Practitioner Views on the Drivers of Change in Alberta Reclamation Practices: Past and Future

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REPORT SUMMARY

The Canadian Land Reclamation Association celebrated its 50th anniversary at the annual conference in Edmonton, March 5-7, 2025. A panel of practitioners from BC, AB, SK, MB, ON, QC and NS, plus members representing National, Indigenous and US perspectives were tasked with answering two questions:

- What is the single most important event in the last 50 years that shaped reclamation / restoration / rehabilitation in your jurisdiction, and why?
    - The "event" may be establishment or change or removal of legislation, change in practice or technology, establishment of a new industry with new challenges, involvement of new stakeholders, etc.
- What is likely to be the single most important reclamation / restoration / rehabilitation challenge in the next 10 years in your jurisdiction, and why?

To get a broad perspective on the answers to these questions for Alberta, the author reached out to over 200 Alberta practitioners, and 72 people provided responses. This report summarizes their responses.

The dominant themes presented at the conference as Alberta's perspective were:

Past Driver: Development, implementation and evolution of reclamation certification criteria, enabled by the *Environmental Protection and Enhancement Act* and associated *Conservation and Reclamation Regulation* in 1993. Codification of reclamation requirements removed subjectivity, improved transparency, allowed for training, and ultimately set the stage for the use of professional signoff and the ability to certify sites without an inquiry. While most responses focused on the wellsite criteria, some noted the lack of criteria for other disturbance types, especially oil sands mines.

Future Driver: Based on the sheer magnitude of the disturbed area and the challenges associated with reclaiming tailings ponds the oil sands are the big driver for the next 10 years. Additional challenges are development of water release criteria from oil sands mines and subsequent releases to the environment, and the uncertainty around the looming financial security requirements as mines age.

The next five Past Drivers were:

- Setting equivalent land capability as the objective of reclamation
- Development of legislation
- Establishment of soil salvage requirements
- Emphasis on ecological function
- Development of technology and tools

The next five Future Drivers were:

- Capacity and capability, including human resources, use of professionals, education and research, and communication and collaboration
- Regulatory capacity
- Policy adequacy
- Concerns about pace of reclamation
- Potential for use of technology and data

Several respondents noted pre-1975 legislation (the *Surface Reclamation Act* in 1963 and the *Land Surface Conservation and Reclamation Act* in 1973) were foundational to the development of today's reclamation program.

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ACRONYMS

AI	Artificial Intelligence
AOSERP	Alberta Oil Sands Environmental Research Program
ASMR	American Society of Mining and Reclamation
ASSMR	American Society of Surface Mining and Reclamation
CEMA	Cumulative Environmental Management Association
CLRA	Canadian Land Reclamation Association
CONRAD	Canadian Oil Sands Network for Research and Development
COSIA	Canada's Oil Sands Innovation Alliance
CRR	*Conservation and Reclamation Regulation*
ELC	Equivalent Land Capability
EPEA	*Environmental Protection and Enhancement Act*
FFT	Fluid Fine Tailings
GSI	Geographic Information Systems
IK	Indigenous Knowledge
LiDAR	Light Detection and Ranging
MFSP	Mine Financial Security Program
MFT	Mature Fine Tailings
OSLI	Oil Sands Leadership Initiative
PTAC	Petroleum Technology Alliance Canada
RCAG	Reclamation Criteria Advisory Group
RRTAC	Reclamation Research Technical Advisory Committee
SOX	*Sarbanes-Oxley Act* (US)
SRA	*Surface Reclamation Act*
SRP	Site Rehabilitation Program

1 INTRODUCTION

The Canadian Land Reclamation Association (CLRA) celebrated its 50th anniversary at the annual conference in Edmonton, March 5-7, 2025. A panel of practitioners from BC, AB, SK, MB, ON, QC and NS, plus members representing Indigenous and US perspectives were tasked with answering two questions:

- What is the single most important event in the last 50 years that shaped reclamation / restoration / rehabilitation in your jurisdiction, and why?
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- What is likely to be the single most important reclamation / restoration / rehabilitation challenge in the next 10 years in your jurisdiction, and why?

The challenge is to know the past 50 years to improve on the next 50.

To get a broad perspective on the answers to these questions for Alberta, the author reached out to over 200 Alberta practitioners. Seventy-six people provided responses to the questions before the conference and another four afterwards, for a total of 80 (Figure 1); some individuals provided more than one answer to the questions.[1] This report summarizes their responses. The responses have been organized by themes chosen by the author and the themes are organized in descending order based on the number of responses. Some responses have been edited for clarity or brevity.

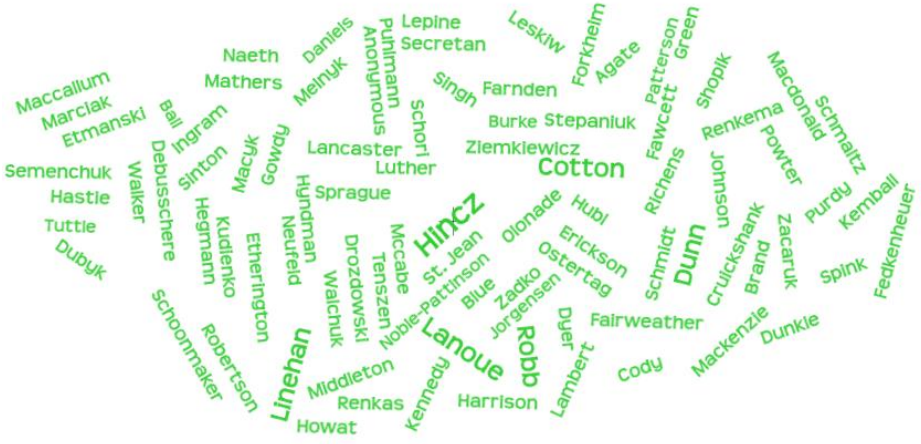

Figure 1. Respondents.

[1] For an international mining perspective see Appendix 1.1.

2 PAST DRIVERS FOR CHANGE

Well, I haven't been on an Alberta mine in 35 years, but I've been doing work in southeast BC lately. Alberta is far ahead.

2.1 Criteria

The development of the first reclamation standards in the late 70's or early 80's (I can't remember when the very first version of reclamation standards came out but think it was in that general timeline).[2] These were the foundation on which things like the 1994 contaminant criteria and the 1995 wellsite criteria all the way up to our current guidelines were built on.

As a Soil Scientist, it would probably have to be the invention of the Soil Quality Criteria (Alberta Soils Advisory Committee, 1987). This document reshaped regulations and practices in Alberta and is still used today. It's timeless.

There was a major change in site restoration standards in Alberta in 1995-96 that was the predecessor to, and that led directly to, the 2010 Reclamation Criteria. This was the introduction of the Free-To-Grow standards on Crown lands for the forest industry that really modified the expectations for all site disturbances on Crown land but also on private lands later through the 2010 Criteria (See Appendix 1.2 for more information).

Inclusion of CRR s. 3 authority to develop Standards, Criteria, and Guidelines.

The 1990's reclamation criteria. Of course I think this, because I graduated in 1991 from Olds College and was fresh out of school and ready to apply what I learned (I think it was the 1993 criteria.)

I don't think you can talk about reclamation in Alberta over the last 50 years and not bring up the 1994/1995 criteria, the 2010 Reclamation Criteria, or the Reclamation Criteria Advisory Group (RCAG) that helped develop the 2010 Criteria. The Criteria brought the reclamation industry together and really increased the amount of folks working in reclamation.

Reclamation certificate applications prior to criteria were a couple pages of administrative information and no technical information of the condition of the site! After the 1993 Criteria, reclamation applications for oil and gas sites contained actual data and reclamation expectations. Industry, government and landowners then had a road map to follow. The established criteria was not perfect … but it was a start to achieve equivalent land capability and everyone was talking the same language on what a reclaimed site should look like. Then the 2010 Reclamation Criteria came along and further blazed the trail to achieve equivalent land capability.

[2] Author's Note: See Land Conservation and Reclamation Council (1977, 1980, 1982).

Single most event to me was Legislation and Criteria. In 1984, a 3-page application compared to and up to and beyond a 250-page document now I don't think it was a challenge, but continued efforts to try and set practical guidelines was important for everyone. Without continued legislation good people were doing their best with little guidance and financial resources.

I feel the development of reclamation criteria was a significant milestone. I recall many years ago thinking how great it would be if we could have something to compare against once we deemed a site to be reclaimed. I developed a very crude set of criteria for the sites I worked on and even submitted it, but it didn't gain traction; you know how the government works. I feel the current criteria are far from perfect but at least there's common ground to work from.

The "event" that changed reclamation forever in Alberta was the development of reclamation criteria.

The development of standardized reclamation criteria for various end land uses. Providing objective measurements for many parameters has removed a significant amount of regulatory uncertainty which is particularly important for conducting audits and responding to landowner complaints. There is still some subjectivity, but much better than drive-by reclamation!

I believe it was the establishment of reclamation criteria for industrial activities. I sat on the working committee that was made up of 3 oil and gas industry representatives, 3 agricultural representatives and 3 Alberta Government representatives. It wasn't perfect; however, it was the first time it was attempted and was accomplished after about 10 months of meeting and arm wrestling. I felt it was very close to capturing what actuality "works" in the field rather than a desk compilation of what may work. This was a very different experience to the one I was involved with in Saskatchewan where the government people had limited field experience but, even after field testing the criteria and seeing some unreasonable expectations, did not change the requirements.

The adoption of oil and gas reclamation criteria. While it has changed and evolved since its initial inception, the fact that they were introduced and have been improved upon is paramount to the reclamation industry in Alberta.

The evolution of reclamation criteria formed the basis for how reclamation in the province is defined and assessed – restoration vs. reclamation, what is equivalent land capability and how is it evaluated, and how conservation impacts successful reclamation.

Evolution of Reclamation Guidelines: EPEA paved the way for subsequent enhancements to Alberta Tier 1 and 2 Soil and Groundwater Remediation Guidelines, as well as modern wetland, forest, and peatland reclamation policies.

The most important event has been the introduction of reclamation criteria. I've experienced the most significant criteria changes with the 2007 Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands in the Green Area and most recently the 2017 Peatland

Criteria for Wellsites and Associated Facilities. These criteria (along with the 2010 Reclamation Criteria) have established science-based guidelines for assessing reclamation success but more importantly are focused on the ecological success of reclaimed lands.

Introduction of the Upstream Oil and Gas Reclamation Criteria and updates.

Issuing reclamation criteria for various land uses.

Creation of the 1994 wellsite criteria.

The introduction of regulations to ensure standards were a huge leap forward for the industry (95 I think?).[3]

Change from the 1995 to the 2010 reclamation criteria: the change in criteria provided a more statistical and scientific assessment that was more easily backed than the 1995 criteria, which was heavily influenced by the assessor.

When we moved to new 2010 criteria, we grouped White Area forested with Cultivated sites. Not only are most of these marginal at best as cultivated sites, almost to all of these wind up having a Green Area control site. White Area should have gone with Green Area Forested Criteria.

The 2007 forested criteria update or whatever precipitated its development. Was there a single event that caused the government at the time to address this need, or was it just slow awareness from cumulative effects? Regardless, that time period marks when we started putting some real attention towards the "rest" of the province that isn't farmland and brought ecological principles into our work, not just agricultural.

Change in forested criteria – recognizing the importance of establishing a woody vegetation component to sites that are ultimately intended to support forests. Concurrent with this was the emphasis on reducing active utilization of grasses to support revegetation into a forested state.

The 2010 Forested criteria – shift from green and growing to trees – more long-term outcome based.

Creation of peatland criteria, identifying wetlands as important functional ecosystems.

Changes to the *Weed Control Act* wound up taking things like meadow hawkweed from not even nuisance weed to prohibited noxious. There needs to be ways to acknowledge the fact in that case that the weed was allowed to fester for decades but now you can't have one on your site.

I chose the following because without them the 2010 wellsite reclamation criteria and the 2017 Peatland Criteria would not have been possible. Even the oilsands revegetation guide and the riparian guides that I worked on almost 20 years ago were based on the assumption of

[3] Author's Note: Given the date I have assumed this is a reference to the 1995 wellsite criteria.

relative (regional) edatope position (i.e., ecosite) as the repeatable and durable ecological unit over time.

- Development of ecosite classification systems (all three of the guides in Alberta: Archibald, Beckingham, Klappstein, Corns) since they:
    - Embraced the edatope concept;
    - Put into legislation as required mapping and thus a common reference point for determining impacts; and
    - Became core to most EIA work; base for plant community and wildlife habitat assessments, used to screen for and as a foundation for rare plant potential, productivity potential, rare community potential, setting targets for reclamation.
- Development of the Water for Life initiative and the resultant Alberta wetland policy that then led to the wetland replacement and other activities.

The complete reliance on criteria as part of this system. While an objective standard is good, it has completely removed the expertise of land reclamation expert to properly assess the land. The land can meet the criteria but not be properly reclaimed.[4] I am thinking of a particular case, where the site met the criteria, but the landowner showed that the protein content of the plants where not the same [onsite and offsite]. I am worried that the criteria are not good enough to ensure the land ends up back the way it was even after 10 or 20 years have passed.

2.2 Equivalent Land Capability

The setting of high expectations and standards for reclamation (i.e., a reasonably realistic expectation for "equivalent land capability (ELC)") and making mining companies directly and publicly accountable for performance relative to those expectations/standards. In Alberta, the closest we got to that was in the Cumulative Environmental Management Association (CEMA) era, where mining companies (somewhat grudgingly) were openly discussing the concept of ELC with stakeholders and rights holders, were reasonably responsive to those discussions, and a lot of progress was made. We have largely lost that public accountability, and I believe there has since been considerable erosion of any sense of responsibility and accountability.

> *I think the single most important step was establishing "equivalent land capability" as the goal of reclamation. The wisdom of the choice permits variability across the province yet also comes back to a foundational view that "restoration-like" solutions are intended.*

[4] Author's Opinion: The opposite is also possible – a site is suitably reclaimed but does not meet the criteria. In some cases, this is "allowed" via justifications.

Definitions in EPEA and CRR of key terms like conservation and reclamation (defined under EPEA) and equivalent land capability (defined in the CRR). In addition, sections such as CRR s. 2 The objective of conservation and reclamation of specified land is to return the specified land to an equivalent land capability).

