

LANDFORM
DESIGN
INSTITUTE

Fall 2023

Landform Design Quarterly

Institute expanding lectures and courses

By David Wylynko

As it approaches its fifth year of operation, the Landform Design Institute is focusing on responding to the demand for more lectures and courses on landform design. Interest in these educational opportunities is on the rise, as indicated by the popularity of the two short courses the Institute presented in Alberta, Canada (2019 in Edmonton and 2022 in Calgary).

Given that popularity, the Institute will soon start making archived copies of its quarterly “Lunch and Learn” lectures available to all landform design practitioners (see “Food for Thought” on page 4 and “Spotlight: Lunch-and-Learn preview” on page 5). And due to the success of the lectures, a new series is being planned for individual and student members, who will soon have exclusive access to presentations tailored to their interests. Several “Tools of Landform Design” talks are now being prepared and will be available through the members’ site at landformdesign.net. LDI members can watch for more details in their email inbox.

Gord McKenna, LDI founder and chair, has noted the importance of education to



LDI Technical Advisory Panel member Jerry Vandenberg at a 2022 short course

ensure practitioners enter the field as well equipped as possible.

Course development will be a focus of the LDI Board of Directors’ first-ever in-person meeting, which will occur November 23–24 in Edmonton, Alberta. Board members Gord McKenna, Lois Boxill, Christine Daly, Anne Naeth, and Mike O’Kane will meet to discuss all the LDI’s plans for the future. Administrator Jasmine Winter will produce an agenda and coordinate the retreat.

Over the past year, the Institute has routinely engaged in discussions with academic institutions in Canada and abroad with a view to jointly producing coursework. Those interactions are already

producing collaborative endeavours (see “New online course on mine closure unveiled” on page 3).

But the Institute is also considering a homegrown independent introductory course to landform design to be launched in 2024.

Landform design practitioners interested in attending such a virtual course are encouraged to email the institute at admin@landformdesign.com.

David Wylynko (davidw@westhawk.com) is the director of communications for the LDI and principal of the writing, editing, and graphic and web design firm West Hawk Associates (westhawk.com).

Making landform design routine worldwide

The Landform Design Institute is dedicated to creating and supporting a community of landform design practitioners. Its intention is to help their teams design and build truly sustainable mining landscapes. Its mission is to make landform design routine in the mining industry worldwide by 2030.

Institute expanding corporate membership

The LDI continues to attract corporate members and, on the strength of those who joined in the first few years, is building a strong global network among the landform design practitioners associated with these companies.

The earliest companies to join included BHP, the JDS Group of Companies, Klohn Crippen Berger, Knight Piésold, Swanson Environmental Strategies, and Teck Resources. McKenna Geotechnical and Okane Consultants were the two original corporate members.

More recent additions include BGC Engineering, MERIT, and Northback. Established in 1990, BGC Engineering is an international consulting firm that provides professional services in applied

earth sciences. MERIT is a program operating in Mongolia that helps public institutions implement responsible natural resource management.

Northback is focused on the development of the Grassy Mountain steelmaking coal project in Canada, and has offices in Calgary and the Crowsnest Pass, Alberta.

In the spring of 2023, the 12th member to join was Canada's Oil Sands Innovation Alliance (COSIA), a group of operators in Alberta's oil sands that works with scientists and academics to reduce the industry's environmental impacts.

COSIA was founded in 2012 by the largest companies then working in the oil sands of northern Alberta with a mission

of "responsible and sustainable growth of Canada's Oil Sands while delivering accelerated improvement in environmental performance through collaborative action and innovation."

Members of the alliance currently include Canadian Natural Resources, Cenovus Energy, Conoco Phillips, Imperial Oil, Suncor Energy, and Syncrude Canada, which collectively employ tens of thousands of employees.

The LDI's 12 corporate members, and those yet to join, will make a dramatic contribution to the evolution of effective landform design, and to supporting the Institute's mandate of making landform design routine in the industry worldwide by 2030.



New online course on mine closure unveiled

LDI Board Member Mike O'Kane is one of seven mine-closure experts who will be sharing their insights this fall as part of a new online course offered by the Australasian Institute of Mining and Metallurgy (AusIMM).

