	Regional water management alternative - uses of treated tailings water; could help address perceptions of pipelines; better characterization of treated tailings; develop related standards	★			★							
Determination of appropriate offsets		★			★		★	★		★		
How do we take an integrated system approach to plan development and reclamation of functioning ecosystems that are acceptable externally (note part about acceptability is more likely Low readiness)		★			★				★	★	★	
Public perception of climate change effects as a result of oil sands		★			★						★	
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
How will we continue to develop the resources if we can't save the caribou?		★			★		★	★				

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Disposal of treated water (mines and in-situ)		★			★		★	★				★
Baseline information on groundwater (overall coordinated groundwater inventory in northeast Alberta - there are pockets now where we know but …)		★			★				★		★	
Actually implementing a regional monitoring plan (Alberta Environmental Monitoring, Evaluation and Reporting Agency)		★			★				★			★
Desire to return what was there instead of creating a resilient landscape in the face of an uncertain future		★			★					★	★	★
Discharge/return to the environment of process-affected water		★			★		★	★			★	★
Evaluate all mine closure plans on a regional basis to understand final landscape (will we be happy with the final picture?)		★			★					★	★	
Management of low solids water on mining sites for closure (storage, seepage, quantities required, limits on intake, treatment)		★			★				★	★	★	
Limits of pipeline capacity to transport oil (effectively imposing a rate and development limit)		★			★							★
Technological advances and availability may make oil available at lower costs elsewhere (economic impact)		★			★				★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Effects of policy changes over time (e.g., equivalent land capability; reclamation changing to restoration)		★			★					★	★	
Reclaiming large disturbed footprint to equivalent land capability (as defined today)		★			★					★	★	
Lower prices in markets can shift research and development priorities		★			★							★
Change in governments can impact policy		★			★					★		
Water Act needs reform to not require ongoing licence or approval for otherwise acceptable water features (e.g., end pit lake would require "evaporative loss" licence)(e.g., very robust structure (1 km wide) qualifies as a dam)	Expand section 79 to declare end pit lakes as a *natural water body*; adjust *Water (Ministerial) Regulation* definition of *dam* to recognize a robust landform as not requiring regulation as a dam	★				★	★					
Availability of reporting data/information (people accessing available corporate information)		★				★			★		★	
Reclamation material balance		★				★						
Capacity of Alberta Energy Regulator to meet new responsibilities (dam safety; delicencing of dams - can't go to closure until delicenced; trust in Regulator after OBED spill)		★				★			★	★		

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Will there be increased flexibility under Directive 074 to allow for more appropriate implementation (move to outcomes; short term issues affect social licence)(policy gap may be addressed with new frameworks; willingness gap may be reduced with time)		★				★		★	★	★	★	
Aboriginal issues (understanding their needs - varies by family, politics, tradition; balance sustainable development with environment and health; footprint impact on Fort McKay; need to show reclamation progress)(low readiness for government but high for industry; unknown for Aboriginal communities)		★		★		★			★	★	★	
Unintended releases (e.g., OBED spill; how do you manage response to these releases? $40M remediation tab for OBED?)(high consequence but low likelihood)		★				★						
Tailings management (technologies to get rid of Mature Fine Tailings; volume grows every year -> forever; depends on $$)		★				★						
Knowledge sharing (is Canada’s Oil Sands Innovation Alliance working? can they overcome bureaucracy and intellectual property challenges?)		★				★						

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Revision of wetlands policy (how to establish wetlands on reclaimed land; what kind(s) - swamps vs. fens vs. bogs vs. marsh; why create wetlands which are not going to be wetlands given climate change?)(low readiness for adaptation)		★		★		★						
Reclamation certification process (who decides; what goes in; where do we go on closure acceptability to all; what are the metrics; need to test the system on areas with undisturbed soil but vegetation removed (does the system work then); planting trees on 3rd party right-of-way; reclamation materials sharing)		★				★						
Management/reduction of GHGs (need varies by sector - in-situ highest but reducing energy consumption; need to develop internal carbon cost targets; some research on peat removal; pipelines vs. other transport		★				★						
Lower Athabasca Regional Plan targets and triggers (no actionable plan, no appropriate measures; biodiversity index; hitting air targets more frequently - need to set release limits and handling capacity)(high readiness for some triggers, medium for others)		★			★	★						
Coke disposal in final landscape (has to be recoverable)		★				★						

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Mismatched jurisdiction on regulations (gaps and overlaps; Migratory Birds Convention Act is international treaty but birds = federal government and habitat = provincial government; expectations are unrealistic - forestry could not comply)(Species at Risk Act - caribou - no habitat destruction = no mining)	Identify/create a single regulatory body; make Alberta solely responsible for all Alberta development (Constitutional amendment?); revisit *incidental take in terms of removing active nests* and deterrence systems (due diligence as a defense); most rules not enforced by federal government	★				★	★					★
Impacts of climate change regulations (economics and regulatory uncertainty)		★				★					★	
Uncertainty on the assumptions about costs associated with closure for upland areas		★				★				★	★	
Aboriginal issues (reclamation land use; post-closure landscape; stewardship; compliance and enforcement; maintenance)			★	★						★	★	★
Mining end game - sustainability of reclaimed landscape (includes: geotechnical, ecosystem stability, defining success measures for certification			★	★				★			★	★
Impacts of climate change on water availability	Manage within most likely forecasts; establish monitoring indicators as signals of change that need adaptation		★	★							★	
Surface salt disposal accumulation (in situ)			★	★				★		★	★	
Changing expectations for changing demography (standards and values)			★	★						★		★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
Government estimating and booking liability of carbon dioxide storage			★	★								★
End pit lakes do not effectively reclaim water (unproven technology; unknown targets)			★	★				★		★	★	
End pit lake liability (government must book liability for perpetual care of end pit lakes - are they willing?)			★	★								★
Movement of contaminated in-situ wastewater in deep aquifers (limited groundwater knowledge; salt disposal; is it recognized as an issue yet?)			★	★				★			★	★
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Labour / knowledge (massive turnover and shortage of people - skilled workforce; colleges, universities, NAIT/SAIT training, Land Reclamation International Graduate School; shoestring federal funding; more programs are focused on mining and remediation rather than reclamation)	Import more foreign trained engineers, biologists, skilled tradespeople; increase enrollment in Science, Technology, Engineering, and Mathematics (STEM), decrease elsewhere; increase capacity in policy and government affairs - more internships, Masters research in oil sands, public policy school		★	★					★			★
Effects of climate change on reclamation success	Invest in research; mobilize existing knowledge on how climate affects forestry; run scenarios; feed data into ecological models; use information to make informed decisions; also important for watershed modeling		★	★							★	
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★
Achievement of a landscape that works as planned (collaborative landscape design amongst operators)			★	★			★			★	★	
What is the end point of reclamation (walk-away or maintenance, and if the latter who would do it? What is the Aboriginal view and could they have a role in long term maintenance; need to understand science, engineering and societal expectations			★		★			★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Reclamation endpoint (expectation at design is not the same as at end; moose, farming, boreal forest? What will climate change mean - wetlands)	Complete biodiversity, integrated land planning and tailings management frameworks; consider offsets for conservation; apply recent research and information; develop alternative policies consistent with risk sharing for closure (shared certification as per Saskatchewan policies for uranium)		★		★							
Certification of new landforms (what is the process for this; how will learnings from prior experience be applied to new features; need right system to progressively monitor shift from landform to reclaimed, closed feature; current focus on lease vs. watershed basis)			★		★				★	★	★	
Upgrading within Alberta / Canada vs. elsewhere (economics and politics as drivers)			★		★			★				★
Uncertainties around groundwater availability and sustainability (both saline and fresh)			★		★				★		★	
Long term degradation and failure of abandoned wells			★			★						