"Standard of the day" versus "standard of today", and equivalent land capability. This was something very important when we were doing mine reclamation certification back in the 1990s and early 2000's. It helped that we were able to look back at our original approvals back in the day, work with Alberta Environment to ensure that our reclamation was satisfactory against what operators understood at that time. This was especially important for soil salvage (or lack thereof), and remediation to sites containing a contaminant source, and being able to demonstrate that reclamation was successful, and lands were safe and were returned to be productive in whatever land class or land use was agreed to in that area.

One of the most important legislative changes was incorporating "Equivalent Land Capability." This started the progressive process of looking at the physical and chemical processes within the entire soil profile which drove the creation of detailed reclamation criteria and review process.

Aiming the development industry towards Equivalent Land Capability was an achievable end use. This indicated that the land would not be the same to pre-disturbance conditions, but it would be equivalent – what it was able to do before it would be able to do post-development. No net loss in ability. Land capability was a defined set of soil characteristics proven over many years of soils study and soils research and most of the Canadian soils were mapped and described as per land capability Canada wide. It was defensible scientifically and achievable – often environmental regulations are set up for failure and are unachievable. This set the reclamation industry on a continual improvement trajectory which allowed for new ideas and techniques.

As I reflect on several appeals and the like, it seems to me that the outcome of the equivalent land capability has served us well and allowed for creativity, thoughtfulness and reasonable flexibility.

EPEA established clear regulatory frameworks requiring companies to obtain reclamation certificates, ensuring sites met Equivalent Land Capability (ELC) standards before being considered reclaimed.

Establishment of reclamation/remediation criteria and legislation to require oil and gas sites be reclaimed to a standard that achieves equivalent land capability.

Adopting Equivalent Land Capability criteria as a guideline for project reclamation design throughout Canada. Working throughout Canada provided exposure to an absence of mature, consistent provincial reclamation criteria required to be adopted on provincial or federal pipeline projects. To manage the risks of inconsistencies, as well as to aid agencies, proponents and public with clear goals and expectations, I am aware of [pipeline] companies utilizing mature reclamation criteria from Alberta to aid in establishing a nationwide set of reclamation criteria (For more details, see Appendix 1.3).

Mine reclamation went from safe and stable, to green it up, to productivity, to "equivalent land capability". Since 1993 and EPEA, the meaning and interpretation of the intentionally ambiguous term Equivalent Land Capability continues to be discussed. Without a common way to apply the concept of Equivalent Land Capability, without an agreed upon manner of assessing it, various entities have filled this void with their own definitions.

I have been thinking about the workshop about equivalent land capability (Oil Sands Research and Information Network, 2011) and the definition and the way that the definition was designed. I think the introduction of Equivalent Land Capability in EPEA and the CRR in 1993 was the single most important event. The definition was progressive and seemingly state of the art at the time. It gave the general public security that the environment was being cared for and respected. Unfortunately, the way that it was implemented as an objective and not a requirement was a failure that has led to constant amnesty and leniency in land reclamation.

2.3 Legislation

One significant event is the establishment of Alberta's *Environmental Protection and Enhancement Act* (EPEA) in 1993. This legislation formalized the requirement for land reclamation and set clear expectations for industries, particularly in the oil and gas sector. It mandated reclamation certifications and introduced stricter guidelines for restoring disturbed landscapes, making reclamation a legal and financial priority. The Act also encouraged advancements in reclamation technologies and stakeholder collaboration, which have played a vital role in restoring ecological balance to disturbed sites.

EPEA was a very important change during the past 50 years. It provided regulators and other stakeholders with modern and comprehensive environmental legislation, which was helpful for managing the rapid pace of oil sands development. Oil sands projects, both mining and in situ, have a large environmental footprint that needs to be carefully managed to ensure good reclamation outcomes.

The 1993 introduction of EPEA. This legislation fundamentally reshaped how reclamation and remediation were approached in the province, introducing strict liability for environmental damage, requiring approval-based reclamation obligations, and strengthening enforcement mechanisms. The Act placed greater responsibility on operators for environmental protection throughout the lifecycle of a project, rather than only at the end of operations.

The establishment of EPEA in 1993 (and previous Acts) formed the basis for how reclamation in the province is defined and assessed – reclamation vs. restoration, what is equivalent land capability and how is it evaluated, and how conservation impacts successful reclamation.

Development of EPEA and the CRR. I think it important to note that in the 30+ years since EPEA/CRR were first proclaimed key terms/sections that were added to EPEA/CRR have

enabled the development of conservation and reclamation policy across a range of land cover types applicable to both public and privately held lands have remained relatively unchanged.

EPEA remains a foundational element in progressive reclamation strategies used today, as it directly led to the current remediation frameworks, environmental site assessments (Phase I, II, III), and risk-based closure approaches.

I would say it was the establishment of EPEA ... I don't think anything else has had such a significant impact on conservation and reclamation in Alberta. It's far from perfect, but the requirements within the Act and the CRR and the issuance of standard conditions that have improved over time based on improved learnings, have driven the changes required to ensure soil is salvaged properly and reclamation (to whatever applicable standard) takes place.

Legislation like EPEA (followed by standards and criteria; enforcement) were most influential. EPEA would not have happened if there hadn't been a societal shift toward environmental protection and conservation in the 60s, leading to governments forming environmental departments, and subsequent actions.

Regulatory changes that better clarified what is needed and set more and higher expectations.

Introduction of the CRR [in 1993].

Establishment of the Code of Practice for Pits. It simplified the application process and sped up the time to obtain approval. With this came 3:1 slopes along property boundaries that reduced sterilization of aggregate, and flatter slopes in the pit floor to help with cultivated land productivity.

The continuing effects of legislation and how that changes practices. The *Species at Risk Act* and caribou is a good example of how legislation changed disturbance and reclamation across the boreal. From a linear disturbance perspective it is that one piece of legislation that has had the most significant effect on current operations and focus of restoration and research of linear disturbance.

2.4 Ecological Function

The transition from the “green is beautiful philosophy” to embracing the ecological approach. The earlier view of planting grass mixtures to demonstrate that the reclamation has been successful to an understanding that the grass inhibits the transition to a natural and self-sustaining ecosystem was a slow and gradual process. In the oil sands region, trees were planted at the early years of the reclamation process, often with minimal success as the grass mats encouraged the establishment of a robust rodent population. Even the use of barley, came with an influx of a rodent population that actively removed the newly planted tree seedlings.

A recognition in policy that native ecosystems have value and reclaiming to non-native "green" cover can create permanent damage and loss to these ecosystems.

The shift from an agronomic to an ecological paradigm, driven by an understanding of natural ecological processes. In the oil sands, a major part of this was the cessation of (1) heavy handed

surface shaping (leading instead to rough and loose placement), agronomic cover cropping and (2) broadcast fertilization (mostly of agronomic cover crops).

I believe that the introduction and expectation of reclamation to natural landscapes as opposed to grass has been the largest improvement and has advanced the rate of equivalent land capability or equivalent land capacity in our province.

For me the biggest change in the last 50 years is the realization that we do not need to plant grass in forested settings prior to revegetating with trees and shrub and the fact that seeding of non-native grasses is detrimental to the recovery of self-sustaining forests. The second most influential change was the establishment of the Oil Sands Vegetation Cooperative that has led to the wide-spread collection of a diversity of shrub and seed collection for reclamation purposes.

The single most important series of event(s) have been those which have led to increased emphasis for reclamation to return ecological function along with the use of native species relevant to the natural region.

One of the most significant improvements was the requirement to use native species for reclamation on native land. This removed the expansion of cheat grass, bluegrass and so many other species that although holding great promise for erosion control had other much more negative effects that are almost irreversible. I conducted reclamation inspections in the late 1970's and early 1980's where essentially, if it was green, it was good, the focus almost exclusively on erosion control. The role of soils was understood but not truly considered at that time and if a couple of inches of topsoil gave good growth for non-native grasses, the standard was met. The long-term implication of this is that buried contaminants, sumps, and poor soils were left in place for future site issues that unfortunately still exist today.

The increased understanding of the importance of using native species for revegetation, and improved approaches for being able to do that (e.g., seed sources, propagation methods, material transfer, etc.).

Some 50 years ago, the focus was slope stabilization and making it green with ecosystem development lagging far, far behind. I like to thing I helped develop and support ecosystem development. And there was always the debate over reforestation versus afforestation.

While restoration of native habitat should not be the objective for all site-based reclamation, where and when it is, site-based objectives should include local and landscape level considerations for ecological structure, composition, and function (an example here with landscape level ecological considerations supporting reclamation objectives could include leaving a clay pad in the middle of a peatland to provide a useful small island of upland treed habitat following reclamation).

The advent of active forest habitat restoration treatments within caribou ranges.

A consistent fundamental goal of "reclamation", recognizing that it was unrealistic to expect the post-disturbance landscape to be an exact replica of pre-disturbance landscape however it was realistic to expect the utility of that landscape to be re-established. In most other jurisdictions, the term "restoration" is used which often connotes the return to original, unlike the focus of as near as practicable in the term "reclamation." This in and of itself creates misaligned expectations of outcomes.

The aggressive conservation and effective deployment of (native) propagule-rich surface soil, with that matter deployed exclusively at the soil surface on reclaimed sites.

For me, the greatest shift was the growing understanding to mimic natural ecosystems and processes, including landforms, water drainage and retention, use of natural seed stock and overburden, and fostering successional processes (e.g., mycorhizzae), rather than first establishing thick grass and clover ground covers for erosion control and then allowing nature to proceed. I am, of course, strongly influenced by the early (1970s) oil sands projects I worked on.[5]

An area that always strikes me as a blind spot is native prairie and the wetland complexes. Fifty years ago, these areas were in dire straits from many factors, most notably farming practices that did not value the importance of these ecosystems. And today not much has changed. Native prairie and wetlands are still in decline as are the wildlife species that depend on them. I had a vision back in 1975 that this was the greatest opportunity for change to improve the management of prairie ecosystems. Unfortunately, it remains as a significant issue that requires effort to protect and restore these systems. Soil loss, shifts in climate, drought and flooding are all combining to make the situation worse and downstream infrastructure is more at risk as that expands into risk prone areas. How we missed this is beyond me. It isn't that we didn't try. A great example is the Alberta wetland policy set up to protect and restore prairie wetlands. However, its application is more focused on the boreal now where wetlands are nowhere near as challenged as they are in the south. We could have done so much more. The programs started in the 1930's so we have no excuses for lack of progress. This may be CLRA's 50th but it is almost the 100th for soil and vegetation reclamation in the prairies.

2.5 Soil Salvage and Replacement

The single most important event was the recognition by the government and industry of the need for topsoil salvage for all industrial disturbances. Also, as a fundamental requirement now, in the 1970's it was not a real requirement. Topsoil salvage was the stepping stone for soil surveys, materials handling, and reclamation planning for all types of development. The use of soil information led to the concept of restoring land capability after disturbance, and the capability concept caused much debate amongst regulators and resource managers. However, this led to ensuring the land after the development was completed or resources depleted to ensure the land

[5] See Appendix 1.2 for more detailed commentary.

could provide future benefits in terms of agriculture production, and wildlife habitat and contribute other resource values (water, air, scenic, recreational benefits).

The most important event that shaped reclamation in Alberta was the 1983 legislative amendment to the *Land Surface Conservation and Reclamation Act* (LSCRA)[6], which mandated topsoil salvage for industrial developments. This requirement was critical because topsoil is essential for restoring land to an equivalent capability post-disturbance. By preserving soil structure, organic matter, microbial communities, and native seed banks, this policy enabled more effective revegetation and ecosystem recovery. Prior to this legislation, land reclamation efforts often struggled due to the loss of topsoil, which severely limited the potential for successful plant establishment and long-term soil productivity. The introduction of mandatory topsoil salvage shifted reclamation from a focus on land stabilization to restoring ecological function – an approach that remains foundational in Alberta's reclamation practices today.

> *The best thing that happened for reclamation was identifying that topsoil is a valuable resource and developing best practices to salvage this resource during construction.*

Selectively salvaging and directly replacing topsoil in an effort to kick start the natural development process to a forest ecosystem. The direct placement of topsoil (hot placement) also had the benefit of reducing the need for fertilizers as the nutrients needed for tree growth were already available within the soils being placed.

The most important event for me was that first acknowledgement of topsoil salvage and replacement as a tangible beneficial practice.

I believe since 1983 the practice of topsoil salvage has been important for reclamation.

Introduction of topsoil salvage was the most important event.

Many important improvements, requirements and refinements have been made since 1983. Almost all of them rely on the finite amount of surface soil that was salvaged at the time of the initial disturbance, often many decades previously. Without the legislative forethought that preserved this valuable resource, the reclamation success we have seen, and further improvements being sought may have been impossible.

A notable failure that I have observed on several operations is in the reclamation planning and implementation stage. That is, to make sure there are areas available for placement of the reclamation materials rather than relying on stockpiles. While stockpiles are necessary, the benefits of having the biological active components of the soils are degraded through time.

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[6] See https://www.canlii.org/en/ab/laws/astat/sa-1983-c-35/latest/sa-1983-c-35.html

Awareness of the importance of soil bred action: advocacy, research, and regulations and standards.

In a lot of areas in the Green Area there is almost no topsoil (north of Hinton, west of Fox Creek). I would say the reality is we were closer to a real assessment when we looked for presence or absence of topsoil or improved growing medium. Vegetation winds up being the end point just like our other land users the FMA holders.

2.6 Technology and Tools

Submissions into One Stop – submissions and approvals.

The creation of OneStop has been a significant improvement in managing upstream sites. It has significantly streamlined the reclamation certificate application process, and has helped with continuity of information, especially when the site changes hands. Reclamation certificates used to take months (and even a year) to obtain, whereas the turnaround time is only one month. The effort required by regulators has been accordingly focused on non-routine sites, while routine sites are handled (i.e., approved) by the system.

While not a singular event, over the past 10+ years we have seen a steady loss of focus on outcome-based decision making and a greater focus on administrative decision making.

The shift to automated systems such as One-Stop is necessary to handle the number of reclamation certificates being applied for, and I'm not suggesting we need/should go back to field inquiries but with that has come a greater focus on binary pass/fail decision making. As a result, significant time and resources are going into documentation of site assessment and remediation and there is less opportunity to incorporate professional justification and "telling the story" of site condition and reclamation efforts. This heavy focus on reporting and documentation is taking time and resources away from completion of reclamation field activities, which is ultimately counter to the objective of accelerating closure in the province.