The Professional Certificate in Integrated Mine Closure is an eight-week, 40-hour program created to expose participants to cutting-edge technologies for managing risks and delivering effective community standards. The course is aimed at mid-level managers (coordinators and superintendents) as well as specialists and other mine-closure practitioners.

According to lead course facilitator Carl Grant, the program is designed to give mid-level managers, specialists, and other mine-closure practitioners a clear idea "about what their role is and how they can contribute to integrated mining closure through risk, opportunity, gap analysis, and associated maturity assessments." Key topics include:

» Environmental stewardship: a comprehensive approach that prioritizes the protection and restoration of the environment,



Mike O'Kane

focusing on responsible mineral residue management, land rehabilitation, and achieving post-mining land uses that leave a positive legacy for communities.

» Social responsibility: strategies to forge strong partnerships with local communities to ensure their voices are heard and their wellbeing is safeguarded during and after closure.

» Collaboration and expertise: how to collaborate with industry experts, research institutions, and government bodies to ensure compliance and further develop leading practices.

In addition to O'Kane and Grant, the course lectures will be delivered by Ana Maria Esteves, co-author of the International Association for Impact Assessment's Guidance for Social Impact Assessment; Kim Ferguson, an expert in the environmental, social and closure aspects of resources projects; Cherie McCullough, an international expert on pit lake sustainability; Jonathan Sanders, who has over 16 years of consulting and owner's experience in mining; and Renee Young, director of conservation and restoration at the Western Australian Biodiversity Science Institute.

The course, which will be delivered 100% online, begins Oct. 9, 2023. More information and registration details are available at ausimm.com/courses.

Choose your tailings tech wisely

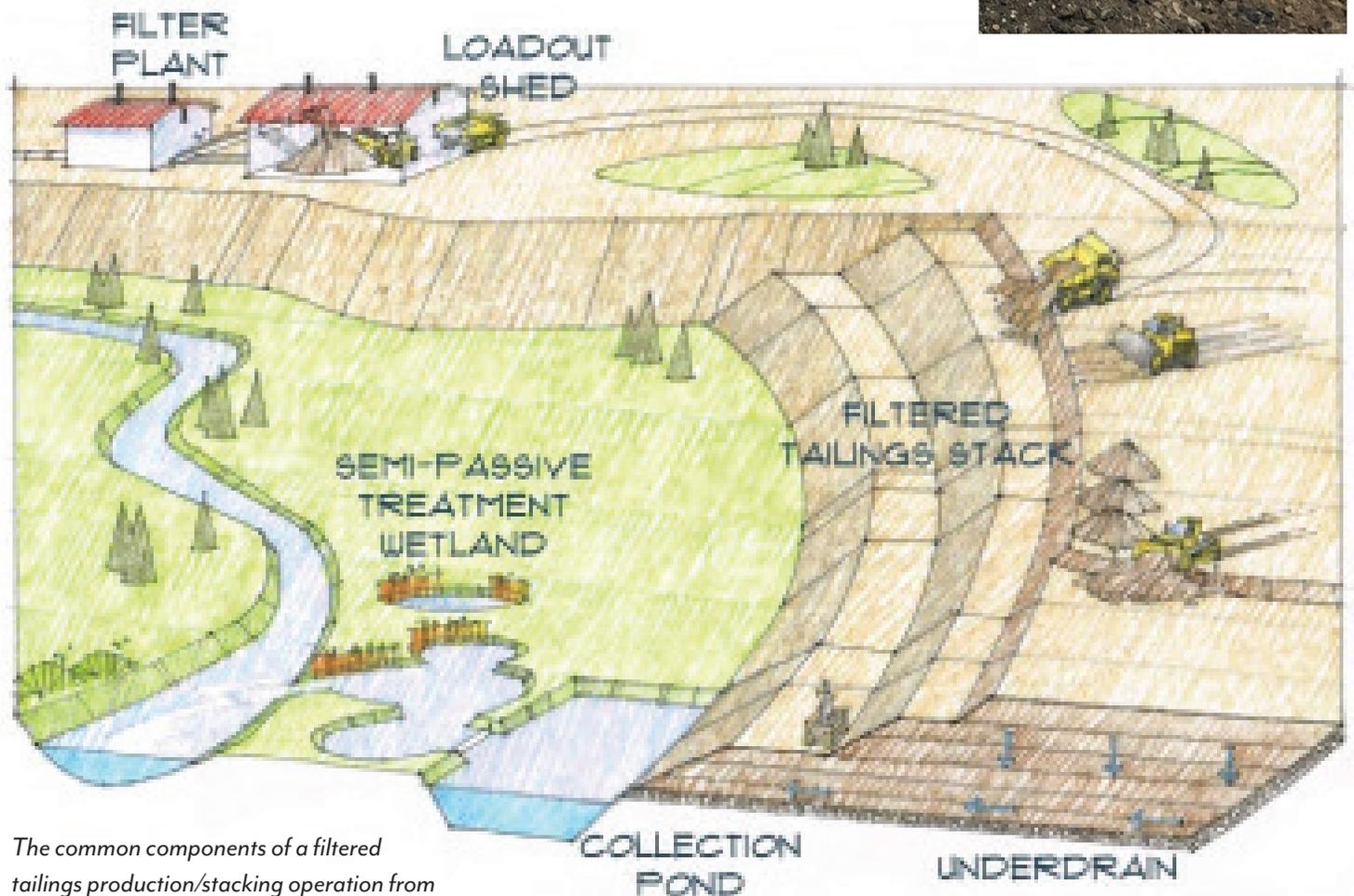
Twenty-nine engineers and other reclamation practitioners from around the world took advantage of a special one-day course on the role of landform design in the management of mine tailings this past spring at the 25th International Conference on Paste, Thickened and Filtered Tailings.