APPENDIX 7: List of Low Readiness Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
Competition from other "unconventional" energy sources (economic pricing and competition for labour and materials)	Planning based on strategic foresight	★		★				★	★			
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Mine Financial Security Program vulnerable to price crashes for resources (relies on another operator coming along; what if they don't?)	Identify scenarios where this might occur and develop solutions	★		★				★		★		
Developing acceptable (demonstrated) reclamation forecasting models	Internal work by operators already; need a joint effort to cooperate and collaborate to calibrate (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency and/or Canada's Oil Sands Innovation Alliance?)	★		★					★		★	
How do we communicate effectively about complex data?	An arms-length organization; independence of experts; issuing of the data; taking the *story* to the people; have to communicate bad stories too; being first interpreter of the data; government to evaluate the data in the short term to be effective	★		★					★	★		
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are we ready to meet the expectations for environmental management given recent court decisions and treaty rights?	Biodiversity, cumulative effects, regional planning and management	★		★			★	★				
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
What does resource disparity across the country mean for Canada?		★		★				★				
Changing industry's position that numbers are self-evident (i.e., correct)		★		★					★		★	
How do we fill information voids (how can oil sands get better information out)?		★		★					★	★	★	
Data information communication (access, availability, interpretation; what is role of data?; concept is to have free available data but not ready to do this; need to understand multiple needs and design systems to support these; need to sort out functionality vs. science)		★		★					★	★	★	
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	
Managing expectations/information of gap between Environmental Impact Assessment predictions and reality (feedback model)	Move from assessing cumulative effects to managing effects; adopt an adaptive management system; identify willingness to change pace of development and spatial/land impact of development; tie reporting to EIA environmental, social and health predictions; continue consultation during construction inspections	★		★							★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	
Providing public information on intended treated tailings water discharge	Better characterization of the effects of tailings (e.g., naphthenic acids); develop risk-related standards for release; utilize existing communication tools (e.g., Oil Sands Information Portal); engagement, education; build trust first; open dialogue to understand expectations	★		★			★					★
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Pipelines are not approved (how will this impact environmental disturbance and impacts, for example from using more trains)	Build more refineries; identify cost-benefits of all options; address the fundamental concern about GHGs, ecological and social issues; educate	★		★								★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Access to market (BC and Energy East pipelines; next US president; key for development; barrier to growth and environment; safety - rail vs. pipeline; positive decisions = dollars gained = investments in environmental protection; accelerated investments) Low readiness for government but high for industry	East-West National - market share and partnerships (share the wealth); establish treaty land claim rights for BC Aboriginals North-South International - political change in government direction (energy security to replace Venezuelan oil); pipeline tariffs to States being crossed; make oil *clean* comparable to conventional oil; have others speak on behalf of industry and government	★		★		★						★
Reclamation of wetlands/peatlands	Use wetland offset payments for higher-value wetland reclamation research; better planning using well-informed tools (include all available data); develop economic tool to determine costs of reclaiming wetlands	★		★						★	★	
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★
Access to energy resources (restrictions on development)	Gauge public opinion through engagement on trade-offs and develop a response (policy) accordingly	★		★				★				
What if capital funding dries up for oil sands projects?	Change royalties to incent development; develop an easily understood story that resonates with investors - less defensive, more comprehensive story-telling about how we are developing the resource with wisdom and integrity	★		★				★				
Impact on project economics of cumulative policies (fisheries, caribou, wetlands)	Policy development must not occur in silos and must include an assessment of existing policy and the cumulative impact; review policy to address conflicts; consider provincial and federal regulations/policies; undertake Government of Alberta review of policies for synergies and conflicts	★		★				★				★
Access to market (infrastructure)	Communicate successes; be transparent on risks; engage stakeholders effectively	★		★					★			★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Uncertainty on the assumptions about costs associated with closure for tailings (includes understanding engineering feasibility of closure plans)		★		★			★			★	★	
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★
Aboriginal issues (understanding their needs - varies by family, politics, tradition; balance sustainable development with environment and health; footprint impact on Fort McKay; need to show reclamation progress)(low readiness for government but high for industry; unknown for Aboriginal communities)		★		★		★			★	★	★	
Revision of wetlands policy (how to establish wetlands on reclaimed land; what kind(s) - swamps vs. fens vs. bogs vs. marsh; why create wetlands which are not going to be wetlands given climate change?)(low readiness for adaptation)		★		★		★						

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reclamation land use; post-closure landscape; stewardship; compliance and enforcement; maintenance)			★	★						★	★	★
Mining end game - sustainability of reclaimed landscape (includes: geotechnical, ecosystem stability, defining success measures for certification			★	★				★			★	★
Impacts of climate change on water availability	Manage within most likely forecasts; establish monitoring indicators as signals of change that need adaptation		★	★							★	
Surface salt disposal accumulation (in situ)			★	★				★		★	★	
Changing expectations for changing demography (standards and values)			★	★						★		★
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
Government estimating and booking liability of carbon dioxide storage			★	★								★
End pit lakes do not effectively reclaim water (unproven technology; unknown targets)			★	★				★		★	★	
End pit lake liability (government must book liability for perpetual care of end pit lakes - are they willing?)			★	★								★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Movement of contaminated in-situ wastewater in deep aquifers (limited groundwater knowledge; salt disposal; is it recognized as an issue yet?)			★	★				★			★	★
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★
Labour / knowledge (massive turnover and shortage of people - skilled workforce; colleges, universities, NAIT/SAIT training, Land Reclamation International Graduate School; shoestring federal funding; more programs are focused on mining and remediation rather than reclamation)	Import more foreign trained engineers, biologists, skilled tradespeople; increase enrollment in Science, Technology, Engineering, and Mathematics (STEM), decrease elsewhere; increase capacity in policy and government affairs - more internships, Masters research in oil sands, public policy school		★	★					★			★
Effects of climate change on reclamation success	Invest in research; mobilize existing knowledge on how climate affects forestry; run scenarios; feed data into ecological models; use information to make informed decisions; also important for watershed modeling		★	★							★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★
Achievement of a landscape that works as planned (collaborative landscape design amongst operators)			★	★			★			★	★	