Another development is Geographic Information Systems (GIS), the tool that can be used for inventory, mapping, monitoring and modelling the areas disturbed and lands around the disturbance.

Another important event was the use of computers and specifically GIS systems that combined data and mapping to track sites from disturbance through to reclamation. When I started all mapping was analog on township maps. The scales were difficult to use for small sites and the accuracy of location was a factor of who entered the data more than where it was located. It had no ability to link data spatially. By the 1990's that capability was beginning to be used and over time this greatly improved reclamation documentation and from that data to assess what worked well and what needed to be improved.

From my perspective (field point of view), I think the most important thing that has happened over the past 50 years is the introduction of Rough Mounding Topsoil placement. When this was first introduced by Al Watson and Lindsey Thompson at Cardinal River Coals back in the early 1990s, it changed the dynamic of reclamation on mine lands. It:

1. Reduced erosion;
2. Created microsites for the planning of trees, and in the harsher environments, vastly increased the survival of newly planted trees;
3. Provided wind protection;
4. Increased water holding capacity of the landscape;
5. Captured snow to help cover the protect seedlings through the winter;
6. Created a rough landscape instead of a flat surface;
7. Increased habitat for wildlife; and
8. Allowed for better incorporation of larger woody debris into the landscape.

This reclamation practice is now common across mines in Alberta and has been adopted by many other jurisdictions. It has also been incorporated into most operating approvals in Alberta in one form or another.

The single most important event was the improvement in the seismic exploration footprint reduction. Historic seismic exploration practices caused massive linear disturbance impacts that compromised the integrity of many Alberta ecosystems and species. The Alberta Chamber of Resources convened regional and sector players over many years to discuss improvements through cross sector access cooperation but also best practices. Caribou habitat protection plans also caused engagement and innovation to occur.

I don't think equipment has changed too much but different reclamation practices have come and gone. Technology was never as big as it has been in past 10 years.

On a personal note, a big change happened when I built my first soil core probe and started failing reclamation certificate inquires for soil profile compaction and incorporating the 50 cm depth of my probe into the first iteration of the reclamation criteria.

2.7 Research and Knowledge

In the late 1970s to mid-80s, the Alberta Oil Sands Environmental Research Program (AOSERP) research was being conducted, foundational to understanding oil sands disturbances and reclamation.[7] Much of it still relevant today. This work created the foundation for standards for oil sands that is still evolving. For the oil sands, this is probably the most significant body of work taking knowledge from almost nothing to a clear understanding of most factors of concern

[7] See https://era.library.ualberta.ca/communities/e4fdd15f-c21d-4612-a2f7-bfec3fdfc1de/collections/d5685fd3-7ba5-4ee0-a4e8-f5d308d18efa for AOSERP reports.

from oil sands development. Further work in CEMA starting around 2001, in reclamation and other fields added to this.

> *Since the beginning, reclamation practices have continuously improved through research and monitoring, yes, but most importantly through the doing of reclamation. The actual application or use of an idea, belief, or method, as opposed to theories relating to it.*

Over the years there have been several research associations in the oil sands on land management and reclamation such as AOSERP and CEMA, but it also included Canadian Oil Sands Network for Research and Development (CONRAD), Oil Sands Leadership Initiative (OSLI) and a few other programs that housed land related research that eventually have been housed under Canada's Oil Sands Innovation Alliance (COSIA) or Petroleum Technology Alliance Canada (PTAC) in the current structure. These programs conducted some new and important research; an example is a thesis on wetland restoration published in 2007 which covers most of what is needed to implement good reclamation but sadly is mostly forgotten by practitioners today.

On-the-ground, progressive reclamation has been undertaken in the mineable oil sands sector for decades. From the beginning, soil was conserved; salvaged and placed or stored in stockpile for future use. From the beginning, trees were planted. Although there is great debate as to the pace of reclamation in the sector (a topic I won't expand on here) the quality of the reclamation speaks for itself.

Years ago, we used a lot of band-aid methods to reclaim and restore wellsites / facilities resulting in the return to fix issues. We have not done as much of that in the last 10 years. Our successes and mistakes are both very important for the future.

2.8 Collaboration and Engagement

In my opinion, the most important "event" in Alberta was the establishment and evolution of regulations requiring reclamation of disturbed lands and doing so with the involvement of government, industry and consulting representatives. The ability of government, industry and consultants to interact, discuss and potentially change the development of regulations was unique to Alberta. This in contrast to the much more confrontational approach in the US (For more on this see Appendix 1.4).

A theme that has had a profound effect on the success of reclamation in Alberta is Alberta's multistakeholder collaborative approach to the understanding and working the issue outside of project-specific regulatory processes. With a broad spectrum of knowledge and experience in resource development activities, government staff and industry representatives collaborated on common goals. It was not uncommon to see government staff and industry representatives on the landscape identifying, discussing and practicing with various equipment and techniques. It always felt like this attention to respect for the landscape added to trust from the landowners.

The cooperative development of legislation and policy by government, industry, consultants, and researchers that built trust and laid the foundation for today's regulatory regime.

I'd say the government and industry working together to conduct soil reclamation trials on coal mined areas, I believe starting in the 80's. There were projects undertaken at Forestburg, Wabamun, Grande Cache and more. This really brought together specialists from government, universities, industry and consultants to pursue a common goal, sharing information and enhancing the implementation of improved reclamation practices. Spinoffs included improved reclamation guidelines, training courses, all leading to better reclamation and reclamation certification.

There have been several good examples of collaborative practices that have improved land management and reclamation through collaborate processes with regulators and industry. Arguably some of these had limited external participation from others such as Indigenous people and ENGOs, but the process was good in working together. The discussions were usually blunt, focused and with an intent to resolve an issue. They were heated at times and always to find solutions despite the raised voices and colourful language. The number of times [a regulator] and I would cross each other was almost famous but always resolved afterwards over a beer and a friendly handshake. Different times. There were also many other activities such as CEMA and its work, until it evolved into lacking purpose and focus of addressing real problems, my opinion.

Increased Public and Stakeholder Engagement: EPEA heightened transparency, leading to more public scrutiny and greater involvement from Indigenous groups and local communities in land restoration decisions.

2.9 Liabilities and Liability Management Programs

The orphan well program to take care of wells that were abandoned and more recently, setting of minimum financial obligations from operating companies to manage those programs in Saskatchewan, Alberta, and British Columbia.

The Licensee Management Program at the AER pushed the oil and gas industry to pay more and more attention to liabilities and not walk away; attention at the backing banker level, where acquisitions and divestitures had liability questions at the forefront.

The development of the Site Rehabilitation Program (SRP)/Mandatory Spend. Federal SRP was a bit of a disaster in the implementation and administration, there was a lack of skilled labour in the work force and funding approvals were neither timely nor logical, but it brought the reclamation industry back into the forefront of Alberta industry. AER's Mandatory Spend requirements have picked up on this and are attempting to hold producers accountable for their reclamation obligations, and maintain similar annual spend for industry. This is keeping

environmental firms in business and allowing new graduates to get into an industry that appears to have a long future ahead of it.

> *The start of the liability programs for conventional oil and gas, then mining, has accentuated the need for proper accounting of reclamation future costs and to manage that liability through financial security programs.*

The requirement for public and material disclosure of environmental liabilities and the decision that those liabilities had to be included in the insolvency discussions of an operating entity in Alberta have had the largest implications on the management of reclamation and remediation activities in the Province (See Appendix 1.6 for a more detailed discussion.).

I feel the establishment of reclamation security has gone a long way to encouraging reclamation. Having funds in place aids in moving reclamation along and in particular, progressive reclamation as the security posted is linked to the maximum cost of reclamation at a given point in time during an operations existence (encourages minimizing disturbance and liability and any given point in time).

Increased financial commitments in industry to improve and complete more projects as per legislation requirements, especially in the past 30 years.

The massive amount of unfunded abandonment liability and increasing number of orphan sites in the oil and gas sector is both significant within the past 50 years and will continue to be a major challenge into the future. I realize that your panel is not including or discussing contaminated site remediation, but surface reclamation is certainly a major component of this issue.

2.10 Capacity and Capability

Standing up the AER as closure approvers. Closure belongs to Albertans and the bouncing between two bodies for closure on a lot of items is frustrating. AER as a regulator day to day works, active approvals and inspections works. Truthfully, closure should never have been moved away from government.

I think the most important change in Alberta was the policy/budget changes that affected Alberta Environment in the early 1990s. The loss of the Development and Reclamation Review Committee and later the Conservation and Reclamation Committee and the Reclamation Research Technical Advisory Committee resulted in:

- Loss of interdepartmental cooperation;
- No focussed guidance or help from the department;
- Dilution of departmental technical capability through turnover of staff;
- No open brainstorming of reclamation solutions other than some organized workshops;

- Loss of trust between civil servants and industry members; and
- Creation of "idiot proof" regulations which don't often work and are not subject to change (See Appendix 1.7 for more details.).

The move from actual inspections by a government employee to the paper-based system. In my view, this breached the "contract" between the Government and the ability for an oil and gas company to "force" its way onto a landowner's land through the Surface Rights System.

> *The move away from every site having an inquiry on site and introduction of the professional sign off process for Upstream Oil and Gas.*

I think that the professional declarations have increased the sense of reliability, both for the practitioners and the applicants.

Another important event that shaped the past 50 years was increased education at more schools. What hasn't changed is the dedication of people in the industry. Mother nature will take back all of this without us, but it is the consultants and operators that pay attention and dedicate their lives to speeding up the process.

One thing that shapes reclamation, etc. for Alberta industries would be regulators and how they interpret/apply/enforce regulation/policy, etc. From a consultant perspective, industry generally only does what regulators tell them to do. Stakeholder and shareholders have some impact, but not nearly the same.

2.11 Oil Sands

The single most important event in the last 50 years in the oil sands mining sector is not an event at all, rather it is the cumulative area of land reclaimed, and the knowledge and experience gained through action. The land is there, it's living. I have had the privilege of experiencing these reclaimed lands through all the stages, from mining, tailings management, landform creation, soil placement, revegetation and beyond … and there is so much opportunity for this real reclamation to inform the theory of it.

I think [expansion of] oil sands mining is the most important event in the last 50 years to shape reclamation in Alberta (For some insights to early reclamation practices see Appendix 1.8).

I would go with the construction and operation of [Syncrude] Mildred Lake in the 1970's[8]. Even though it wasn't the first major oil sands development, I've always understood that the second through the gate is what signals a market, and the footprint certainly ballooned from there.

[8] Author's Note: Syncrude's Mildred Lake Mine was the first project in Alberta to require an Environmental Impact Assessment (Syncrude Canada Ltd., 173)

From my perspective the most important event (realization) in an oil sands context has been the recognition that consolidation of fine tailings is technically and practically just too difficult to be achieved in any normal reclamation timeline and needs to involve significant water releases which were not originally anticipated.

> *The scale of the disturbance and complexity of tailings management has literally transformed Alberta and driven reclamation and liability management policy.*

I believe the most important reclamation challenge in Alberta has been and continues to be oil sands mining reclamation, particularly tailings sites.

The lack of clarity on reclamation criteria for the oil sands mining sector has created what can sometimes feel like a great divide.

The most important reclamation event is Suncor's application of "thin-lift evaporative drying technology" for mature fine tailings (MFT) on a large scale (i.e., large scale at the time) in about 2010. I consider this the most important event in the last 50 years event as:

- Reclamation of the large tailings ponds associated with oil sands mining was not feasible since 1967 when the first pond was constructed;
- The large tailings ponds constitute a major, or dominant, part of the mined areas; and
- It demonstrates the importance and benefits of a collaborative approach in technology development (Suncor, Syncrude, ARC and others).

2.12 Indigenous Engagement and Values

From an Indigenous perspective the most important event that has shaped this work is the *Yahey* v. *British Columbia* decision. This has set the stage to promote large scale reclamation or restoration designed to return the land to near pre-disturbance conditions in the traditional territory of the Blueberry First Nation located in Treaty 8 Territory in NE British Columbia. This case is important because it is the first case in Canada to consider treaty infringements arising from the cumulative effects of development rather than infringement based on a specific project, authorization or legislative restriction. For the first time a court has found that:

1. a Province breached treaty promises by permitting the cumulative impacts of industrial development on treaty rights; and
2. infringed a treaty by taking up lands to such an extent that there are insufficient lands for the meaningful exercise of treaty rights.

This case has set precedence in that it will inform the upcoming Beaver Lake Cree Nation Case set to be heard by the Supreme Court of Canada as well as the recently filed *Duncan's* v. *Alberta* Case. The Blueberry Case has already resulted in offset requirements for one Canada Energy

Regulator regulated development from NE BC to Alberta where the project has been conditioned to offset the loss of Crown lands at a ratio of 2 to 1. The proponent is now required to purchase and set aside intact lands or restore disturbed lands which will be set aside for Indigenous use and oversight. When the Beaver Lake Cree Nation decision is rendered, the outcome will be the law of the land and will apply Nationally. This will likely result in greater Indigenous participation in restoration and oversight of Crown Lands across Canada. New standards will likely be required and the duty to consult should be triggered to inform reclamation and restoration plans. This work could take shape on a landscape scale rather than a project-by-project approach. Reclamation timing is likely to change as developers may be required to decommission, remediate and reclaim land shortly after production has ceased. The potential outcome is restoration, rather than reclamation, of lands. This will support the continued practice of Indigenous rights, transfer of intergenerational knowledge, retention of Indigenous way of life and language all while addressing cumulative effects, loss of biodiversity and climate change. This is what we mean by land back.

End land use function requires defining reclamation success and Indigenous Knowledge (Indigenous use of lands and resources) is so necessary for that.

I would also say that unfortunately consultation and the understanding in Inherent Indigenous and Treaty Rights was not present in the process of conservation and reclamation and that this meant that reclamation targets for equivalent land capability were generally driven to a resource type outcome like agriculture, forestry, commercial/industrial or residential. Healthy robust fully intact ecosystems were not the specific goal. Unrestricted land use/restoration was not generally considered in the reclamation process. It was assumed that if we reclaimed for example to a forest capability that it would not be limiting for wildlife or vegetation, but that does not seem to be the case – and in many instances falls short, and results in cumulative impacts.

Return of land to support traditional [Indigenous] land use values (e.g., renewable harvesting), of which the prime example are outcomes in Northeast British Columbia following the British Columbia Supreme Court (2021) Yahey decision. This trend also has implications to mining projects (we are involved in many) re: return to such conditions, if not even more so "pre-colonial". Arguably if not certainly, the challenges and need are greater for mines than oil and gas. And, if not driven by Indigenous interests, then biodiversity and release contaminant containment and treatment.