The course, presented by LDI Founder Gord McKenna, was offered at the Fairmont Banff Springs Hotel, in Banff, Alberta, Canada, on the first day of the conference. Participants received an introduction to landform design as it applies to tailings landforms and mining landscapes, and an overview of practical methods and examples of landform designs.

Because landform design is a multidisciplinary process, the course material, while tailored for an educated audience, was accessible to experts from a wide range of fields, including hydrology, geochemistry, process engineering, mine management, and the life sciences.

“Part of the reason for why landform design is attracting so much attention these days is that more and more mines are using filtered tailings stacks instead of hydraulic slurry deposition,” said McKenna. “Filtered tailings make sense because they are safer, and easier to manage — in theory. But real-world experience has shown that proper landform design and the choice of tailings technology are intimately connected, and that’s what this course was all about.”

The International Conference on Paste, Thickened and Filtered Tailings has been held annually since 1999 and is sponsored by the Australian Centre for Geomechanics at the University of Western Australia and the Commonwealth Scientific and Industrial Research Organisation.



The common components of a filtered tailings production/stacking operation from an introduction to landform design presented by Gord McKenna at the 25th International Conference on Paste, Thickened and Filtered Tailings.

FOOD FOR THOUGHT: Online lecture series drawing a crowd

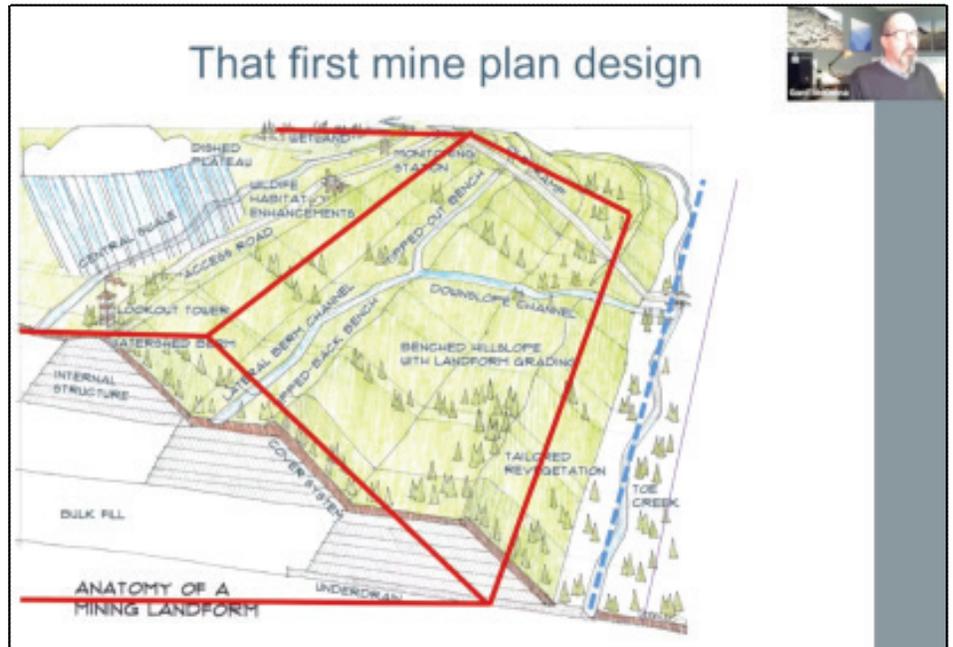
A quarterly series of “Lunch and Learn” lectures hosted by LDI Founder Gord McKenna is proving there’s still an appetite for online gatherings, even without the threat of a global pandemic.