APPENDIX 8: List of Regulatory Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are we ready to meet the expectations for environmental management given recent court decisions and treaty rights?	Biodiversity, cumulative effects, regional planning and management	★		★			★	★				
Providing public information on intended treated tailings water discharge	Better characterization of the effects of tailings (e.g., naphthenic acids); develop risk-related standards for release; utilize existing communication tools (e.g., Oil Sands Information Portal); engagement, education; build trust first; open dialogue to understand expectations	★		★			★					★
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Uncertainty on the assumptions about costs associated with closure for tailings (includes understanding engineering feasibility of closure plans)		★		★			★			★	★	
Social licence to operate (market and resource access, approvals; GHGs/climate change now a global issue; strategic alignment)		★			★		★				★	★
Flexibility and adaptability of regulations to deal with new technologies, legacies of the past, differences between sites (outcomes-based vs. prescriptive)		★			★		★	★				
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★
Need Lower Athabasca Regional Plan and frameworks implemented to define end results		★			★		★	★			★	
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
Determination of appropriate offsets		★			★		★	★		★		
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
How will we continue to develop the resources if we can't save the caribou?		★			★		★	★				
Disposal of treated water (mines and in-situ)		★			★		★	★				★
Discharge/return to the environment of process-affected water		★			★		★	★			★	★
Water Act needs reform to not require ongoing licence or approval for otherwise acceptable water features (e.g., end pit lake would require "evaporative loss" licence)(e.g., very robust structure (1 km wide) qualifies as a dam)	Expand section 79 to declare end pit lakes as a *natural water body*; adjust *Water (Ministerial) Regulation* definition of *dam* to recognize a robust landform as not requiring regulation as a dam	★				★	★					
Mismatched jurisdiction on regulations (gaps and overlaps; Migratory Birds Convention Act is international treaty but birds = federal government and habitat = provincial government; expectations are unrealistic - forestry could not comply)(Species at Risk Act - caribou - no habitat destruction = no mining)	Identify/create a single regulatory body; make Alberta solely responsible for all Alberta development (Constitutional amendment?); revisit *incidental take in terms of removing active nests* and deterrence systems (due diligence as a defense); most rules not enforced by federal government	★				★	★					★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★
Achievement of a landscape that works as planned (collaborative landscape design amongst operators)			★	★			★			★	★	

APPENDIX 9: List of Policy Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
Competition from other "unconventional" energy sources (economic pricing and competition for labour and materials)	Planning based on strategic foresight	★		★				★	★			
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			
Mine Financial Security Program vulnerable to price crashes for resources (relies on another operator coming along; what if they don't?)	Identify scenarios where this might occur and develop solutions	★		★				★		★		
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are we ready to meet the expectations for environmental management given recent court decisions and treaty rights?	Biodiversity, cumulative effects, regional planning and management	★		★			★	★				
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★
What does resource disparity across the country mean for Canada?		★		★				★				
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Access to energy resources (restrictions on development)	Gauge public opinion through engagement on trade-offs and develop a response (policy) accordingly	★		★				★				
What if capital funding dries up for oil sands projects?	Change royalties to incent development; develop an easily understood story that resonates with investors - less defensive, more comprehensive story-telling about how we are developing the resource with wisdom and integrity	★		★				★				
Impact on project economics of cumulative policies (fisheries, caribou, wetlands)	Policy development must not occur in silos and must include an assessment of existing policy and the cumulative impact; review policy to address conflicts; consider provincial and federal regulations/policies; undertake Government of Alberta review of policies for synergies and conflicts	★		★				★				★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Technical processes of dealing with fine tailings (some being tested but uncertain economics, performance, general application)		★			★			★	★		★	
Release water quality (criteria for release; treating will create other waste streams so how to handle them; federal involvement)		★			★			★			★	
Will oil sands end pit lakes work as expected and be socially acceptable?		★			★			★	★	★	★	
Deteriorating quality of resource (ore) leads to higher fines content (best sources already exploited; harder and harder to extract a barrel of oil)		★			★			★			★	
Resolving the "Duty of the Crown to Consult" issues (First Nation positions vs. government positions may not be resolved until big constitutional Supreme Court decision)		★			★			★	★			★
Vulnerability of government decisions to legal challenges (when is a decision a decision?)(is accommodation an option?)		★			★			★				★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Flexibility and adaptability of regulations to deal with new technologies, legacies of the past, differences between sites (outcomes-based vs. prescriptive)		★			★		★	★				
Cost of production (labour, materials, transport) exceeds economic return (oil price)	Strategic foresight and adaptive management; enhance understanding of cumulative economic impact of policy decisions	★			★			★				
Challenge of agreeing on the "facts" in an open information age		★			★			★	★	★	★	
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★
How would we meet federal and/or provincial GHG emission restrictions?		★			★			★	★			
How can we meet environmental management expectations and still be economically viable?		★			★			★	★			
Need Lower Athabasca Regional Plan and frameworks implemented to define end results		★			★		★	★			★	
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
Determination of appropriate offsets		★			★		★	★		★		
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
How will we continue to develop the resources if we can't save the caribou?		★			★		★	★				
Disposal of treated water (mines and in-situ)		★			★		★	★				★
Discharge/return to the environment of process-affected water		★			★		★	★			★	★
Will there be increased flexibility under Directive 074 to allow for more appropriate implementation (move to outcomes; short term issues affect social licence)(policy gap may be addressed with new frameworks; willingness gap may be reduced with time)		★				★		★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Mining end game - sustainability of reclaimed landscape (includes: geotechnical, ecosystem stability, defining success measures for certification			★	★				★			★	★
Surface salt disposal accumulation (in situ)			★	★				★		★	★	
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
End pit lakes do not effectively reclaim water (unproven technology; unknown targets)			★	★				★		★	★	
Movement of contaminated in-situ wastewater in deep aquifers (limited groundwater knowledge; salt disposal; is it recognized as an issue yet?)			★	★				★			★	★
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★
What is the end point of reclamation (walk-away or maintenance, and if the latter who would do it? What is the Aboriginal view and could they have a role in long term maintenance; need to understand science, engineering and societal expectations			★		★			★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Upgrading within Alberta / Canada vs. elsewhere (economics and politics as drivers)			★		★			★				★