The meaningful inclusion of Indigenous Knowledge (IK) and Ways of Knowing. This was not existent 50 years ago and although it remains a significant challenge today, the acceptance of it by western science has been so impactful.

The expansion of Indigenous involvement in land management and reclamation is noteworthy. Over time, Indigenous perspectives on ecological restoration have increasingly informed

practices, emphasizing holistic approaches that integrate traditional ecological knowledge with modern scientific methods.

2.13 Remediation

Requirements for Phase 1 and 2's and remediation as part of reclamation certification.

Along the same lines as above was the greater focus on soil contamination and structure in reclamation to remove or remediate soils to return them to a productive status and to have documentation of that for the records.

2.14 Other

Wetland compensation. Recognizes their importance and ensures the ability to easily calculate the cost. Enables access to more aggregate.

Native seed and plant nurseries have also helped steer reclamation – but I think the regulatory change pushed the need/demand for this. So likely the "event" is the regulatory/criteria shift in 2010.

Acceptance of the fact that resource development has a multi-decadal lifespan and land could not be successfully reclaimed in a matter of months. To that same point, during the project planning phase reclamation was a consideration from the initial steps of defining project footprint, developing vegetation and soil handling techniques, considering the stockpile and storage of materials throughout construction, and including the timely replacement of materials in the definition of project schedules. Throughout project execution all parties observed and often designed and implemented changes in the field to support success at the final stages of reclamation. Additionally, there was tremendous value from having the individuals involved in the planning and application review stages assigned to the project through to the assessment of reclamation success.

In more recent years I would say the introduction of the [AER's] mandatory spend program (Alberta Energy Regulator (n.d.)).

3 FUTURE DRIVERS FOR CHANGE

3.1 Oil Sands

3.1.1 *Tailings*

Oil sands reclamation liability has been estimated to be in the billions of dollars with chemical and groundwater issues to deal with before stabilizing the land surface to provide a useful and safe landscape as it was before. There are plans put forward but remain untested. The methods need to be jointly tested involving all stakeholders so that confidence is built towards reclamation success.

There are ponds containing contaminated wastewater from the processing of the oil sands. They cover about 220 km² and hold 1.2 trillion litres of contaminated water. To date, no tailings pond has ever been certified as "reclaimed".

I believe the most important reclamation challenge in Alberta has been and continues to be oil sands mining reclamation, particularly tailings sites. After 50 years we are still working to solve basic reclamation technical questions, the scale of reclamation required, the mining process and reclamation, the financial issues such as chronic underfunding and regulatory deficiencies due to a captive regulator. Will we be prepared to deal with the long-term legacy reclamation problems when the mines reach closure?

Based on the sheer magnitude of the challenge, I believe the tailings pond reclamation related to the oil sands mines will be by far the biggest technical and financial challenge.

The greatest challenge is and will remain appropriate reclamation of oil sands tailing ponds. The technical challenge of the tailings and related water itself if beyond challenging. Thereafter how to appropriately reclaim boreal forest and its mix of wetlands, fens and the like is challenging. Beyond the scientific element, there will also be the challenge of balancing the desire for "quick fixes" and culturally relevant fixes in the area. all in all – good luck!

In my view, the most important reclamation challenge facing Canadian mining is to develop and implement the means to preclude fluid fine tailings (FFT) from the mine closure landscape in oil sands surface mines. I believe the potential now exists to be able to practically incorporate all fines within tailings sand deposits, thus obviating the need for any further permanent storage of FFT under water in pit lakes. What is needed is a sustained commitment by one or more operators to drive to a working full-scale model that could then be followed by all operations.

I would say it will be huge tailings ponds, there is significant uncertainties with the costs and liabilities program to cover the clean-up of oil sands tailings ponds and the presence of toxic chemicals. Nations within the RMWB have been raising this issue to Alberta and Canada for

years and there remains uncertainty of this clean up and the decommissioning plans for the infrastructure that has been in place for decades.

In my view, although, reclamation of mines and associated infrastructure land remains significant and challenging, the overriding task will be mitigation of process-affected water contamination. This challenge will be extensive and regional in extent, potentially extending to extremes of the watershed, both surface and subsurface. This represents a decontamination/land reclamation of ultimate significance. The authors of *Footprints: The Evolution of Land Conservation and Reclamation in Alberta* pointed out in Chapter Twelve: Challenges and Opportunities that "the challenge of oil sands mines is further complicated by ... rapidly changing tailings technologies ..." (Bott et al., 2016). When the Suncor base plant started production in 1967, it was originally thought that oil sands tailings would be the outstanding reclamation challenge associated with oil sand mining. It was then and is still the case today. In the over half century of oil sands mining since, new tailings technologies have come and gone with no firm and effective solution yet in sight.

Dealing with legacy tailings/tailings ponds.

3.1.2 *Mines and Mine Footprint*

The oil sands footprint on the Wood Buffalo region and tailings treatment and reduction is of a magnitude that it will challenge the financial and technical capacity of the companies, sector, province and country. Innovation in practices and technology have been encouraging but have difficulties being scaled to the size of the legacy impacts and current operations. Our backlog of abandoned wells is also significant but solvable with time/money. Oil sands footprint is much more material.

> *From a single land disturbance type perspective, oil sand mines will prove to be the outstanding and major challenge and potential for environmental and economic liability for the Provence far into the future. The potential impact ranges from individual mine operations to cumulative impacts regional in scale.*

Large scale reclamation closure in the mineable oilsands region. There are fundamental reclamation challenges that need to be resolved including reclamation techniques for novel tailings structures (both chemical and geophysical challenges) and mine water release policy to re-establish landscape-scale hydraulic connectivity. As the mineable oilsands region hits maturity large areas of land that have been progressively reclaimed are approaching final reclamation state and we need to enable the final closure of these areas.

The most significant challenge over the next 10 years will continue to be oil sands reclamation and mine closure where operators will seek to walk away. The province is collecting money in the Mine Financial Security Program (MFSP), but the size and scale of the liability associated

with the tailings facilities needs very careful and independent analysis. Many certainly understood the risks associated with these facilities for decades. But no one seems to be willing to do what it takes to ensure the facilities are properly monitored for environmental concerns and ensure that they meet the standards to close these facilities someday. It's a game of hot potato. And the problem will sit with the province, unfortunately, at the end of the mine life.

On a regional basis the biggest challenge to reclamation is the development of Alberta's oil sands. The magnitude of the disturbance taking place is unprecedented in Canada if not North America. Disturbed oil sands surface mineable area equalled roughly 895 km² in 2013, accounting for less than 1% of the total oil sands area. In 2017, the Pembina Institute reported this number had grown to 940 km². Up to date numbers are not readily available as reporting on environmental issues in the oil sands area is now very intermittent.

I think oil sands mining is the most important challenge in the next 10 years in Alberta. As Base Mine reaches end of mine life, Alberta will need to clarify expectations for whether end pit lakes with tailings are permitted and how reclamation milestones will be assessed, on the path to certification.

Government not providing the necessary guidance on reclamation criteria in time for the oil sands operators to meet mine closure commitments.

3.1.3 *Water*

The big challenge for oil sands is end pit lakes.

Process-affected water is a challenging issue to manage, and it would be helpful to have the benefit of time to do this in an orderly and environmentally acceptable manner. Deferring of this issue until very late in the cycle of oil sands mining may result in less favourable outcomes.

> *The most important reclamation challenge in the next 10 years will be to coordinate federal and provincial regulatory processes to ensure proper management of water from reclaimed oil sands fine tailings.*

Oil sands water release is currently the biggest and most challenging issue in the oil sands. My thinking is that if you can't release the large amounts of water that have accumulated over the last 50+ years you are going to have to have a wate-dominated reclamation/restoration landscape. If such a landscape cannot have any in-pond fine tailings then you also have the very big and somewhat intractable issue of full fine tailings consolidation.

Despite historic commitments by governments to provide the necessary regulatory guidance, two key foundational requirements for water management and tailings facility reclamation at oil sands mines remain outstanding: treated mine water release and pit lakes.

3.2 Capacity and Capability

3.2.1 *Human Resources*

Human resources are expected to be much more transient, creating challenge to achieving consistency and engagement while resource development project timelines continue to extend. In the past, there has been much reliance on relationships in building the necessary trust to advance the practice. Looking forward new approaches will be needed to build this trust and cooperation. Perhaps the parallel increase in duration of project timelines will provide opportunity to balance this concern.

The biggest hurdle that we will face in the next 10 years is the labour force. I specifically see two areas of the labour force that will become a challenge

- The first being equipment operators, cat skinners that excel at reclamation work have been few and far between for a while and it seems like there is a lack of new operators who have taken up the mantle.
- The second being environmental consultants/supervisors, where in the past 5 to 10 years, the environmental industry was in a bit of a decline. Skilled intermediate consultants are lacking at the moment (however they may be showing up now as we are ~5 years post-SRP).

> *Getting committed individuals to choose land reclamation as a career path. For many reasons it is not viewed with as much passion and excitement as it has been. Many do not want to work in an environment that supports oil and gas and mining.*

Equipment operators! We need a succession plan for "cat drivers" who can actually do the work. Have you seen what the average age of a construction crew is lately? (Honestly a dozer costs $750,000+ nowadays, never mind a trained and competent operator who is also a "good skilled" operator!!) We need more "doers".

The other thing I have a real problem with is the fact that we have oil and gas companies hiring people without education – they know how to operate heavy equipment, but they don't understand the end point that we require for our land and there seems to be no professional associations that back us on this. It is difficult for us to justify our work and our expertise when somebody can hire Joe's Oilfield and they can butcher a site and nobody holds them accountable. You can say oh well, we'll get it when we do the assessment, and we'll make them do more work. The problem is if you've done reclamation, you will know that not only is a huge part of it how they built a location if somebody doesn't know what they're doing when they put a site back, they could potentially mess it up forever in a sense of having to replace entire topsoil or applying amendments for years however you want to tackle it bottom line is they have no business practicing reclamation.

There are fewer people interested in joining the reclamation field because they don't want to be associated with “dirty” natural resource development, even though they can be a part of making things better.

> *I’m going to say competence and capacity. I think our focus on desktop tools and reducing field time (in the name of cost savings) will bite us in the ass. I think we’re going to be dominated by armchair experts for a while on all sides – practitioners, regulators, operators – and that will lead to a lot of wheel spinning because neither side will know or accept the practical solutions.*

Reclamation is so multi-disciplinary that you just can’t excel without time to learn in the field, talk to people that live in the field (e.g., farmers and equipment operators), and see what things are truly like in the field.

Workforce and resource constraints: The aging workforce of experienced environmental professionals, coupled with talent shortages, may impact reclamation project quality and efficiency.

I think mentorship of the new people from experienced personal is key. As mentors we need to relay our success and our mistakes. We cannot lose the knowledge we have learned with soil, water and vegetation still having a common ground that they did 50 years ago. Some practices that we did 40 years ago have come around again. The industry needs to be strong with continued education / technology and seminars like CLRA. A code of ethics and working with good people and alliances is key. There may not be as many individual practitioners anymore.

3.2.2 *Use of Professionals*

I am not sure how far this will go, but resources to address reclamation and determine regulatory requirements are met will not be increased. This combined with the need for experienced and qualified personnel will be a big challenge. It seems reclamation success is still an open question given the large audience of land users, coming to grips is an ongoing challenge.

The role of environmental professionals in reclamation:

- Increasingly, Producers are opting to use non-professionals with little or no reclamation experience to reclaim sites.
- This trend raises concerns about job scarcity for environmental professionals. We have seen a steady decline in students/new graduates entering the industry in recent years and this trend of using non-professionals does not make the profession more appealing to newcomers.
- The use of non-professionals to reclaim sites, especially in sensitive ecosystems, can create irreversible impacts on the landscape. I have personally conducted several failing

DSAs on sites that were reclaimed by non-professionals and end up taking significantly more time, resources, and money to try and repair deficiencies and meet reclamation criteria.

- To address this, legislative and regulatory changes are needed to ensure that reclamation work is conducted by qualified environmental professionals, maintaining the integrity and success of land reclamation efforts.

> *The de-emphasis on the need for government regulation, supervision or enforcement.*

Workforce and resource constraints: Increased reliance on third-party contractors and automation tools will require enhanced data integration skills and training for regulatory professionals.

3.2.3 *Education and Research*

I think the biggest challenge will be trying to find enough skilled people to support the reclamation/restoration work coming our way (scary considering how few people were registered in Anne Naeth's University of Alberta program this year). Capacity building will be key (while people like you and I are still in the picture).

Educational establishment changes (e.g., less focus on soils or other "practical" sciences).

Willingness of industry to continue to do reclamation research to allow for continual improvement and to adapt practices to a changing environment. There seems to be less commitment to reclamation research programs than in the past, almost like we've reached a spot where we think we know everything. Government or non-for-profits may have to step up to fill this gap.

Maintaining the pace of innovation given that a major research facility was recently shut down, some research funding organizations are unwieldy, and academic researchers are largely out of touch with needs (not their fault, and a few great exceptions).

3.2.4 *Communication and Collaboration*

Stakeholder (landowner) involvement (i.e., not incorporating the site into their farming operation and delaying process).

With the continued 'busy-ness' of resource development projects, there will be a need for effective forums and messaging about reclamation to avoid having reclamation become the afterthought of development.

Going forward we need a new model for project development which includes First Nations and other stakeholders including for reclamation planning and possibly research to build the trust in projects.

I think the big challenge will be dealing with the public and building more trust in the science and art of reclamation/restoration/rehabilitation, counteracting the nonsense (disinformation) that is "out there" in the public's mind. The "experts" who get their disinformation from social media and unfortunately espouse their expertise loudly on social media are formidable as the public puts as much stock in their viewpoints as they do in the words of the true experts working in the field with years of training and experience. Unfortunately, some of our missteps of the past (disinformation) provide fodder for the pseudo experts to put out there, fodder to be misconstrued to the public, including our politicians. The challenge is how to accomplish getting our successes known to those outside of our fields, especially when most of us are not necessarily skilled in this area.

Public perception is and always will be a challenge. There are continual pressures facing the regulators from uninformed public.

I think that the challenge will be battling the dis/misinformation facing other scientific disciplines that seek to manage our cumulative impacts.