The lectures, each of which explores a different topic in mine reclamation and landform design and are available to corporate members of the LDI, attracted about 40 participants when the series debuted in 2022, but this year attendance is now regularly above 70.

Among the topics covered so far: Safe Closure for Tailings Facilities, How to Develop a Design Basis Memorandum, the Technology Readiness Level tool, Designing Landform Slopes, and Aesthetics for Landform Design.

Each lecture is followed by a question-and-answer session and McKenna does his best to wrap up within the hour.

Future lectures in the preparation stage include Designing landform plateaus, Implementing landform design at your mine, Designing for surface water and groundwater interactions, and Soft tailings.



Gord McKenna explored the anatomy of mining landforms in the fourth Lunch and Learn lecture earlier this year.

The first in the series, Safe closure for tailings facilities, will be posted online for public viewing later this year, with subsequent lectures appearing at regular intervals on the web through landformdesign.com.

DBM guidance document scheduled for release this fall

The LDI will soon release its hallmark publication, a Design Basis Memorandum (DBM) guidance document, for use by landform design practitioners worldwide. Preparation of the DBM was initiated at the landform design short course held in Calgary in November of 2022.

Since then, a dedicated team of private-sector landform design practitioners has been working to craft the new document, which the Institute hopes will become a global standard for DBMs. The document is currently in

revision and will be reviewed and revised by the editorial team, independent reviewers, and the LDI Board and Technical Advisory Panel this fall.



The document will include a review of the literature and historical context involving DBMs as part of mining landform design, a section on preparing to write a DBM, another on the contents, and a summary. The Institute will reach out to notify all LDI corporate, individual, and student members, as well as practitioners worldwide, when the new guide is ready for distribution, and a launch date and venue will be set soon to announce the document’s release.

Lunch-and-Learn preview

The continuing “Lunch and Learn” series for corporate members resumes in November of 2023. That lecture will focus on designing landform plateaus. In February of 2024, we will look at the rarely discussed topic of landform evolution. In May, we focus on implementing landform design at individual mines. In the summer of 2024, the lecture topic will be designing for landform surface water and groundwater interactions. The fall 2024 lecture will be landform design for soft tailings. Below is a preview of the February 2024 lecture.

By Gord McKenna

It might seem like a contradiction to assign a finite design life to a mining landform that will be a permanent feature of the landscape. The design life relates to how long a landform will perform as intended (with monitoring and maintenance) before it needs (costly) rehabilitation. Some jurisdictions require a design that will last forever (“in perpetuity”), while others require consideration of hundreds or thousands of years.