APPENDIX 10: List of Capacity Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
Competition from other "unconventional" energy sources (economic pricing and competition for labour and materials)	Planning based on strategic foresight	★		★				★	★			
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			
Developing acceptable (demonstrated) reclamation forecasting models	Internal work by operators already; need a joint effort to cooperate and collaborate to calibrate (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency and/or Canada's Oil Sands Innovation Alliance?)	★		★					★		★	
How do we communicate effectively about complex data?	An arms-length organization; independence of experts; issuing of the data; taking the *story* to the people; have to communicate bad stories too; being first interpreter of the data; government to evaluate the data in the short term to be effective	★		★					★	★		

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	
Changing industry's position that numbers are self-evident (i.e., correct)		★		★					★		★	
How do we fill information voids (how can oil sands get better information out)?		★		★					★	★	★	
Data information communication (access, availability, interpretation; what is role of data?; concept is to have free available data but not ready to do this; need to understand multiple needs and design systems to support these; need to sort out functionality vs. science)		★		★					★	★	★	
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★
Access to market (infrastructure)	Communicate successes; be transparent on risks; engage stakeholders effectively	★		★					★			★
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Shifting regulatory regime (new frameworks, monitoring, resources, accountability)		★			★				★	★	★	
Technical processes of dealing with fine tailings (some being tested but uncertain economics, performance, general application)		★			★			★	★		★	
Labour force costs and availability uncertainties		★			★				★			
Will oil sands end pit lakes work as expected and be socially acceptable?		★			★			★	★	★	★	
Capacity of regulators to process what needs to be processed (enough resources and appropriate focus on what matters)		★			★				★			

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Resolving the "Duty of the Crown to Consult" issues (First Nation positions vs. government positions may not be resolved until big constitutional Supreme Court decision)		★			★			★	★			★
Maintaining a sustainable, effective, successful multistakeholder forum to move regional issues forward (in coordination with other technical groups doing research and monitoring)		★			★				★			★
Demographics - loss of experience, knowledge, talent (knowledge transfer)		★			★				★			
Challenges of policy implementation (defining deliverables, capacity to deliver)		★			★				★			
No more (added) access to markets due to limits on new pipelines rail and tankers	Strategic foresight and adaptive management	★			★				★		★	
Deteriorating infrastructure adds costs and uncertainty, and harms reputation (e.g., pipeline breaks)	Needs to be incorporated into industry financial planning	★			★				★			★
Challenge of agreeing on the "facts" in an open information age		★			★			★	★	★	★	
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
How would we meet federal and/or provincial GHG emission restrictions?		★			★			★	★			
How can we meet environmental management expectations and still be economically viable?		★			★			★	★			
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
How do we take an integrated system approach to plan development and reclamation of functioning ecosystems that are acceptable externally (note part about acceptability is more likely Low readiness)		★			★				★	★	★	
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
Baseline information on groundwater (overall coordinated groundwater inventory in northeast Alberta - there are pockets now where we know but …)		★			★				★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Actually implementing a regional monitoring plan (Alberta Environmental Monitoring, Evaluation and Reporting Agency)		★			★				★			★
Management of low solids water on mining sites for closure (storage, seepage, quantities required, limits on intake, treatment)		★			★				★	★	★	
Technological advances and availability may make oil available at lower costs elsewhere (economic impact)		★			★				★		★	
Availability of reporting data/information (people accessing available corporate information)		★				★			★		★	
Capacity of Alberta Energy Regulator to meet new responsibilities (dam safety; delicencing of dams - can't go to closure until delicenced; trust in Regulator after OBED spill)		★				★			★	★		
Will there be increased flexibility under Directive 074 to allow for more appropriate implementation (move to outcomes; short term issues affect social licence)(policy gap may be addressed with new frameworks; willingness gap may be reduced with time)		★				★		★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (understanding their needs - varies by family, politics, tradition; balance sustainable development with environment and health; footprint impact on Fort McKay; need to show reclamation progress)(low readiness for government but high for industry; unknown for Aboriginal communities)		★		★		★			★	★	★	
Labour / knowledge (massive turnover and shortage of people - skilled workforce; colleges, universities, NAIT/SAIT training, Land Reclamation International Graduate School; shoestring federal funding; more programs are focused on mining and remediation rather than reclamation)	Import more foreign trained engineers, biologists, skilled tradespeople; increase enrollment in Science, Technology, Engineering, and Mathematics (STEM), decrease elsewhere; increase capacity in policy and government affairs - more internships, Masters research in oil sands, public policy school		★	★					★			★
What is the end point of reclamation (walk-away or maintenance, and if the latter who would do it? What is the Aboriginal view and could they have a role in long term maintenance; need to understand science, engineering and societal expectations			★		★			★	★	★	★	
Certification of new landforms (what is the process for this; how will learnings from prior experience be applied to new features; need right system to progressively monitor shift from landform to reclaimed, closed feature; current focus on lease vs. watershed basis)			★		★				★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Uncertainties around groundwater availability and sustainability (both saline and fresh)			★		★				★		★	