3.2.5 *Other*

Legislative, policy, and practice capacity to deal with an unknown, unforeseen or unexpected event (e.g., a new industry, a major tailings failure, refusal of the tailings in pit lake reclamation option).

Increased development and development in sensitive areas. The world needs more natural resources to support the development of "green" technologies, including batteries – this is an ironic position to be in. New mines, expansions, more oil, etc. means more disturbance and therefore more reclamation. Some of these projects will be pushing into sensitive areas that we have no experience reclaiming (e.g. the Suncor Fort Hills McLelland Lake patterned fen, the arctic, caribou habitat, etc.).

Given the changing global political climates and increasing costs associated with remediation and reclamation and increasing numbers of orphan wells, I suspect keeping the momentum going will be a challenge.

3.3 Policy

Restoration should not be a word we shy away from – it is often incorrectly defined to suggest "putting back that which was there before in same places and proportions" … nature rarely does this in practice after natural disturbance.

We really have to leave behind the notion of "make it like it was before" and help the regulators and public understand that this is not possible or desirable in many cases, but the goal should be

to establish a functioning ecosystem within the constraints imposed by local climate and other environmental factors.

> *It is time we write a "simple word" provincial reclamation policy (or strategy) that better defines equivalent capability … especially providing clarity for equivalent capability when reclamation targets focus on local native soils and vegetation … personally I think the clarity exists, but only to practitioners.*

How will the definition of reclamation evolve considering the Subregional Plans that require the return of biophysical habitat for caribou? The lines between restoration and reclamation have become blurred for many stakeholders. What is acceptable? How does industry communicate the difference between reclamation and restoration and is social license and expectations changing?

I believe the next steps for Alberta if you want to consider it a driver is a consolidation of [reclamation] approach and policy. We have standards for different land-bases, different activities and disturbances and some that don't have a standard or expectation at all (private lands not on disposition but in [reclamation] and public lands like old seismic disturbances). It's time to standardize the expectations to one that covers all the province no matter how or when the site was disturbed. This way you have a universal approach with common end objectives and criteria. It will take some negotiations to achieve that but if the regulators push it, it can be done to develop them best future outcomes in the for all restoration in the province.

The integration of renewable energy developments, such as solar farms and wind projects, presents new reclamation challenges, including adapting practices to new types of land disturbance. These challenges will demand interdisciplinary expertise and forward-thinking policies to ensure long-term sustainability and ecological health.

The most important reclamation challenge in the next 10 years will be to adapt environmental assessment and reclamation planning and implementation to a shorter timeframe. Existing information sources, such as the AER's Data Hub[9], will be essential. Reasons for this:

- In the US there are already concerns that the requirement for Environmental Assessments will be eliminated for "fast track" projects. It is not as clear whether reclamation planning and implementation will also be abridged to bring some new projects, or expansion of operating projects, on stream more quickly.
- In Canada there will be political and industry pressure to significantly reduce the timeline to expand existing projects and bring new projects on stream. This may also result in

[9] See https://www.aer.ca/data-and-performance-reports/data-hub

modification of environmental assessment and reclamation planning and implementation to fast-track projects.

The gap between what the plan is on paper and what happens in the field. The need for the continued application of science to determine what reclamation success is. The challenge then is for interpretation of monitoring and modelling the effects of development to be credible.

It will be the continuing misunderstanding of the criteria by the AER. I say this [because] the spirit of land reclamation in Alberta and elsewhere has been lost either in the surface rights acts and regulations or the misunderstanding of what the criteria "was" to be – we have the same "woke" issues in our society where people get confused between what is the same and what is equal.[10]

We cannot overthink what we do and make it harder than it is. We need to make more cost-effective decisions.

SIMPLIFICATION. OMG, the 2010 Reclamation Criteria wrecked the business in my opinion.

Would it be beneficial to create a single set of conservation and reclamation criteria for both designing environmental protection measures as well as measuring reclamation success across the nation [for transboundary projects such as pipelines].

Closure is an awesome business, but all the fun has been sucked right out of it, and we still have the same problem ... if someone (read landowner) doesn't like it, no matter how much $$$, science, and reporting has been thrown at a site, it's still not good enough. Do you think the 80/20 rule still applies or has that needle moved over time? I stand by the fact that we need simple reclamation criteria, informed by big data to eliminate duplication/redundancy that covers 80% of the sites and then we have the harder 20% of the stuff. Putting a site to bed should almost get us there, most of the time. Spend the money on real improvement instead of reports. Monitor with the magic of satellite imagery over time.

Going forward as someone who between being a Forest Officer and running a consulting business, I see one of the biggest problems being that the regulatory bodies are not holding the oil and gas companies accountable for closure. There's a lot of self-reporting.

3.4 Pace of Reclamation

It will be the same as the past 30 years! Getting companies to commit to cleaning up their liability. I mentioned the mandatory spend as a huge step forward, and it is. But this is still an issue since companies can spend their money on abandonment only and not do any environmental work and still meet the requirements. We need to either dictate a split on the

[10] Author's opinion: Never mind what is "equivalent".

spend (50/50 split between abandonment/environment) or introduce mandatory timelines for reclamation like BC British Columbia Energy Regulator (n.d.).

Right now, the AER is taking about “spending”, the COVID money was about “spending”... everything is about how much we spend instead of the ultimate reclamation outcome – reclamation certificates. I would like to see reporting shift back in that direction.

Reclamation is becoming increasingly costly and burdensome. It is increasingly difficult for operators to get a reclamation certificate (assessment criteria more onerous, reclamation certificate rejections are increasing). If it is too difficult to obtain, then even responsible companies will not fulfil their reclamation requirements or attempt to secure reclamation certificates. It always comes down to a business decision if it is more costly to do reclamation and get a certificate than what is posted for security it just won't happen (between you and me I can't tell you how many times I was asked if we could defer reclamation and not spend the money at this time, but then the same thing was happening the next year, and the next and the next). For an operator reclaiming a pit is not the most palatable thing as there is no revenue being generated from an operation at that point in its life cycle – it is viewed as sunk money by senior managers and accountants.

The most important challenge is to attain more mine reclamation certification to bolster company/regulator reputations, reduce company liability, reduce liability to the Alberta taxpayer and create a track record to returning lands back to a level of equivalent capability. This will take courage from all stakeholders.

I believe that one of the largest challenges over the next ten years will be the certification and return to the Crown of mined lands on the east slope of the Rocky Mountains. The difficulty for both the regulator and the mine owner is the assumption of liability. The mine owner is reluctant to allow public access on land it leases because of potential liability risks. The regulator does not want to assume the liability of managing this either (See Appendix 1.9 for more commentary.)

I think one of the biggest challenges will be getting reclamation certificates on mine lands. The industry has to work with both the regulators and the public to ensure that when the land is ready to be returned to the province, it has not only met all regulatory requirements but is also sustainable and on the right trajectory to be left in the hands of the public.

Reclamation of remote sites in northern Alberta – many remote wellsites and associated facilities, particularly padded sites, remain un-reclaimed due to limited economic and regulatory incentives for producers.

During my career at Alberta Environment, I worked with a variety of surface disturbances including gravel pits, pipelines, oil and gas well sites, water and sewer mains, electric power lines, coal and oil sand mines, in situ operations, borrow pits, quarries, and highway development. While activities other than mines might be of a relatively minor and local scale of

impact, collectively and province-wide, all these activities represent significant land disturbance and impact. So, from that perspective, the sum total of these surface disturbing operations over time represents a significant challenge over the next ten years and beyond.

Public expectations for faster reclamation (e.g., Indigenous co-management, ESG demands) are pushing industry to demonstrate verifiable progress.

New reclamation inventories.

3.5 Technology and Data

Use of digital tools and lack of people on the ground in the field. It seems in general we are moving away from wanting to either be in the field or have people in the field and want to use digital tools for as much as possible to save time and money. This will help streamline and create efficiencies, but we also need to ensure we are using new tools with open eyes and being aware of the risks.

How do we find new technologies to help us find more efficiencies so we can do more work? Data management at the producer and government level is very slowly improving. And where will artificial intelligence (AI) play a part? Additionally, how to we prevent garbage in garbage out information and relying too much on AI where we don't get full understanding on what is happening on sites and we're just pushing reports into the machine …[11]

I think it will be AI and not having to re-do every single site like a standalone science experiment. It should reduce costs, lab time, contractor inputs etc. OneStop in particular should be able to mine big data to give us good information.

> *Use of remote sensing in place of "on the ground" assessments – how do we verify and standardize the use of this technology? How to we gain public trust when using new technologies and proving that some technologies can provide equivalent, or sometimes better data than boots on the ground assessments? At what point is it acceptable to adapt and use such technologies in our evaluations and decisions?*

The combined impact of big data, AI and processing power on GIS tools. We are close to being able to input census level data (not survey level) through desktop applications connected to cloud computing technology at reasonable cost. Some of this data could even be near real time feeding into mapping and analytical tools or models. For the practitioner this means much more and careful attention needs to be spent on data collection, understanding the impacts and biases of data gathering protocols, limitation of methods (field plots, drones, infrared and other imagery,

[11] Author's Note: See Appendix 1.12 for an AI-generated summary of key reclamation events in Alberta and note the bias and errors in it as a cautionary tale.

LiDAR). The processing power and tools will make outputs (maps, analysis, models) easier to produce without any understanding of underlying ecology or other knowledge needed. Outputs will look and seem better but only those who understand the data will have a foothold on how they actually reflect reality.

I think of the massive data sets of oil sands mine reclamation that informs us of where we were but provides no direction for where we should go. It isn't that it is a waste, far from it, but we need to analyse it to predict the future rather than measure past performance. This requires a complete reconsideration of where we were, we are and where we are going. Revisiting our current data, our practices and confirm how they can be used into the future to ensure we are adaptive. Along with that is the commensurate change in policy and legislation to allow for that change. And to be humble in knowing that we don't really know the future and that simply saying we will make some broad adaptive factors is not likely to be workable.

I can only foresee what the impact of AI will be on the reclamation planning will be for the future. We have come a long way in integrating information and AI will continue to do this.

Advancement of digital- and AI-driven reclamation monitoring:

- Increasing reliance on remote sensing, AI-driven impact assessments, and machine learning for data synthesis.
- Regulatory bodies and consultants will need to keep pace with digital compliance tracking and real-time site monitoring (e.g., drone and LiDAR surveys).

Advancement and changes in technology – agriculture is ahead of the energy industry in this space. As industry catches up to agriculture, will industry accept and consider landowner's use of technology when evaluating reclamation outcomes (e.g., combine yields etc.)?

Technology integration in reclamation assessment – drones, satellite imagery.

I'd love to see more use/regulatory acceptance of remote sensing for assessing reclamation, rather than having to send people out on a site for hours to measure vegetation parameters.

The most significant reclamation challenge in Alberta over the next decade will be ensuring that rapid technological advancements do not distract from the fundamental work required to reclaim native plant communities at scale, particularly in the mineable oil sands. The mineable oil sands region represents one of the largest areas requiring reclamation in Alberta, making it a critical focus for improving reclamation practices. While digital tools and software for monitoring vegetation continue to improve, there is a growing risk that the industry will over-prioritize data collection and analysis at the expense of actually enhancing reclamation outcomes.

Don't let technology take over basic decisions. Putting the land in condition to succeed, listen and watch to what the land is telling you. At this point in time, the more grey hair the better to push to the next stage.

Amazing mapping. OMG – the days of ordering air photos and hoping you got the right ones compared to using your phone and apps like Landtracker, or the amazing software Abadata (that I literally cannot live without). I'm a spatial thinker so it has been wonderful to have this tech at

my fingertips. I used to think I was smart being able to find locations using my brain and a map ... now – you plunk in the LSD and pure magic is readily available.

Pressure to incorporate yield data into cultivated land criteria to give more assurance that crop yields are similar on and off site. This would give more assurance to landowners who are using combine yield data/mapping technology.

3.6 Environment and Ecology

Response to calls for increased biodiversity focus, nature positive or "net gain", disturbance offsetting through restoration, response to species shifts such as caribou decline. These are the external pressures, and they are generally aligned with real biophysical changes that we see evidence for.

I hear people saying we reclaim to biodiversity without clarification if it is at the landscape, species or genetic level and to what metrics used to assess biodiversity. Mostly it ends up being we used native species and over time we believe it will become more like what was there before. This is a very simplistic view of biodiversity (See Appendix 1.11 for commentary).

Better connecting reclamation criteria to forest resiliency (Pyper et al., 2013; Welham 2013). If we want to reclaim to some type of equivalent land capability, what we should also be ensuring (embedded in land capability) is ensuring these reclaimed forests are self-sustaining / resilient to future change.

- This is a challenging thing to measure and to be certain of in the face of our changing climate.
- There are certainly best practices that logic suggests would be good strategies (mixed-species planting for example, broadleaf and coniferous species to buffer for future disturbance in the short and long-term) but these are not truly proven strategies as all of this is happening in real-time.
- How can we embed what we believe are logical best practices into criteria – if we do not have sufficient data to push for "more" in our criteria then it can be difficult to rationalize incorporation.

Why do we spend so much attention on coniferous trees? We have total control over coniferous trees in terms of collecting local seed, growing it in greenhouses, where to plant, when to plan, how old to plant. And in lower elevations even in the Forest Management Areas, deciduous trees should be planted right along with the coniferous trees. The deciduous trees will grow faster, lay down litter and the coniferous trees will eventually replace them anyway. Establishing a shrub canopy under trees seems to be a low priority as well.

Likely more and more of a shift to ecological restoration in untamed lands.

We have too long focused on "native plants" in seed mixes to the point where native plants in seed mixes have become the end land use replacing all other considerations. We have become so conservative in thinking about reclamation that experimentation is not encouraged. I doubt if

approval would be given now to create bighorn sheep habitat where there previously had been none. This has been a major achievement in a continent where habitat loss for bighorn sheep has been the norm. Regulations have gotten so far out of reality that the Master Schedule of Standards and Conditions 10.15 Species At Risk, Grizzly Bear #1935 says "The disposition holder must not seed legumes". What nonsense.