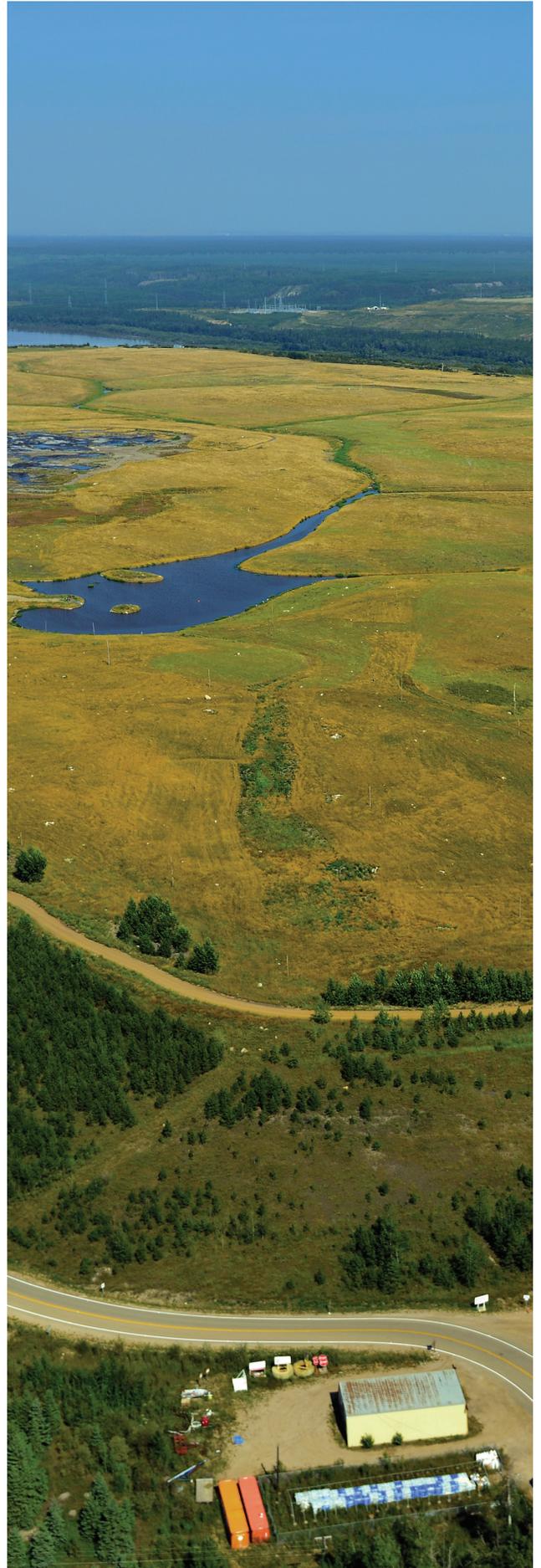
Given this uncertainty, the design life is typically undeclared. For comparison, municipal landfills may have a post-closure design life of between 10 and 200 years, while concrete dams have a design life of 100 years, elements of such dams 20 to 60 years and other civil structures 30 to 100 years.

All of us, but engineers, geologists, and ecologists in particular, recognize that all landforms evolve under the influence of external and internal forces. Accordingly, in the 1980s, the US Mill Tailings Remedial Action Program recognized that it was impractical, and perhaps unprofessional, to offer an infinite design life. Instead, they advised that “Control shall be designed to ... be effective for up to 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years.”