APPENDIX 11: List of Experience Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Mine Financial Security Program vulnerable to price crashes for resources (relies on another operator coming along; what if they don't?)	Identify scenarios where this might occur and develop solutions	★		★				★		★		
How do we communicate effectively about complex data?	An arms-length organization; independence of experts; issuing of the data; taking the *story* to the people; have to communicate bad stories too; being first interpreter of the data; government to evaluate the data in the short term to be effective	★		★					★	★		
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
How do we fill information voids (how can oil sands get better information out)?		★		★					★	★	★	
Data information communication (access, availability, interpretation; what is role of data?; concept is to have free available data but not ready to do this; need to understand multiple needs and design systems to support these; need to sort out functionality vs. science)		★		★					★	★	★	
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	
Reclamation of wetlands/peatlands	Use wetland offset payments for higher-value wetland reclamation research; better planning using well-informed tools (include all available data); develop economic tool to determine costs of reclaiming wetlands	★		★						★	★	
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	
Effect of climate change on viability of mineable oil sands (specifically CO_2 output)		★		★			★	★	★	★		
Uncertainty on the assumptions about costs associated with closure for tailings (includes understanding engineering feasibility of closure plans)		★		★			★			★	★	
Shifting regulatory regime (new frameworks, monitoring, resources, accountability)		★			★				★	★	★	
Will oil sands end pit lakes work as expected and be socially acceptable?		★			★			★	★	★	★	
Challenge of agreeing on the "facts" in an open information age		★			★			★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★
Determination of appropriate offsets		★			★		★	★		★		
How do we take an integrated system approach to plan development and reclamation of functioning ecosystems that are acceptable externally (note part about acceptability is more likely Low readiness)		★			★				★	★	★	
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
Desire to return what was there instead of creating a resilient landscape in the face of an uncertain future		★			★					★	★	★
Evaluate all mine closure plans on a regional basis to understand final landscape (will we be happy with the final picture?)		★			★					★	★	
Management of low solids water on mining sites for closure (storage, seepage, quantities required, limits on intake, treatment)		★			★				★	★	★	
Effects of policy changes over time (e.g., equivalent land capability; reclamation changing to restoration)		★			★					★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Reclaiming large disturbed footprint to equivalent land capability (as defined today)		★			★					★	★	
Change in governments can impact policy		★			★					★		
Capacity of Alberta Energy Regulator to meet new responsibilities (dam safety; delicencing of dams - can't go to closure until delicenced; trust in Regulator after OBED spill)		★				★			★	★		
Will there be increased flexibility under Directive 074 to allow for more appropriate implementation (move to outcomes; short term issues affect social licence)(policy gap may be addressed with new frameworks; willingness gap may be reduced with time)		★				★		★	★	★	★	
Aboriginal issues (understanding their needs - varies by family, politics, tradition; balance sustainable development with environment and health; footprint impact on Fort McKay; need to show reclamation progress)(low readiness for government but high for industry; unknown for Aboriginal communities)		★		★		★			★	★	★	
Uncertainty on the assumptions about costs associated with closure for upland areas		★				★				★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reclamation land use; post-closure landscape; stewardship; compliance and enforcement; maintenance)			★	★						★	★	★
Surface salt disposal accumulation (in situ)			★	★				★		★	★	
Changing expectations for changing demography (standards and values)			★	★						★		★
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
End pit lakes do not effectively reclaim water (unproven technology; unknown targets)			★	★				★		★	★	
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★
Achievement of a landscape that works as planned (collaborative landscape design amongst operators)			★	★			★			★	★	
What is the end point of reclamation (walk-away or maintenance, and if the latter who would do it? What is the Aboriginal view and could they have a role in long term maintenance; need to understand science, engineering and societal expectations			★		★			★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Certification of new landforms (what is the process for this; how will learnings from prior experience be applied to new features; need right system to progressively monitor shift from landform to reclaimed, closed feature; current focus on lease vs. watershed basis)			★		★				★	★	★	

APPENDIX 12: List of Knowledge Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
Developing acceptable (demonstrated) reclamation forecasting models	Internal work by operators already; need a joint effort to cooperate and collaborate to calibrate (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency and/or Canada's Oil Sands Innovation Alliance?)	★		★					★		★	
Advance energy literacy (will it increase certainty?)		★		★				★	★	★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★
Changing industry's position that numbers are self-evident (i.e., correct)		★		★					★		★	
How do we fill information voids (how can oil sands get better information out)?		★		★					★	★	★	
Data information communication (access, availability, interpretation; what is role of data?; concept is to have free available data but not ready to do this; need to understand multiple needs and design systems to support these; need to sort out functionality vs. science)		★		★					★	★	★	
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Managing expectations/information of gap between Environmental Impact Assessment predictions and reality (feedback model)	Move from assessing cumulative effects to managing effects; adopt an adaptive management system; identify willingness to change pace of development and spatial/land impact of development; tie reporting to EIA environmental, social and health predictions; continue consultation during construction inspections	★		★							★	★
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Reclamation of wetlands/peatlands	Use wetland offset payments for higher-value wetland reclamation research; better planning using well-informed tools (include all available data); develop economic tool to determine costs of reclaiming wetlands	★		★						★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Uncertainty on the assumptions about costs associated with closure for tailings (includes understanding engineering feasibility of closure plans)		★		★			★			★	★	
Shifting regulatory regime (new frameworks, monitoring, resources, accountability)		★			★				★	★	★	
Social licence to operate (market and resource access, approvals; GHGs/climate change now a global issue; strategic alignment)		★			★		★				★	★
Cheap, credible monitoring technologies needed for the long term (certainty of monitoring programs getting baselines)		★			★						★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Technical processes of dealing with fine tailings (some being tested but uncertain economics, performance, general application)		★			★			★	★		★	
Release water quality (criteria for release; treating will create other waste streams so how to handle them; federal involvement)		★			★			★			★	
Will oil sands end pit lakes work as expected and be socially acceptable?		★			★			★	★	★	★	
Deteriorating quality of resource (ore) leads to higher fines content (best sources already exploited; harder and harder to extract a barrel of oil)		★			★			★			★	
No more (added) access to markets due to limits on new pipelines rail and tankers	Strategic foresight and adaptive management	★			★				★		★	
Challenge of agreeing on the "facts" in an open information age		★			★			★	★	★	★	
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★
Need Lower Athabasca Regional Plan and frameworks implemented to define end results		★			★		★	★			★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
How do we take an integrated system approach to plan development and reclamation of functioning ecosystems that are acceptable externally (note part about acceptability is more likely Low readiness)		★			★				★	★	★	
Public perception of climate change effects as a result of oil sands		★			★						★	
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
Baseline information on groundwater (overall coordinated groundwater inventory in northeast Alberta - there are pockets now where we know but …)		★			★				★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Desire to return what was there instead of creating a resilient landscape in the face of an uncertain future		★			★					★	★	★
Discharge/return to the environment of process-affected water		★			★		★	★			★	★
Evaluate all mine closure plans on a regional basis to understand final landscape (will we be happy with the final picture?)		★			★					★	★	
Management of low solids water on mining sites for closure (storage, seepage, quantities required, limits on intake, treatment)		★			★				★	★	★	
Technological advances and availability may make oil available at lower costs elsewhere (economic impact)		★			★				★		★	
Effects of policy changes over time (e.g., equivalent land capability; reclamation changing to restoration)		★			★					★	★	
Reclaiming large disturbed footprint to equivalent land capability (as defined today)		★			★					★	★	
Availability of reporting data/information (people accessing available corporate information)		★				★			★		★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Will there be increased flexibility under Directive 074 to allow for more appropriate implementation (move to outcomes; short term issues affect social licence)(policy gap may be addressed with new frameworks; willingness gap may be reduced with time)		★				★		★	★	★	★	
Aboriginal issues (understanding their needs - varies by family, politics, tradition; balance sustainable development with environment and health; footprint impact on Fort McKay; need to show reclamation progress)(low readiness for government but high for industry; unknown for Aboriginal communities)		★		★		★			★	★	★	
Impacts of climate change regulations (economics and regulatory uncertainty)		★				★					★	
Uncertainty on the assumptions about costs associated with closure for upland areas		★				★				★	★	
Aboriginal issues (reclamation land use; post-closure landscape; stewardship; compliance and enforcement; maintenance)			★	★						★	★	★
Mining end game - sustainability of reclaimed landscape (includes: geotechnical, ecosystem stability, defining success measures for certification			★	★				★			★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Impacts of climate change on water availability	Manage within most likely forecasts; establish monitoring indicators as signals of change that need adaptation		★	★							★	
Surface salt disposal accumulation (in situ)			★	★				★		★	★	
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
End pit lakes do not effectively reclaim water (unproven technology; unknown targets)			★	★				★		★	★	
Movement of contaminated in-situ wastewater in deep aquifers (limited groundwater knowledge; salt disposal; is it recognized as an issue yet?)			★	★				★			★	★
Effects of climate change on reclamation success	Invest in research; mobilize existing knowledge on how climate affects forestry; run scenarios; feed data into ecological models; use information to make informed decisions; also important for watershed modeling		★	★							★	
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★
Achievement of a landscape that works as planned (collaborative landscape design amongst operators)			★	★			★			★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
What is the end point of reclamation (walk-away or maintenance, and if the latter who would do it? What is the Aboriginal view and could they have a role in long term maintenance; need to understand science, engineering and societal expectations			★		★			★	★	★	★	
Certification of new landforms (what is the process for this; how will learnings from prior experience be applied to new features; need right system to progressively monitor shift from landform to reclaimed, closed feature; current focus on lease vs. watershed basis)			★		★				★	★	★	
Uncertainties around groundwater availability and sustainability (both saline and fresh)			★		★				★		★	