The focus needs to shift from recording vegetation to actively restoring it. Currently, reclaimed sites in the mineable oil sands are dominated by a limited number of species, with shrub planting densities far below natural levels. The reliance on stockpiled soils further exacerbates this issue, as they tend to support aggressive colonizers that inhibit the establishment of diverse plant communities. Although initiatives like the Oil Sands Vegetation Cooperative have increased access to some understory species, efforts to incorporate a broader range of native plants on a larger scale remain limited. To truly advance reclamation, we need investment in large-scale planting methods, improved soil handling techniques, and innovative propagation strategies that go beyond the current handful of species. The challenge is not a lack of technology – it is ensuring that technology serves as a tool to increase planting densities and species diversity rather than a distraction from these priorities. If industry does not shift focus, we risk failing to meet long-term reclamation goals in one of Alberta's most significant reclamation landscapes.

In the next 10 years I would like to see more experimentation with new reclamation practices. The three pillars of reclamation in Alberta are landscape, soil, vegetation. Wildlife is viewed as an add on – it should be the fourth pillar.

Right now, "rough mounding" is applied everywhere whether it is needed or not followed by a "nurse crop" an agricultural concept that will stabilize soil, lay down a litter layer and allow "space" for trees to develop. Usually the "nurse crop" is some inedible non-flowering plant like annual wild rye. Good grief. If a nurse crop is really necessary at least use a plant that is edible by ungulates or has flowers to encourage the pollinators. Even yellow sweet clover was better even though things looked pretty yellow for a few years. Ungulates provide an alternate nutrient cycle to the detritus cycle, and they should be encouraged to use reclaimed areas as soon as possible.

Reclamation will change from pushing dirt around well sites with a dozer and decompacting subsoil to remote sensing, AI and other technological advancements. However, we must not lose our way in the fog of technology and remember most things humans eat are a product of the soil. So insuring soils and other key components of the ecosystem are conserved for future generations.

Over-regulation, based on my experience in Alberta. The overarching regulatory position of some policy makers (e.g., Alberta Government) to protect caribou, to limit land disturbance through SRPs, etc. will definitely have an impact on doing timely and effective reclamation. The

desire to plant trees and shrubs that will support caribou habitat at the expense of natural biodiversity and what was there before will change the landscape. This opportunity to play God by changing ecosystems to support one species over another will inevitably result in challenging reclamation practices and ethical considerations.

Changes in carbon offset policies and nature-based solutions (e.g., wetlands, forest reclamation) could shift economic drivers for industry

Reclaiming a pit or borrow pit to a wetland. The proposed [reclamation criteria] require extensive monitoring requirements making it an undesirable option around end pit lakes.

I believe that water management at the landscape and soil moisture levels will become critical. This will arise because of more extreme weather – droughts to floods. Optimizing water use will also help to enhance carbon sequestration.

Increased complexity with cumulative effects and the need to adjust reclamation practices as well as expectations for increased climate variability.

Noxious weed challenges.

3.7 Liabilities and Liability Management Programs

I think that the most important conservation and reclamation challenge over the next decade in Alberta will be to address the build-up of reclamation liabilities and rising costs to address them.

The reclamation backlog and liability in Alberta is truly staggering. While the political aspect of it is a tremendous barrier to getting on with things, I feel this is the one that requires and will require for a very long time a concerted and sustained effort. Why it is so difficult to make serious progress with this continues to amaze me, after sitting at the industry table and seeing the willingness to proceed. Yet it remains a very large problem that will not ever go away.

> *I fear our liability management system(s) might be tested to levels not previously thought possible, with the risk being more and more sites requiring remediation and reclamation using taxpayer dollars … some policy and regulatory updates may be required.*

Funding reclamation work as the number of viable licensees declines and the inventory of unreclaimed sites remains high. Tackling the liability issue should have been a key priority in the early 2000s.

Cumulative impact of disturbed areas and the associated liability. I really fear that as the resource becomes depleted more and more companies will walk away and there is not nearly enough $$$ set aside to reclaim/restore the areas they disturbed.

On a provincial scale the presence of orphan wells in Alberta will present a major challenge over the next decade. In 2022, the AER reported that there were about 170,000 abandoned wells in

the province while in 2021, the Alberta Liabilities Disclosure Project estimated that there were 300,000 un-reclaimed wells which included orphan wells. Orphans are defined as wells, facilities, pipelines and associated sites that do not have a financially viable and responsible owner.

The risk of abandoned sites in response to economic shocks, even with the assurances government has tried to put in place. The abandoned wellsites are an example of how hard this can be.

Reclamation liability for orphaned wells and long-term land-use monitoring remains a grey area, creating financial and legal uncertainty for operators.

Financial ability of companies to complete restoration/reclamation/rehabilitation.

Rising costs of land reclamation and liability management create pressure to remain profitable while meeting tightened stakeholder expectations.

Economy (potential for more orphan wells).

A reclamation issue that may be significant over the coming 10 years and has recently become front-of mind for me is the legacy of unreclaimed, pre-legislation coal mines[12]. For example, many people in the Crowsnest Pass feel that the only way to "clean up" the old Grassy Mountain mine site in the Crowsnest Pass, which was left unreclaimed 60 years ago, is for the current mine applicant to proceed with a full scale mine at that location and then eventually reclaim it properly.

For oil sands mines, the MFSP should apply to single mine sites, not multiple mine sites[13] (or forever expanding mine sites) owned by a single company, and some form of tailings deposit should be included to better incent progress on mature fine tailings reclamation.

I see redesign of the reclamation security regime governing oil sands as the most important reclamation challenge in Alberta in the next 10 years. The current regime presents significant risks for extensive orphaned liabilities. The need for redesign is presented well in Olszynski et al. (2023). The latest figures I have seen are $57.3 billion in closure liabilities with 2.9% of that amount held as security.

The greatest challenge for the next 10 years will be when older sites start or continue to fail. For example, when sumps that were buried on oil and gas sites start leaking. I am afraid what will happen if the clay lining (if it had one) eventually fails and the sump begins to leak. Someone told me that the life expectancy of a buried sump is 100 years, and we are beginning to reach the 100-year life span for the sumps that got buried.

[12] Author's Note: Coal mines abandoned before implementation of the *Surface Reclamation Act* on July 1, 1963 are exempted from the requirement to reclaim and get a reclamation certificate.

[13] Author's Note: MFSP does apply to single mines.

I think Alberta enforcement of pipeline reclamation/closure is worth mentioning here. There is just a lot of footprint out there that folks may not be fully aware of. It boggles the mind. Further, there are a lot of nuances regarding the processes needed to address this challenge.

I see reclamation of pipelines falling behind the current reclamation criteria.

3.8 Climate Change

Climate change is the most significant challenge. Our current reclamation thought process is not that everything is constant but that it is as it was 100 or more years ago. We restore native prairie to what evolved over thousands of years ago as if nothing has or will change into the future. We replant trees after we removed 100-year-old trees as if the same conditions exist today that they did when that tree was a seedling 100 years ago. And our monitoring is of what we did not what we are going to do. Yes, we do research but how well is it focused on the future issues or testing potential future scenarios.

Climate change – shifting climate and ecosystems will require adjustments to reclamation practices (permafrost changes, more arid lands (grassland areas moving and spreading), drought on cultivated lands including crop growth and economic land use pressures for food production, more severe weather may adjust timelines for reclamation, wildfires (pre- and post-reclamation), etc.).

Climate change – shifting vegetation zones, new invasive species, and extreme climate conditions will be a challenge.

> *I suspect many will choose what is affecting our lives everyday – climate change. Not only must reclamation strive to restore ecosystems for the immediate future but also try to anticipate extremes in weather, temperatures, precipitation, wind and sun exposure that will occur over the next several decades. Effects from climate change will affect landform and water drainage/storage design and resiliency, soil composition and maintenance, plant species selection, planting design, soil microfauna and more.*

Climate change is another concern – how will climate change impact reclamation success in the boreal?

The biggest challenge is likely to be balancing reclamation with climate resilience. Alberta's industries, particularly oil and gas, are facing pressure to accelerate reclamation efforts while also addressing the impacts of climate change on restored ecosystems. The need to design reclamation plans that withstand extreme weather events, shifting precipitation patterns, and increasing temperatures will require innovative solutions and collaboration between government, industry, Indigenous communities, and researchers.

Reclamation of remote sites in northern Alberta – Climate change is impacting winter conditions, reducing the availability of frozen ground access, which has traditionally been crucial for cost-effective reclamation in these areas.

It won't be climate change (you can quote me).

3.9 Indigenous Engagement and Reclamation for Traditional Uses

I foresee developing more and more First Nation Partnerships and hopefully real relationships with Nations that help improve communities and have everyone learn a bit of Indigenous Knowledge to help move reclamation sites forward.

Incorporation of Indigenous values into reclamation. There is a need to complete reclamation well, and in a timely manner to ensure disturbed landscapes are not left stranded for longer than necessary. Engagement of Indigenous communities is necessary, but it takes time. Sometimes it takes way too long and is way too challenging to accomplish. Further work is required on this, and work that began in CEMA related to engaging the communities should be brought back to the forefront (specific to northern Alberta). We need a better way to decrease the gap, because I believe that the gap between Indigenous values and "western" reclamation, at least in the oil sands, is not that far apart (but it serves some people well to continue to present it as a large gap).

How do we consider traditional end land use desires and needs when evaluating equivalent land capability? How do we consider industry reclamation obligations taking into consideration reconciliation? How will this be evaluated/measured, if at all?

From an Indigenous perspective the single most important challenge will be dealing with the over-development of Crown Lands in Alberta. I led a project where we mapped the uptake of land in Treaty 6 Territory from the late 1800s to current times. In this work we identified land use relating to: Alteration of land for agriculture; Municipal settlements (towns, villages); Roads and infrastructure; Forestry; Sand and gravel; Oil and gas; and Mining. We then applied a 50-metre buffer to each disturbance, this was done to acknowledge that indigenous land users tend to avoid areas in close proximity to industrial activity that may result in pollution, contamination and impacts to the health of culturally significant vegetation and wildlife. This work was completed using a digital video which showed the systematic uptake of land with each new sector. The two sectors contributing to loss of land the most are agriculture and oil and gas development. The map starts with lands relatively intact with small agricultural settlements and towns showing up, then the rail enters the scene and agricultural development spreads rapidly. In the 1950s with the onset of oil and gas discovery and production, the map turns almost completely red in the following decades. Using this data and mapping tool it has been determined that less than 5%, likely now 3%, of Crown Land remains intact in Treaty 6 Territory within Alberta. Some of this land is inaccessible due to restricted access and or terrain. Basically, there is nowhere left for Treaty 6 First Nations and Metis within the region to safely

practice rights in a healthy environment. The courts are likely to find in favour of Beaver Lake Cree Nation given the outcome of the Yahey case. How will this be managed on such as vast scale? Who will pay for it? What will motivate resource developers to pay for this as reclamation is purely cost in the eyes of corporations that value profit? This may result in strained relations between the resource development sector and Indigenous Peoples in Canada. We should start the conversation in preparation for this outcome however little action is being taken, projects continue to advance, oil and gas has ramped up in recent years and the duty to consult has failed Indigenous Peoples in Alberta thereby creating risk for Alberta and the private sector alike.

Cumulative effects on Treaty rights – two pending cases in Alberta (Beaver Lake Cree claim commenced in 2008 and trial delayed in 2024 and set to start in 2025 and the 2022 claim submitted by the Duncan's First Nation) after the Yahey (Blueberry River) decision in BC. The outcome of these will affect not only new project approval processes but likely reclamation approvals and ensuring First Nations are consulted on reclamation on Traditional Lands and may push for additional reclamation on historic disturbances that have not been delt with like seismic lines etc. and setting First Nations priorities of areas to be restored quicker (Powell (2023).

Capability to return land to support traditional [Indigenous] land use values.

3.10 Risk

Increased risk aversion from the regulator/government and increased pressure from industry to "do less" creates an interesting division and "kick the can down the road" type of scenario. Not sure this will come to a head within the next 10 years though.

Development of an adaptive policy and regulatory framework that enables, not encumbers, innovative approaches for assessing environmental outcomes related to the three R's (remediation, reclamation, and restoration).

As project timelines continue to grow, there is increased risk that changes in government could result in policy change and even in change in support for specific resource development initiatives. This increased risk has also proven to have a notable impact on resource development investment. The fewer resource development opportunities, the less opportunity to grow and test improved techniques in activities such as reclamation.

The rapid pace of technological changes will likely require policy makers and regulators to shift and increase their degree of risk-tolerance when considering new approaches/technologies for environmental and regulatory monitoring. This tends to be counter to the traditional risk-averse nature of these organizations due to their respective roles and need to engage with various stakeholders (industry/landowner/land manager) and Indigenous communities.

The lack of political will to enforce the environmental regulatory system that so many have worked hard to create. We are already seeing an "erosion" of environmental protection/conservation with the current governments (both in Alberta and in the US). In Alberta, the reversal of the decision not to allow coal mining in the eastern slopes is an example. The current government in the US is also likely to "walk back" current environmental protections and reduce action on climate change. It will be a huge challenge for the next generation of reclamation/restoration practitioners, who will have to "transcend reigning paradigms" and continue to find ways of mending our disturbed landscapes.

Recognition that the licensee is always on the hook and the consultants' exorbitant rates for "liability" are out of control. Do you know of one environmental company that has ever been held to account? I think they take themselves a little bit too seriously, they are not on the hook, the licensees are on the hook (forever).

3.11 Regulatory

A challenge that will likely continue to be of great influence in the future is the politicization of issues in the context of an increasing pace of change in human resources and policies. Federal-provincial tensions will continue to enter the reclamation discussion through the regulatory process overlap in natural resource mandates. The differences in regulatory processes are rife with opportunities for detractors to suggest faults. With links to other topics on the political agendas, relatively solvable issues can become a big deal.

There is no timeline on reclamation (there is a duty to reclaim, but that could take place in 100 years). Many operators are adapting a "let it sit there and things will grow and take care of themselves in time attitude". Like what has happened in the oil patch, I feel there will be an increasing number of "orphan pits" in the future where reclamation does not get completed – companies will just walk away from their responsibilities, in part because the true cost of reclamation does not match the true security provided (Smoky Coal Mine in Grande Cache comes to mind).

3.12 Land Uses

How do the desires of recreational end land users' factor into evaluating equivalent land capability? See Freehill (2025) for example.

I hope to see more of a focus on adjustments to land use changes and long-term use. I feel like the current structure can still be difficult to work through when sites have alternative end points.

Higher the land value the more scrutiny on quality of reclamation with respect to equivalent capability. This will spill over into public lands and requirements for reclamation.