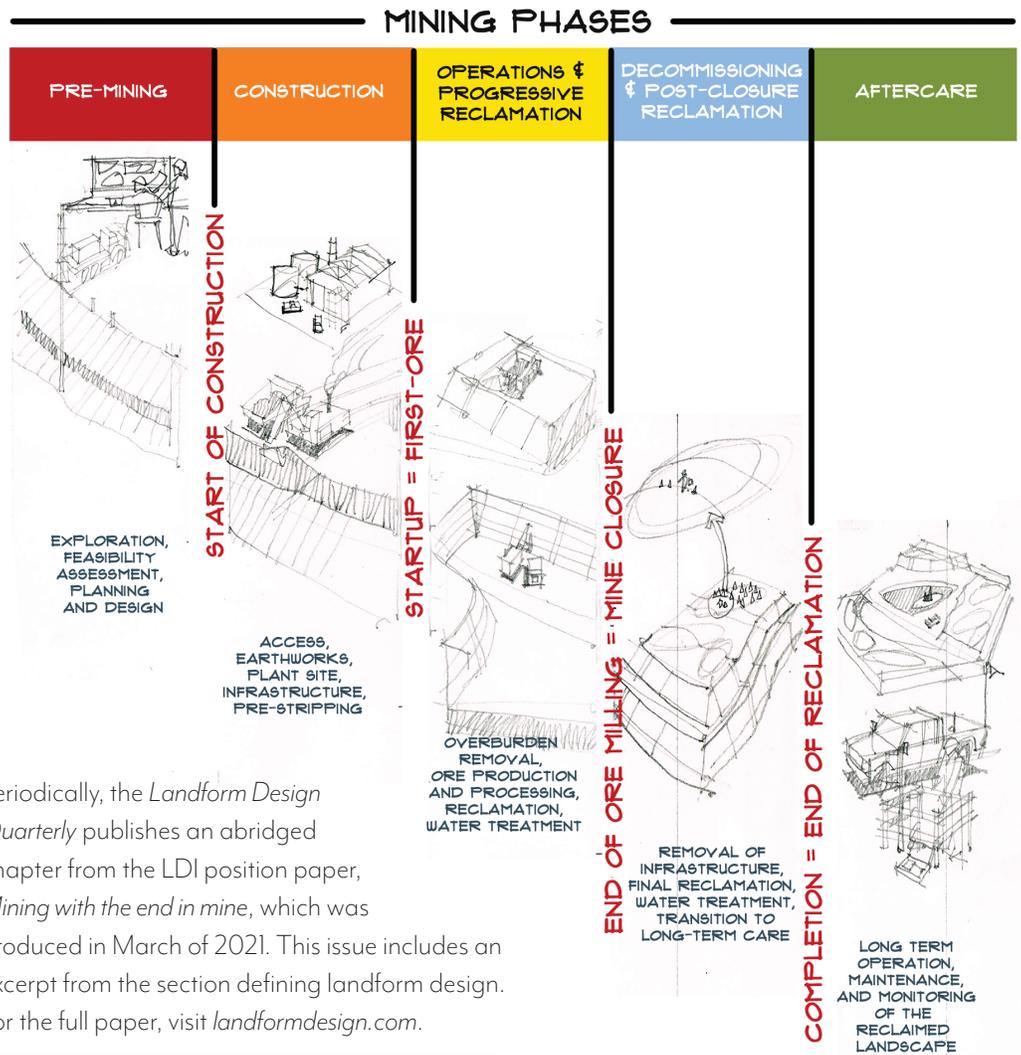
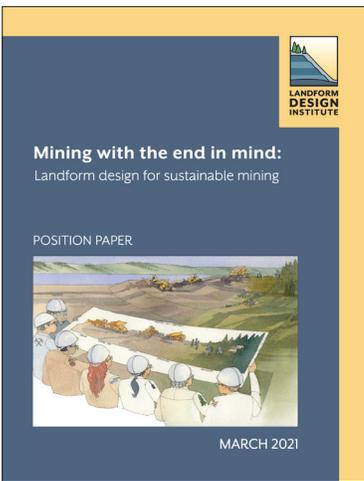
Since 2005, an international consensus has begun to emerge on a 1,000-year time horizon for tailings landforms. This forecast is intended to balance the lack of precedence in civil engineering, up-front costs, impact on land use, and need to respect government budgets and communities.

Recently the LDI conducted a literature review on mining landform design life and it is now drafting a how-to document for practitioners, regulators, and local communities. Building on this work, the “Lunch and Learn” series will provide an overview of the literature, a draft definition of design life, how to select a value, and how to use it in design.

Gord McKenna is the founder and chair of the Landform Design Institute. Contact him with your questions or interest in learning more at gord@landformdesign.com. For more information on joining the 12 current corporate members in supporting the Institute’s work, contact Administrator Jasmine Winter at admin@landformdesign.com.



Back to basics: Defining landform design



Periodically, the *Landform Design Quarterly* publishes an abridged chapter from the LDI position paper, *Mining with the end in mind*, which was produced in March of 2021. This issue includes an excerpt from the section defining landform design. For the full paper, visit landformdesign.com.

Landform design is the integrated, multidisciplinary design and construction of mining landforms and landscapes, directed by a dedicated team working with different mine operations groups and others over the life of the mine and beyond.

The focus is on achieving successful reclamation — reclamation that will steadily fulfill the specific vision, goals, and objectives of the mining company, the regulator, and Indigenous and local communities.

It achieves signoff on completion, confirming that all mining operations and reclamation for a landform or landscape have been satisfactorily completed, and that the residual risks are acceptable to all parties.

Landform design allows all parties to work together to manage costs and risks, minimize liability, and produce progressively reclaimed landscapes with confidence and

with pride.