APPENDIX 13: List of Willingness Gap Challenges

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are governments too slow in reacting to public views (especially when the views are changing)?		★		★				★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Managing expectations/information of gap between Environmental Impact Assessment predictions and reality (feedback model)	Move from assessing cumulative effects to managing effects; adopt an adaptive management system; identify willingness to change pace of development and spatial/land impact of development; tie reporting to EIA environmental, social and health predictions; continue consultation during construction inspections	★		★							★	★
Providing public information on intended treated tailings water discharge	Better characterization of the effects of tailings (e.g., naphthenic acids); develop risk-related standards for release; utilize existing communication tools (e.g., Oil Sands Information Portal); engagement, education; build trust first; open dialogue to understand expectations	★		★			★					★
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Pipelines are not approved (how will this impact environmental disturbance and impacts, for example from using more trains)	Build more refineries; identify cost-benefits of all options; address the fundamental concern about GHGs, ecological and social issues; educate	★		★								★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Access to market (BC and Energy East pipelines; next US president; key for development; barrier to growth and environment; safety - rail vs. pipeline; positive decisions = dollars gained = investments in environmental protection; accelerated investments) Low readiness for government but high for industry	East-West National - market share and partnerships (share the wealth); establish treaty land claim rights for BC Aboriginals North-South International - political change in government direction (energy security to replace Venezuelan oil); pipeline tariffs to States being crossed; make oil *clean* comparable to conventional oil; have others speak on behalf of industry and government	★		★		★						★
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Impact on project economics of cumulative policies (fisheries, caribou, wetlands)	Policy development must not occur in silos and must include an assessment of existing policy and the cumulative impact; review policy to address conflicts; consider provincial and federal regulations/policies; undertake Government of Alberta review of policies for synergies and conflicts	★		★				★				★
Access to market (infrastructure)	Communicate successes; be transparent on risks; engage stakeholders effectively	★		★					★			★
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★
Expression of aboriginal rights and how those are addressed in regulatory processes		★		★			★	★	★		★	★
Social licence to operate (market and resource access, approvals; GHGs/climate change now a global issue; strategic alignment)		★			★		★				★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Enhancing regional collaboration on solutions (risk management, culture; examples - Canada's Oil Sands Innovation Alliance, Oil Sands Leadership Initiative)		★			★							★
Resolving the "Duty of the Crown to Consult" issues (First Nation positions vs. government positions may not be resolved until big constitutional Supreme Court decision)		★			★			★	★			★
Maintaining a sustainable, effective, successful multistakeholder forum to move regional issues forward (in coordination with other technical groups doing research and monitoring)		★			★				★			★
Vulnerability of government decisions to legal challenges (when is a decision a decision?)(is accommodation an option?)		★			★			★				★
Deteriorating infrastructure adds costs and uncertainty, and harms reputation (e.g., pipeline breaks)	Needs to be incorporated into industry financial planning	★			★				★			★
How do we address the overall concerns for regional environmental impacts (things like integrated landscape management; mitigation)		★			★		★	★	★		★	★
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
How will cumulative effects be managed in the oil sands?		★			★		★	★	★	★	★	★
Disposal of treated water (mines and in-situ)		★			★		★	★				★
Actually implementing a regional monitoring plan (Alberta Environmental Monitoring, Evaluation and Reporting Agency)		★			★				★			★
Desire to return what was there instead of creating a resilient landscape in the face of an uncertain future		★			★					★	★	★
Discharge/return to the environment of process-affected water		★			★		★	★			★	★
Limits of pipeline capacity to transport oil (effectively imposing a rate and development limit)		★			★							★
Lower prices in markets can shift research and development priorities		★			★							★
Mismatched jurisdiction on regulations (gaps and overlaps; Migratory Birds Convention Act is international treaty but birds = federal government and habitat = provincial government; expectations are unrealistic - forestry could not comply)(Species at Risk Act - caribou - no habitat destruction = no mining)	Identify/create a single regulatory body; make Alberta solely responsible for all Alberta development (Constitutional amendment?); revisit *incidental take in terms of removing active nests* and deterrence systems (due diligence as a defense); most rules not enforced by federal government	★				★	★					★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reclamation land use; post-closure landscape; stewardship; compliance and enforcement; maintenance)			★	★						★	★	★
Mining end game - sustainability of reclaimed landscape (includes: geotechnical, ecosystem stability, defining success measures for certification			★	★				★			★	★
Changing expectations for changing demography (standards and values)			★	★						★		★
Climate change adaptation for reclamation (vegetation - tree zones)			★	★				★		★	★	★
Government estimating and booking liability of carbon dioxide storage			★	★								★
End pit lake liability (government must book liability for perpetual care of end pit lakes - are they willing?)			★	★								★
Movement of contaminated in-situ wastewater in deep aquifers (limited groundwater knowledge; salt disposal; is it recognized as an issue yet?)			★	★				★			★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★
Labour / knowledge (massive turnover and shortage of people - skilled workforce; colleges, universities, NAIT/SAIT training, Land Reclamation International Graduate School; shoestring federal funding; more programs are focused on mining and remediation rather than reclamation)	Import more foreign trained engineers, biologists, skilled tradespeople; increase enrollment in Science, Technology, Engineering, and Mathematics (STEM), decrease elsewhere; increase capacity in policy and government affairs - more internships, Masters research in oil sands, public policy school		★	★					★			★
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★
Upgrading within Alberta / Canada vs. elsewhere (economics and politics as drivers)			★		★			★				★