3.13 Remediation

Truly addressing cumulative impacts and reducing our industrial footprint will be the single biggest challenge, because there is a general failure to understand what these impacts are costing us. Cumulative impacts persist in many instances of reclamation, and the impacts that remain

after the clean-up of spills is particularly concerning and alarming. Often falling back on, it is better to leave it alone as the “cure” will do more damage than the “disease”. This feels really broken. We continue to give amnesty in the name of resource development. I know there is a better way.

Another challenge will be the long-term remediation efforts that companies will have to undertake once coal mining is completed, such as selenium and acid mine drainage treatments. Monitoring and treatment for some of these contaminants can be long-term (100 years), and the companies need to have the public's trust that they are committed to doing what is best for the environment.

Tier 2 and Subsoil Salinity Tool (SST) updates require ongoing industry adaptation, but regulatory clarity is often slow to evolve.

3.14 Other

I think one of the major challenges will be continuing to work out how best to reclaim tailings ponds, be they associated with coal mining, gold mining, oil sands mining as we have been working on them for many years and still require more effort as to how best to handle them. I expect it will also apply to "critical minerals" mines as well.

Creating a sustainable local seed production industry and supporting policy and funding to supply genetically and latitudinally appropriate native seed at quantity for restoration of disturbances in native grasslands.

4 ADDITIONAL COMMENTS

4.1 Pre-1975 Context

4.1.1 *Early Organizations*

The establishment of Alberta Environment in 1971.

The early work on oil sands reclamation (AOSERP) also ranks up there because it demonstrated how complex reclamation challenges can be.

4.1.2 *Early Legislation*

Although pre-1975, development of the 1963 *Surface Reclamation Act* (SRA)[14] and 1973 *Land Surface Conservation and Reclamation Act* (LSCRA)[15] were the foundation for reclamation requirements.

The establishment of legislation that set the stage for reclamation in Alberta – the SRA in 1963 and the LSCRA in 1973.

The enactment of the LSCRA and Regs in 1973 changed the focus of land reclamation in Alberta from site "cleanup" to a mandate to return disturbed land to a per-disturbance condition. This was a "huge" mindset and game change, in my opinion.

I think the most important event in the last 50 years for Alberta was the LSCRA in 1973, now rolled into EPEA. This legislation has guided meaningful reclamation in Alberta since then.

The establishment of the LSCRA brought reclamation from a "nice to do", into an understanding that it is part of development.

If I'm right that the first "duty to reclaim" legislation for Alberta (my jurisdiction) was the SRA in 1963 then that's too old for the last 50 years.

I believe that the most important event in reclamation in Alberta was the 1973 LSCRA. It evolved until 1983 to include the selective conservation of topsoil and organic matter, as well as the authority to enforce topsoil salvage.

The single most important event in the last 50 years was the passing of the 1973 LSCRA which heralded the "modern" era of reclamation in Alberta. It resulted in many changes in policies and regulations that provided a focus for the research and reclamation practice to follow.

The single most important event to shape C&R in Alberta, was the passing of the LSCRA in 1973 and amended in 1983. Why? Because I think the LSCRA forced Albertans to have a conversation about soil and its role in our lives, that resulted in a shift in awareness about soil as the backbone of agriculture, as an essential resource and critical component of terrestrial ecosystems, that, in our lifetimes, is non-renewable. Awareness bred action: advocacy, research,

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[14] See Government of Alberta (1963) https://www.canlii.org/en/ab/laws/astat/sa-1963-c-64/latest/sa-1963-c-64.html

[15] See Government of Alberta (1973) https://www.canlii.org/en/ab/laws/astat/sa-1973-c-34/latest/sa-1973-c-34.html

and Regulations and standards. This legislation also happened to be the driver behind my being hired as a fresh university graduate in 1982, so there may be some bias.

4.1.3 *Regional Planning*

To begin, going back to 1975, one of the major turning points was the shift in political power that started in 1971 with Peter Lougheed as premier. This shift changed the role of government from caretaker for the public to active engagement of the public. One outcome was the regional land use planning and notably the foothills land management initiated with Kananaskis Country. This set the tone from bureaucratic decisions on land management to planned management with various zones. This evolved over years as the land management planning process struggled through many issues. The result has been a more comprehensive approach to land management including more rigourous planning and approval processes, more mitigation, more monitoring and more public engagement. Although decades in development, this shift is one of the most significant to change land management including reclamation. The current process of sub-regional planning in the boreal is the latest iteration, the third version over 50 years.

4.2 Longer-term Thinking

I suggest the challenge isn't really for the next 10 years give that reclamation programs are over many decades and 10 years is really just a moment in time. My suggestion is what are the challenges for the next century.

A case in point is the realization after the droughts of the 1930's that farming practices were not implemented by the 40's, 50's or even the 90's. Even today, although most have adopted much better farming practices, we have not fully embraced changes as described 90 years ago.

The challenge I see for the next century is to rethink our monitoring and management practices to adapt to change, increased development, higher expectations from the public, in policies and legislation and the effects of climate variations.

4.3 Application of Reclamation to Other Problems

Another important challenge, although not focussed on reclamation, will be minimizing carbon emissions from thawing Cryosols. Knowledge gained in reclamation will be most helpful in developing successful strategies for this purpose.

Regenerative farming techniques: more of our land base included and approved in regenerative farming practices and exporting regenerative farming to all areas across the globe to repair our soils and reverse climate change. Building up our soil's organic carbon not only changes what our soils produce to support more healthy food and more food, it also creates microclimate to increase moisture retention, reduces fertilizer and herbicide and pesticide use. It allows for many more animals, insects and microbes to successfully survive increasing biodiversity instead of monoculture deserts, bringing our exhausted soils to improved condition. It also removes most if not all manmade carbon into the soil for long term storage.

5 SUMMARY

Based on the most frequently mentioned themes, the Alberta answers to the two panel questions were:

Past Driver: Development, implementation and evolution of reclamation certification criteria, enabled by the *Environmental Protection and Enhancement Act* and associated *Conservation and Reclamation Regulation* in 1993. Codification of reclamation requirements removed subjectivity, improved transparency, allowed for training, and ultimately set the stage for the use of professional signoff and the ability to certify sites without an inquiry. While most responses focused on the wellsite criteria, some noted the lack of criteria for other disturbance types, especially oil sands mines.

Future Driver: Based on the sheer magnitude of the disturbed area and the challenges associated with reclaiming tailings ponds the oil sands are the big driver for the next 10 years. Additional challenges are development of water release criteria from oil sands mines and subsequent releases to the environment, and the uncertainty around the looming financial security requirements as mines age.

The next five Past Drivers were:

- Setting equivalent land capability as the objective of reclamation
- Development of legislation
- Establishment of soil salvage requirements
- Emphasis on ecological function
- Development of technology and tools

The next five Future Drivers were:

- Capacity and capability, including human resources, use of professionals, education and research, and communication and collaboration
- Regulatory capacity
- Policy adequacy
- Concerns about pace of reclamation
- Potential for use of technology and data

Readers may be interested in comparing the responses against previous documents describing the state-of-the-art at various time periods, including:

> Hocking, D. and W.R. MacDonald (Editors), 1974. Proceedings of a Workshop on Reclamation of Disturbed Lands in Alberta. March 27-28, 1974, Edmonton, Alberta. Northern Forest Research Centre Information Report NOR-X-116. 216 pp. https://www.cclmportal.ca/resource/proceedings-workshop-reclamation-disturbed-lands-alberta

Land Conservation and Reclamation Council, 1977. Guidelines for the Reclamation of Land in Alberta. 3 pp. plus appendices. https://www.cclmportal.ca/resource/guidelines-reclamation-land-alberta

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Oil Sands Research and Information Network, 2014. Survey of Oil Sands Environmental Management Research and Information Needs. Oil Sands Research and Information Network, University of Alberta, School of Energy and the Environment, Edmonton, Alberta. OSRIN Report No. TR-58. 67 pp. https://www.cclmportal.ca/resource/survey-oil-sands-environmental-management-research-and-information-needs

Oil Sands Research and Information Network, 2014. Oil Sands Rules, Tools and Capacity: Are we Ready for Upcoming Challenges? Oil Sands Research and Information Network, University of Alberta, School of Energy and the Environment, Edmonton, Alberta. OSRIN

Report No. TR-53. 120 pp. https://www.cclmportal.ca/resource/oil-sands-rules-tools-and-capacity-are-we-ready-upcoming-challenges

Bott, R., G. Chandler and P. McKenzie-Brown, 2016. Footprints: The Evolution of Land Conservation and Reclamation in Alberta. https://www.cclmportal.ca/resource/footprints-evolution-land-conservation-and-reclamation-alberta

Powter, C.B., 2024. Reclamation Workshop: Towards a Shared Foundation for Innovation and Evolution. Prepared by Enviro Q&A Services, Edmonton, Alberta, for Alberta Chapter/Canadian Land Reclamation Association. 116 pp. https://www.cclmportal.ca/resource/reclamation-workshop-towards-shared-foundation-innovation-and-evolution

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APPENDIX 1 Detailed Submissions

Some people provided detailed content to back up their submissions. A summary of the key point is provided in the body of the report, and the details are provided here.

Appendix 1.1 International Mining Perspective

I recently experienced a career highlight of working on a mine closure and reclamation project in Mongolia funded by Global Affairs Canada. Our firm was hired to provide a broad range of mine closure and reclamation expertise, including stakeholder engagement advisory services, technical closure and reclamation training for in-country consultants, and project management advisory services for the coordinating NGO, MERIT (Mongolia: Enhancing Resource Management through Institutional Transformation). The resulting mine closure plan was the first to be developed under the country's new mine closure regulations, by a state-owned mining company and in-country consultants, supported by Canadian advisors.

Mongolia is a developing democracy, striving to develop resources for export to improve quality of life for its citizens, and to increase national wealth. As such, the mining industry has undergone significant expansion. Along with this mining expansion have come the attendant issues – an immature regulatory regime with inadequate technical and enforcement capacity, unplanned land disturbance, groundwater quality and quantity issues affecting herders and local communities, inadequate consultation with local communities, and inadequate or non-existent closure planning.

Throughout working on this project, it became clear to me that the most important "event" in reclamation in developing countries in the last 50 years has been the rapid expansion of mines, and the concomitant environmental disturbance and impacts on local communities. The rapid expansion comes from international companies which may or may not be good stewards and neighbours, from in-country artisanal (small scale) miners which fly under the regulatory radar, or from state-owned enterprises whose governments are eager to participate in the mining economy. As such, significant areas of land and water have been impacted by mining activities, which will require reclamation and remediation, and local communities have experienced impacts to their economic livelihoods and health.

The most important reclamation challenge for developing mining jurisdictions in the next decade, as mining accelerates to feed the renewable energy transition, will be building in-country capacity to develop and execute fit-for-purpose mine closure and reclamation plans. This is multi-faceted: in-country scientists and engineers require training in modern mine closure and reclamation practices which they can adapt to the local context; governments require continuing support in developing appropriate regulations, technical know-how, and enforcement capacity to ensure mining companies operate responsibly and do not leave legacy liabilities; mining companies need help undertaking meaningful engagement and training programs for local communities. Each of these tasks are significant undertakings, requiring worldwide expertise and pilot projects.

International NGOs such as the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) are leveraging technical expertise from mature jurisdictions

(i.e., Canada) and studying the impacts of mining in developing countries to build mine closure and reclamation capacity within those developing countries. Such endeavours must continue.

Appendix 1.2 Free-to-Grow

The Free-to-Grow standard required the regeneration of a comparable ecosystem and the assurance that would be achieved, which had not been the requirement prior to that in Alberta. The expectations applied surpassed those of the old reclamation standards (pre-2010) and established specified objectives for site conditions regarding vegetation patterns and sustainability.

When the process to develop the 2010 Criteria was occurring in 2008-2009 SRD pushed very hard to utilize the same expectations in those as we had built in the Free-To-Grow standards. We almost matched except for not requiring a yield or utilization component in the 2010 Criteria which left the reclaimed sites on Crown ambiguous regarding future use.

Some forest companies include the industrial reclaimed and certified sites in their land base while others do not. It is not mandatory, but sites are reclaimed and can be put on a growth curve which is very comparable to adjacent lands.

This is an opinion of a practitioner who was directly involved in developing both the Free-to-Grow and the 2010 Reclamation Criteria and was very happy with the ultimate result.

Appendix 1.3 Adoption of Equivalent Land Capability Across Canada

To add to project success, many proponents require reclamation requirements to be evaluated and then mitigation integrated into a projects overall environmental design to ensure; project reclamation commitments are designed, identified and integrated into project installation, as well as to ensure a thorough cost estimate regarding overall project management, budgeting and completion of requirements.

Where consistent reclamation criteria do not exist, a project then is required to add significant costs, schedule and regulatory risk to its schedules. This is done where projects of similar size, disturbance or impacts were just 10 kilometres away or under a completely different regulatory agency's oversight, usually result in significantly different reclamation expectations due to lack of established criteria. Some expectations were significantly diverse and heavily influenced on past project risks and experience and negotiating abilities vs. science and project abilities or limitations, agency and technical personnel and agency representatives, project specific personnel negotiating abilities or proponents/agency familiarity of similar project requirements.

Alberta certification criteria provided all stakeholders in projects (proponents, regulatory agencies, public) with a clear understanding of the goals and targets right down to the detailed technical criteria. Biophysical data collection was influenced to include all detailed criteria to aid in designing the high-quality conservation and reclamation plans for projects. Post-construction environmental monitoring of dozens of yearly projects nation-wide also aided in a verification process thus assisting in perfecting general and specific construction conservation and reclamation handling techniques for site- and region-specific projects.

Appendix 1.4 Elaborating on Collaboration

The initial reclamation requirement often was just to have the area be “green”, that is, the reclaimed area just needed to have some type of grass growing on it, any grass. As the collective “we” learned more about soils and vegetation, regulations evolved to require more effort. With greater effort required by the regulations, those of us working in industry were able to have more leverage within our industry to have industry put more effort into reclamation of their disturbed lands. Of course, there were many disagreements and discussions among us, but we were able to sit around a table and have those discussions, as uncomfortable as they might have been at times ... and still have a coffee or a beer together afterwards. These regulations put our reclamation efforts at the leading edge of disturbed land reclamation technology, I think in the world but definitely in North America. I often gave presentations at American Society of Surface Mining and Reclamation (ASSMR, today's ASMR) conferences and my American colleagues could not believe what was all being done in Alberta in terms of reclamation regarding soil handling, replacement and revegetation. Of course, we have only continued to evolve with the requirements and today specify native species to use, for example, species that are adapted to the particular area. This approach has led to many studies and graduate degrees to improve reclamation/restoration results. Of course there were, and are, critics today who look at early efforts and claim things are not reclaimable based on those early efforts. However, there has been tremendous improvement in approaches to reclamation over the past 50 years and the beauty of research is that there is always more to do as we find out what we really don't know. Unfortunately, we were not, are not, as good at trumpeting to those outside our fields what good work was being done, to the politicians and upper management in government and industry.