The design of a landform starts before mining begins (or as soon as practical for mines already in production), and continues throughout each period: development, operations and progressive reclamation, final reclamation, and aftercare.

In essence, landform design is about integration:

- » **Integration across spatial scales** – the mining region, the landscape (mine site), the landform, the element, and the microsite
- » **Integration across disciplines** – mine planning, geotechnical, surface water, groundwater, geochemistry, soils, vegetation, wildlife, traditional knowledge, and others
- » **Integration across time scales** – pre-mining, construction, operations and progressive reclamation, decommissioning

and post-closure reclamation, and long-term aftercare

- » **Integration across communities** – mining industry, practitioners, regulators, and Indigenous and local communities
- » **Integration within the mine** – management, project design, engineering, technical consultants, reclamation operations, and maintenance operations
- » **Integration across the financial system** – mines and mining companies, and local, state, and federal governments.

Myriad publications offer various accounts of the “mining cycle.” Most describe mining as a linear process of discrete phases, including exploration, development, operations, and reclamation. The process can last several decades. Many assume reclamation occurs only after mine operations have ceased. In reality, all these

continued on page 5

Back to basics, continued from page 4

activities are generally concurrent during every phase of mining.

The Institute has embraced a modification of the oft-used mining-cycle timeline, employing a more useful system of five phases and four milestones, as shown in the “mining phases” figure.

While it is meant to apply to the whole lease, it can be adapted to individual landforms (or groups of adjacent landforms). Each of the milestones is akin to a project management gate.

Each involves obtaining approval (or signoff) from mine management, the regulator, and Indigenous and local communities.

In recent years, mine closure has evolved from an identifiable singular event into either the indeterminately long period after mining operations or a phase that includes all reclamation activities, such as those featured in the production of a mine closure plan.

This reclamation-based “closure” framework has led some to erroneously assume that no activities related to reclamation need to be considered or implemented until the final years of mine operations.

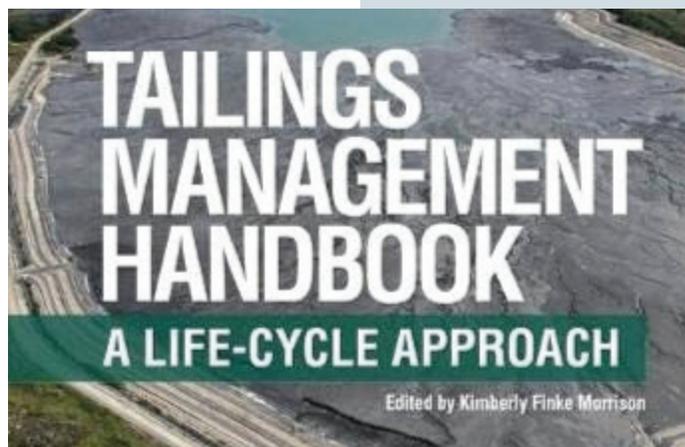
This is an unfortunate consequence of the term itself. The Institute argues that a change in terminology is needed, and that “closure” should revert to being considered a point in time rather than a phase.

Many mining companies focus on some form of regulatory signoff for completion of the closed and reclaimed mining landforms or more commonly the mine landscape as a whole.

Most expect to recover their bond as part of the release of liability and obligation, which seldom if ever comes. It is now generally recognized that each mine needs to be reclaimed to a safe and suitable post-mining use with access for local communities.

At the same time, it is clear that almost all mines will require aftercare in the form of monitoring and maintenance for decades or centuries.

(*Mining with the end in mind* also contains comprehensive lists of landform types and elements, levels of landform design, and spatial scales).



Tailings handbook authors host closure webinar

The *Tailings Management Handbook: A Life-Cycle Approach* is one of the most comprehensive documents ever produced on the subject, with the print version coming in at 1,024 pages.

But even at that page count, the publisher, the Society for Mining, Metallurgy & and Exploration (SME), isn't expecting the handbook to be the last word. As part of efforts to explore the topics covered by the 100-plus authors in more detail, the SME has organized webinars to dig deeper into each chapter.