APPENDIX 14: Solutions

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Aboriginal issues (reflecting Traditional Land Use in LARP and frameworks; stewardship initiatives; compliance and enforcement; conservation offsets)	Earlier involvement; incorporate Traditional Land Use into decisions; develop more *understandable* terminology; go to field to demonstrate impacts; incremental; create shared values; need to be part of decision-making for reclamation and closure	★		★	★					★	★	★
Concept of walk-away closure may not apply (liability transfer from industry to government)	Paradigm shift has already occurred in oil sands industry (e.g., Suncor South Tailings Pond pumping system for decades after closure); change meaning of certificate; transfer stewardship (with funds) to First Nations; define realistic end goals that may include managed sites (e.g., golf courses, parks, research institutes)	★		★				★			★	★
No releases possible if natural levels of constituents already carcinogenic? (federal involvement)	Need existing and new baseline studies and health studies to establish links (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency?); suitable technical treatment or other solutions needed (role for Canada's Oil Sands Innovation Alliance?)	★		★					★		★	★
Competition from other "unconventional" energy sources (economic pricing and competition for labour and materials)	Planning based on strategic foresight	★		★				★	★			
Increase in number of "at risk" species listed in next number of years (tradeoffs, conservation offsets, etc.)	Need management plans for existing *Species At Risk Act* species; have not stopped development for species at risk so far; need better understanding of options and trade-offs	★		★			★	★	★			

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Mine Financial Security Program vulnerable to price crashes for resources (relies on another operator coming along; what if they don't?)	Identify scenarios where this might occur and develop solutions	★		★				★		★		
Developing acceptable (demonstrated) reclamation forecasting models	Internal work by operators already; need a joint effort to cooperate and collaborate to calibrate (role for Alberta Environmental Monitoring, Evaluation and Reporting Agency and/or Canada's Oil Sands Innovation Alliance?)	★		★					★		★	
How do we communicate effectively about complex data?	An arms-length organization; independence of experts; issuing of the data; taking the *story* to the people; have to communicate bad stories too; being first interpreter of the data; government to evaluate the data in the short term to be effective	★		★					★	★		
Are we prepared to manage development within the context of environmental limits?	Government must set the regulations for today but could/will change in the future (but not be retroactive); provides certainty to investors	★		★			★	★		★	★	
New methods of communication will drive change	Build relationships and demonstrate success	★		★			★					★
Are we ready to meet the expectations for environmental management given recent court decisions and treaty rights?	Biodiversity, cumulative effects, regional planning and management	★		★			★	★				
Restoration of hydrological regime in support of reclamation certification	Existing data collection in reclaimed landscapes and integrate with models; identify acceptable reclaimed hydrological regimes; pilot for site-specific features/conditions	★		★				★		★	★	

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Managing expectations/information of gap between Environmental Impact Assessment predictions and reality (feedback model)	Move from assessing cumulative effects to managing effects; adopt an adaptive management system; identify willingness to change pace of development and spatial/land impact of development; tie reporting to EIA environmental, social and health predictions; continue consultation during construction inspections	★		★							★	★
Proximity between oil facilities and human population centres (cultural and health impacts)	Support municipalities in long range planning; provide (access to) information regarding air quality; Alberta Environmental Monitoring, Evaluation and Reporting Agency must have mandate for communication of *layman level* information on health and environmental impacts; role for Alberta Water Portal; develop a Fort MacMurray-based organization?	★		★				★	★		★	
Providing public information on intended treated tailings water discharge	Better characterization of the effects of tailings (e.g., naphthenic acids); develop risk-related standards for release; utilize existing communication tools (e.g., Oil Sands Information Portal); engagement, education; build trust first; open dialogue to understand expectations	★		★			★					★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Loss of experienced experts (significant human resource issue; change in demographics)	Develop retention programs, succession planning and programs; identify critical roles and ensure knowledge transfer; develop knowledge management programs; Develop adequate performance programs for Alberta Energy Regulator, Alberta Environment and Sustainable Resource Development, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★				★	★			★
Pipelines are not approved (how will this impact environmental disturbance and impacts, for example from using more trains)	Build more refineries; identify cost-benefits of all options; address the fundamental concern about GHGs, ecological and social issues; educate	★		★								★
Release criteria for water (need policy; low readiness for government but high for industry)	Government needs to take the lead (change perception/awareness of whether this is the right thing to do); need risk communication; discuss the *why* politically; science is there but need to figure out how to educate the public	★		★		★	★	★			★	★
Access to market (BC and Energy East pipelines; next US president; key for development; barrier to growth and environment; safety - rail vs. pipeline; positive decisions = dollars gained = investments in environmental protection; accelerated investments) Low readiness for government but high for industry	East-West National - market share and partnerships (share the wealth); establish treaty land claim rights for BC Aboriginals North-South International - political change in government direction (energy security to replace Venezuelan oil); pipeline tariffs to States being crossed; make oil *clean* comparable to conventional oil; have others speak on behalf of industry and government	★		★		★						★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Reclamation of wetlands/peatlands	Use wetland offset payments for higher-value wetland reclamation research; better planning using well-informed tools (include all available data); develop economic tool to determine costs of reclaiming wetlands	★		★						★	★	
Demonstrating land stewardship to attain social licence	Learn from others; share information on successes ad failures; find an environmental champion for oil sands development	★		★						★	★	★
Access to historical information and put it in perspective (accessible, useful, applicable)	Regional database that is easily accessible with geospatial component; metadata for searching; include ALL reports (e.g., pre-disturbance assessment); use for conditions and to develop stakeholder confidence; format needs to be consistent, managed consistently; need one umbrella agency to manage information from Government of Alberta, Alberta Energy Regulator, Alberta Environmental Monitoring, Evaluation and Reporting Agency	★		★					★	★		★
Access to energy resources (restrictions on development)	Gauge public opinion through engagement on trade-offs and develop a response (policy) accordingly	★		★				★				
What if capital funding dries up for oil sands projects?	Change royalties to incent development; develop an easily understood story that resonates with investors - less defensive, more comprehensive story-telling about how we are developing the resource with wisdom and integrity	★		★				★				