I think a copy(ies) of the publication “Footprints” should be in waiting areas of our provincial and federal officials’ offices to advertise how long, and to what extent, Alberta has been doing leading edge work. Of course, there is still more to be done but the book gives a good overall perspective.

Appendix 1.5 Mimicking Natural Systems

One of my early favourite reclamation projects was Gail Harrison’s reclamation of a gravel pit in Banff National Park that we toured during one conference (I think CLRA). Instead of a flat area, they created a series of small rolling hills and hollows to create damp to wetland areas in the hollows and varied exposures and slopes on the hillocks. Then they spread newly excavated surface soil/forest duff and woody debris (I think salvaged from the recent highway expansion in the park) to foster regeneration of local species and communities, as well as soil biota. I remember the team she worked included a bulldozer operator who loved the idea and was able to create the “hard” landscape for the team, then expertly feathered out the topsoil/forest duff and woody debris through the site. I believe a number of the more recent oil sands projects now use this type of “natural” approach. I suspect you know many examples.

I also saw during my career so many good examples of stream and wetland restoration in Alberta, BC and in other jurisdictions including the US. I think Lorne Fitch was an early leader in southern Alberta in fencing to exclude cattle then using woody features and rock placement to

create shade and eddy pools, etc. Ron Wallace also led a team on the Oldman Dam doing similar (in the Crowsnest Pass). I know from work that Stantec did that stream restoration is now common – taking highly channelized or even culverted streams and creating sinuous channels with overhangs, rock and wood features, shade, and riparian communities. I also love to see our Canadian engineer, the beaver[16], being used to augment wetland and watercourse restoration.

I am sure there are many technical and much more sophisticated reclamation techniques and discoveries out there, but for me, the trend to naturalization was a game changer and it appeared to work well in many situations.

Appendix 1.6 *Sarbanes-Oxley Act* and Redwater Decision

Sarbanes-Oxley Act

The *Sarbanes-Oxley Act* (SOX) was signed into law by President George W. Bush on July 30, 2002. The law was a response to financial scandals at companies like Enron, Tyco International, and WorldCom, which shook investor confidence in corporate financial statements.

The SOX Act was intended to:

- Enhance corporate responsibility;
- Increase financial disclosures;
- Combat corporate and accounting fraud;
- Create the Public Company Accounting Oversight Board to oversee auditors;
- Increase criminal penalties for white-collar crimes and conspiracies; and
- Add failure to certify corporate financial reports as a criminal offense.

SOX has far-reaching implications for non-U.S. companies that issue securities in the United States or whose securities are traded on U.S. securities exchanges. Upon signing SOX into law, President Bush remarked that the Act provided for "the most far-reaching reforms of American business practices since the time of Franklin Delano Roosevelt". SOX's purpose is "to protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities laws, and for other purposes."

Briefly, SOX imposes new responsibilities and obligations upon CEOs and CFOs, audit committees and auditors, Boards of Directors, and attorneys with respect to their reporting requirements, via internal and external controls.

> Internal controls provided in SOX include new disclosure and certification requirements for CEOs and CFOs with attached civil and criminal liability; restrictions on officer and director transactions and disgorgement of bonuses and profits where financial restatements are issued; whistle-blower protections; black-out periods on insider trading intended to protect

[16] For additional information on beavers and reclamation see Eaton et al. (2013).

employees stock option values and pensions invested in 401Ks; and rules applicable to in-house attorneys.

External controls provided in SOX included the establishment of a new regulatory body, the Public Company Accounting Oversight Board (PCAOB) to oversee accounting firms; auditor and audit committee reporting requirements to PCAOB; and rules for external attorneys providing legal advice.

Canada enacted complimentary legislation in 2003. Many Canadian companies that were publicly traded – or who strove to achieve a higher level of public disclosure – adopted the SOX disclosure requirements and practices.

By the mid 2000's many of the major resource development companies in Alberta were complying with the increased disclosure requirements. In particular, it was the first time that a material number was put on the environmental liabilities associated with their operations in the Province, and these were numbers that had the weight of a publicly disclosed number signed off by the highest financial authority within the company.

The 2016 Redwater Decision.

The Redwater decision was a 2019 Supreme Court of Canada[17] ruling that addressed the environmental obligations of an insolvent oil and gas company:

The Case

- The case involved Redwater Energy Corporation, an Alberta oil and gas company that went bankrupt in 2015. The company left behind liabilities, including:
  - 17 producing wells;
  - Money owed to creditors; and
  - The cost of environmental cleanup.

The Ruling

The Supreme Court ruled that the trustee for the company could not walk away from the cleanup costs. The court held that:

- The Alberta Energy Regulator (AER) was not a creditor;
- The AER was exercising a public duty for the benefit of citizens;
- The AER's abandonment orders were not provable claims; and
- There was no conflict between the *Bankruptcy and Insolvency Act* (BIA) and Alberta's environmental legislation.

The Implications

[17] See https://decisions.scc-csc.ca/scc-csc/scc-csc/en/item/17474/index.do

The ruling has implications for the cleanup of oil and gas wells across Canada. It also:

- Represented a policy shift in favor of environmental obligation;
- Underscored the importance of regulators as interested stakeholders in the insolvency process; and
- Exposed a massive liability iceberg in the province's conventional oil and gas sector.

Appendix 1.7 Department Changes

I had opportunity to work before and after the changes and found the before much more creative and fun to come up with reclamation solutions based on science and a cooperative approach to testing solutions in Alberta. I remember testing ideas with Land reclamation Division staff and folks at the University of Alberta among others over very productive and creative lunches during this time. Many of the ideas we were able to implement and show off via RRTAC among others. If we hadn't had these opportunities, there would be no reclamation program at the University of Alberta.

After the department changes, reclamation interactions diminished and there were less qualified professionals in regulatory rolls, and less qualified professionals in the industry hence the perceived need for idiot proof regulations some of which drove me crazy and made my job looking for creative reclamation solutions much more difficult.

For example, I would propose a reclamation solution for a client suited to his site conditions only to have the client reject it as it contradicted the regulation. The regulatory rigidity precluded creativity and often discouraged professionalism.

Appendix 1.8 Oil Sands Historical Reclamation Practices

Back in the mid 70's were the early days of reclamation in northern Alberta's oil sands development. Erosion control was the focus. Quick establishment of aggressive agronomic grasses and legumes were the order of the day. However, this dense cover of grasses and legume, made the successful establishment of tree and shrub species challenging be it from vegetation competition, or rodent girdling. It soon became apparent the main soil amendment, muskeg, contained many viable plant propagates that quickly would provide a native cover of trees, shrubs herbs etc and provide the erosion control.

The next challenge was how to reclaim fine tails, the mixture of clays, silts that were discarded during the bitumen extraction process. These were very challenging times as the fines also contained trace amounts of chemically toxic materials naturally found in bitumen and from chemicals used in the extraction process. I left the oil sands as this was getting started but it is my understanding, great strides have been made in reclaiming fine tails. The slurry of fine tails of the 1970's have also changed resulting in significantly lower water content sometime referred to as paste.

Appendix 1.9 Coal Certification

Due to the operation and subsequent closure of several coal mines, thousands of hectares of previously publicly accessible land are now inaccessible. The requirements of certification, allowing the land to return to the crown, are clearly presented in the applicable *Environmental Protection and Enhancement Act* approvals and are generally an agreement between the regulator and the mine owner. The path towards certification should be clear.

Public stakeholders pressure both the regulators and the mine owner to regain access to the land for a number of recreational activities. A large amount of the land is no longer required for resource extraction, it has been fully reclaimed but the vegetation may or may not meet the reclamation criteria, in part, because the vegetation, especially trees, require more growth. Other areas were never mined because of a premature mine closure but may have been logged and then reforested as part of the mine reclamation. Many of these areas meet the applicable reforestation criteria and could return to the Crown.

In most cases the land is stable, and erosion has been mitigated and some of the land meets the reclamation criteria, some does not. The topography does present risks, but similar risks were present prior to mining. This land should be accessible to Albertans without undue risk to the province or the mine operator.

Appendix 1.10 Climate Change

Increasing temperatures are not the only worry; if the Atlantic Meridional Overturning Circulation (AMOC), which drives the Gulf Stream, fails (as predicted in 25 to 40 years), parts of the eastern coastal US and Canada and much of Europe will be dealing with average temperatures that are 10 C lower than present with associated effects on precipitation.

I again believe that mimicking responses of natural communities to climate change will provide one of the better solutions and perhaps a pathway for reclamation planning. But perhaps climate change may shift our ideas on end uses. While I tend to think about reclamation as restoring natural self-sustaining communities, shifts in human populations and agriculture due to climate change may demand that we chose human-centric needs for reclamation too (e.g., agriculture, housing).

Appendix 1.11 Biodiversity

In addition, I thought about some more historical context and the introduction of the term biodiversity is relatively new, only 30 years since it was in mainstream. The 1992 publication of the book Diversity of Life by E.O. Wilson, was instrumental in getting the concept and terminology in common use. This despite the work of Darwin's 1859 publication "On the Origin of Species" which is the foundational piece on the understanding of biodiversity. Since 1992 the word, biodiversity, occurs more and more often, but, it is not really understood or dealt with in its true definition of the variations of scale of biodiversity. The inclusion of the concept of biodiversity is a key event in that it became a buzz word with little to no meaning.

Appendix 1.12 Chronological Overview of Environmental Restoration Efforts: Sourced from an internet search with AI

Thanks to Tony Schori for producing this.[18]

Introduction

Alberta, Canada, with its rich deposits of minerals and fossil fuels, has been a major player in the mining industry. Over the past five decades, significant efforts have been made to reclaim and restore mined lands to their natural state, ensuring environmental sustainability and community well-being. This document outlines key reclamation events that have shaped the landscape of Alberta.

1970s: The Beginning of Environmental Awareness

In the 1970s, the environmental movement gained momentum, leading to increased awareness of the impacts of mining. Alberta introduced the Land Surface Conservation and Reclamation Act in 1973, marking the province's commitment to environmental protection. This legislation required mining companies to develop reclamation plans before commencing operations, setting the stage for future reclamation efforts.

1980s: Establishment of Reclamation Standards

During the 1980s, Alberta developed more stringent reclamation standards to ensure the effective restoration of mined lands. The *Alberta Environmental Protection and Enhancement Act* (AEPEA) was enacted in 1983, providing a comprehensive framework for environmental management and reclamation. This Act mandated that mining companies must reclaim disturbed lands to a state that is equivalent to or better than its original condition.

1990s: Advances in Reclamation Technology

The 1990s saw significant advances in reclamation technology and practices. The Alberta Research Council (ARC) played a crucial role in developing innovative techniques for land restoration. One notable project was the Syncrude Canada Ltd. reclamation initiative, which focused on reclaiming oil sands tailings ponds. This project involved extensive research and experimentation, leading to the successful establishment of vegetation and wildlife habitats on reclaimed lands.

2000s: Collaborative Approaches to Reclamation

In the 2000s, collaborative approaches to reclamation became more prominent. The Cumulative Environmental Management Association (CEMA) was formed in 2000, bringing together industry, government, and Indigenous communities to address cumulative environmental impacts and develop sustainable reclamation practices. CEMA's work has resulted in numerous

[18] Author's Notes: Missing *Surface Reclamation Act* in 1963, wrong date and name for EPEA, wrong description of Equivalent Land Capability, and significant bias to oil sands.

guidelines and best practices for mine reclamation, ensuring that all stakeholders are involved in the reclamation process.

2008: The Oil Sands Reclamation Dialogue

In 2008, the Oil Sands Reclamation Dialogue was initiated to promote transparency and accountability in the reclamation of oil sands mines. This dialogue involved stakeholders from various sectors, including industry, government, academics, and environmental organizations. It focused on sharing knowledge, identifying challenges, and developing solutions to enhance reclamation efforts in the oil sands region.

2010s: Reclamation Success Stories

The 2010s were marked by several successful reclamation projects, showcasing Alberta's commitment to restoring mined lands. The Suncor Energy Millennium Mine reclamation project, completed in 2010, was one of the largest reclamation efforts in the province. This project involved the re-establishment of wetlands, forests, and wildlife habitats, demonstrating the potential for large-scale reclamation success.

2015: Fort Hills Oil Sands Project

The Fort Hills Oil Sands Project, led by Teck Resources Limited, Suncor Energy Inc., and Total E&P Canada Ltd., commenced reclamation activities in 2015. This project emphasized the importance of early reclamation planning and progressive reclamation techniques. The companies involved have committed to restoring the land to a self-sustaining boreal forest ecosystem, ensuring long-term environmental sustainability.

2020s: Embracing Innovation and Indigenous Knowledge

The 2020s have seen a greater emphasis on embracing innovation and incorporating Indigenous knowledge into reclamation practices. The Alberta Indigenous Wisdom Advisory Panel, established in 2020,[19] provides guidance on integrating traditional ecological knowledge into reclamation projects. This collaborative approach ensures that reclamation efforts respect Indigenous cultural values and contribute to the preservation of traditional lands.

2022: The Alberta Reclamation Hub

In 2022, the Alberta Reclamation Hub was launched to promote research, innovation, and knowledge-sharing in mine reclamation. This hub serves as a central platform for stakeholders to collaborate, access resources, and share best practices. It aims to drive continuous improvement in reclamation techniques and outcomes, ensuring that Alberta remains a leader in environmental restoration.

[19] See https://www.alberta.ca/AGS-directory/MR_1014_2017-05-31_MRD_IndigenousWisdomAdvisoryPanel_toPost.pdf and note date difference.

Conclusion

Over the past 50 years, Alberta has made significant strides in mine reclamation, driven by a commitment to environmental sustainability and community well-being. From the early legislative efforts in the 1970s to the innovative projects of the 2020s, the province has demonstrated a strong dedication to restoring mined lands to their natural state. By embracing collaboration, innovation, and Indigenous knowledge, Alberta continues to set the standard for successful mine reclamation, ensuring a sustainable future for generations to come.