Two of the seven authors of Chapter 16: Closure Planning and Landform Design, LDI Founder Gord McKenna and Phil Crouse of Stantec, were tasked with delivering an hour-long webinar on their contribution. The webinar, which was held this past May, drew an audience of 37 from mining firms, universities, and industry service companies around the world.

McKenna and Crouse discussed the importance of designing tailings storage facilities with closure in mind, the resources available for the job, the design process, closure team composition, monitoring and maintenance and implementation issues. The primary take-home message of the webinar was “Successful planning, design, construction, operation, and closure of a TSF is only possible with a clear and viable plan for closure in mind; closure should not be an afterthought.”

As McKenna summed up: “It's not just about geotechnical stability — it's providing protection for downstream environments and upstream environments, protecting the environment from windblown tailings and other aspects in operation and enclosure and to ultimately create a safe and stable landform that meets what you've set out for your design basis and leaves a positive mining legacy.”

The other five authors of the chapter are Jason Andrews of Engineering Analytics, Mike Henderson of the Colorado School of Mines, Neeltje Slingerland of Golder Associates (now WSP), David Williams of the University of Queensland, and Kim Finke Morrison of Newmount Corporation. The full *Tailings Management Handbook* can be purchased in both print and ebook formats directly from the SME at smenet.org.

Programs set for pair of mine closure conferences

Reno, Nevada, and Vancouver, B.C., are the host cities of two of the year's biggest mine closure-oriented conferences, putting landform designers in the Pacific Northwest in the lucky position of being within day's drive of both.

The 16th International Conference on Mine Closure is scheduled for October 2–5, 2023, at the Nugget Casino in Reno, and Tailings and Mine Waste 2023 will be held November 5–8, 2023 at the Marriott Parq Hotel in Vancouver. Programs and keynote speaker have now been confirmed.

The keynote speakers for the Reno gathering include:

- » Kate Sommerville, general manager of legacy assets for BHP, who will discuss “Closure and Community: Demystify the Life of Mine”
- » Laurel Sayer, chief executive officer of Perpetua Resources, who will explore “How the Future of American Mining is Found in Addressing the Past”
- » Rob Bowell, a corporate consultant in geochemistry for SRK Consulting, who will focus on “Natural Attenuation in the Vadose Zone: Nature's Gift to Mine Closure”
- » Dana Bennett, interim president of the Nevada Mining Association
- » Rob Kuczynski, chief of Nevada's Bureau of Mining Regulation and Reclamation.

More program information and abstracts are available from the conference website at acgmineclosure.com.

TAILINGS AND MINE WASTE 2023



In Vancouver, the scheduled keynote speakers are:

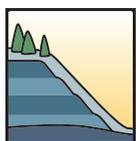
- » Angela Küpper, a director and principal geotechnical engineer at BGC Engineering
- » Ed McRoberts, a geotechnical engineer with WSP Canada
- » Bjorn Weeks, a senior advisor at Teck Resources.



MineClosure

Tailings and Mine Waste 2023 is devoted to geotechnical, environmental, and regulatory topics related to tailings and mine waste management. The agenda also includes short courses on Moving Beyond TSF Monitoring Status Quo – An Introduction to Emerging and Innovative Technologies; Filtered Tailings Management – Planning, Design, Construction, and Operation; Tailings Geotechnics: Recent Advances and Perspectives; Site Investigation for Tailings, Mine Waste & Heap Leach; Risk Assessment; and Tailings Management Systems.

Conference details and registration information can be found at tailingsandminewaste.com.



**LANDFORM
DESIGN
INSTITUTE**

The *Landform Design Quarterly* is a publication of the Landform Design Institute, a not-for-profit corporation based in Vancouver, BC. All contents are protected by copyright and may be used only for non-commercial purposes. All other rights are reserved and commercial uses including publication, broadcast, or redistribution in any medium are prohibited. Permission to copy may be sought from the Landform Design Institute. © 2023 The Landform Design Institute

Publisher: Landform Design Institute

Editor: David Wylynko, West Hawk Associates

Designer: James Hrynyshyn, West Hawk Associates

Illustrations (pages 3, 4, and 6): Derrill Shuttleworth

CONTACTING THE LDI

5223 Laurel Drive
Delta, BC, V4K 4S4
Canada

+1.604.838.6773

info@landformdesign.com

landformdesign.com

@LandformDesign