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Impact on project economics of cumulative policies (fisheries, caribou, wetlands)	Policy development must not occur in silos and must include an assessment of existing policy and the cumulative impact; review policy to address conflicts; consider provincial and federal regulations/policies; undertake Government of Alberta review of policies for synergies and conflicts	★		★				★				★
Access to market (infrastructure)	Communicate successes; be transparent on risks; engage stakeholders effectively	★		★					★			★
Effluent discharge criteria for oil sands mines (costs, technology, perception)	Technical aspect (who does this? parameters for metals, pH, salinity so it is safe for biological function in Athabasca River); which government rules apply (provincial, federal); develop stakeholder agreements (Aboriginal communities) on scope and implementation; overcome human perception and lack of trust; 3rd party validation of results	★		★			★		★		★	★
Management of fluid fine tailings / mature fine tailings at closure	There is no feasible solution yet; determine what technology works (non-segregating tailings, multiple technologies needed and/or being tested); identify different scenarios to determine acceptable outcomes (safe, stable, no fatal flaws for water); need to be able to move from research to commercial application reliably	★		★			★		★	★	★	
Understanding future uses of disturbed landscapes and designing for those uses (physical, spiritual, traditional)	Design plans to meet community needs; get early engagement in design; need regulatory support; determine acceptable outcomes	★		★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Understand what closure would/should look like and the arrangements required for maintenance	Idea that companies will walk away is not realistic; Aboriginal-led companies can help develop and implement solution (involved in long term maintenance as they are the long term users); sustainable community involvement; several generations before animals/plants are perceived safe to be harvested; determine appropriate split in responsibility for long term maintenance implementation - company for 20 years then community takes over once established criteria met	★		★			★			★	★	
No more (added) access to markets due to limits on new pipelines rail and tankers	Strategic foresight and adaptive management	★			★				★		★	
Deteriorating infrastructure adds costs and uncertainty, and harms reputation (e.g., pipeline breaks)	Needs to be incorporated into industry financial planning	★			★				★			★
Cost of production (labour, materials, transport) exceeds economic return (oil price)	Strategic foresight and adaptive management; enhance understanding of cumulative economic impact of policy decisions	★			★			★				
Caribou habitat restoration for in-situ operations (legislative complexity)(medium readiness for short term actions to address declining populations; low readiness to address long term habitat restoration in the context of reclamation goals)	Plant trees in linear corridors; apply forestry practices in those areas; make these practices part of the approval; look at research for less intrusive seismic	★		★	★			★		★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Water release (what is the end point, criteria; what contaminants; where to measure; depends on hydrologic regime (and vice versa); understand instream flow needs impacts on discharge (and vice versa); linked to Aboriginal expectations)	Reinvigorate technical analysis and review around criteria/indicators for release; identify gaps; consider how to include Aboriginal groups in the process (as water users)	★			★		★	★	★		★	
Can the AER balance the two mandate responsibilities of not sterilizing the resource and achieving sustainable development? (mindset may need a generational change)	Develop working definition for *best in class*; mandate of integrated regulator is to provide policy direction	★			★		★	★	★		★	
Identifying effective treatment technology and communicating viability for intended treated tailings water release	Regional water management alternative - uses of treated tailings water; could help address perceptions of pipelines; better characterization of treated tailings; develop related standards	★			★							
Water Act needs reform to not require ongoing licence or approval for otherwise acceptable water features (e.g., end pit lake would require "evaporative loss" licence)(e.g., very robust structure (1 km wide) qualifies as a dam)	Expand section 79 to declare end pit lakes as a *natural water body*; adjust *Water (Ministerial) Regulation* definition of *dam* to recognize a robust landform as not requiring regulation as a dam	★				★	★					
Mismatched jurisdiction on regulations (gaps and overlaps; Migratory Birds Convention Act is international treaty but birds = federal government and habitat = provincial government; expectations are unrealistic - forestry could not comply)(Species at Risk Act - caribou - no habitat destruction = no mining)	Identify/create a single regulatory body; make Alberta solely responsible for all Alberta development (Constitutional amendment?); revisit *incidental take in terms of removing active nests* and deterrence systems (due diligence as a defense); most rules not enforced by federal government	★				★	★					★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Impacts of climate change on water availability	Manage within most likely forecasts; establish monitoring indicators as signals of change that need adaptation		★	★							★	
Regional water treatment and management (biggest challenge; collaborative treatment approaches; will regulatory system allow this? Suncor/Syncrude will not share common water channels but have parallel streams; regional integrated closure hydrology; in-situ treated water technology and regulation)	Suncor sending water to Husky and Firebag; create an incentive program to further support efficient water use; confirm who has liability for water in transfer pipeline; confirm water transfer rules re: basins and sub-basins; determine value of pit lakes to other off-stream reservoirs for storage		★	★			★	★				★
Labour / knowledge (massive turnover and shortage of people - skilled workforce; colleges, universities, NAIT/SAIT training, Land Reclamation International Graduate School; shoestring federal funding; more programs are focused on mining and remediation rather than reclamation)	Import more foreign trained engineers, biologists, skilled tradespeople; increase enrollment in Science, Technology, Engineering, and Mathematics (STEM), decrease elsewhere; increase capacity in policy and government affairs - more internships, Masters research in oil sands, public policy school		★	★					★			★
Effects of climate change on reclamation success	Invest in research; mobilize existing knowledge on how climate affects forestry; run scenarios; feed data into ecological models; use information to make informed decisions; also important for watershed modeling		★	★							★	
How do we decide trade-offs regarding resource development vs. ecosystem integrity (pressure now)	Find common, very specific, values; political will is required; develop scenarios to understand what the trade-offs are; acknowledge that there will not be consensus, but understand what everyone can live with - shift mentality that compromise will have to happen		★	★						★	★	★

Challenge	Solutions	Time		Readiness			Gaps					
		5	10	Low	Medium	High	Regulation	Policy	Capacity	Experience	Knowledg	Willingnes
Reclamation endpoint (expectation at design is not the same as at end; moose, farming, boreal forest? What will climate change mean - wetlands)	Complete biodiversity, integrated land planning and tailings management frameworks; consider offsets for conservation; apply recent research and information; develop alternative policies consistent with risk sharing for closure (shared certification as per Saskatchewan policies for uranium)		★		★							

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