

## GAPP Eligibility Form 2025

Industry Receptor Lead (name, Position, company):	Jeff Violo, COO, Luminous BioSolutions Inc.	Researcher Lead (Name, Position, Institution):	Dr. Shawn Lewenza, Professor, Athabasca U & Adjunct Professor, UofC
Is the Industry Receptor Lead a Canadian for-profit enterprise?			Yes
1. What is the key challenge or opportunity as <u>defined by the Industry Receptor</u> ? How can a genomics-derived solution address the need or opportunity?			
<p>Alberta's oil sands face a critical challenge: 1.486 trillion liters of toxic naphthenic acid (NA) laden tailings water, hindering land reclamation and incurring \$45-130 billion in liabilities. Current NA monitoring is slow (weeks) and costly (\$500-1000/sample), bottlenecking remediation efforts. Our genomics-derived NA monitoring and bioaugmentation solution offers a rapid, cost effective approach through:</p> <ol style="list-style-type: none"> <li>1. <b>Engineered Bacterial Biosensors:</b> Commercialize and field-test NA biosensors that report levels within 24 hours, reducing monitoring costs by 80-90%.</li> <li>2. <b>Genomics-Guided Bioaugmentation:</b> Identify and optimize NA-degrading bacterial communities for enhanced wetland treatment, sequencing and genetic screening of genomes to understand NA degradation pathways.</li> <li>3. <b>Microbial Community Tracking:</b> Monitor microbial community shifts during bioaugmentation trials using 16S rRNA sequencing.</li> <li>4. <b>AI-Powered Genomic Analytics:</b> Integrate real-time data for predictive remediation strategies.</li> </ol> <p>This proactive, genomics-driven approach will transform tailings management, enabling operators to meet regulatory requirements and reduce liabilities</p>			
2. What are the specific quantitative/measurable deliverables expected at the end of the project?			
<p>Our project will deliver:</p> <ol style="list-style-type: none"> <li>1. <b>NA Concentration Reduction:</b> Genomically-optimized bacterial treatment will reduce naphthenic acid (NA) concentrations in 200+ million m<sup>3</sup> of tailings water from 50-120 mg/L to &lt;10 mg/L (safe release threshold).</li> <li>2. <b>Accelerated &amp; Cost-Effective Monitoring:</b> Rapid, inexpensive and long-term biosensor NA monitoring will reduce current monitoring costs by 80-90% and accelerate treatment oversight.</li> <li>3. <b>Environmental &amp; Regulatory Impact:</b> This will lead to reduced fugitive GHG emissions from ponds, enable safe water release, accelerate land reclamation, ensure regulatory compliance (Directive 085), and significantly mitigate environmental risk.</li> </ol>			
3. The Industry Receptor is expected to set the research priorities for the project and lead the proposal development and Project. Describe the role that the Researcher plays in supporting the Industry Receptor partner(s) and the activities it will lead. If the Researcher has a position with the Industry Receptor, describe how the Industry Receptor will have clear decision-making processes that are independent of the Researcher.			
<p>Dr. Shawn Lewenza (CSO) and University Partners will support Luminous BioSolutions' goals by leading research to optimize biosensor performance through genomics and synthetic biology, identify optimal NA degradation strains, ensure independent scientific validation, and train HQP for the industry.</p> <p>As the Industry Receptor, Luminous BioSolutions will lead the project. Jeff Violo (COO) handles all business and commercial decisions, and Greg Saunders (CTO) manages technology and commercialization. Commercial and strategic decisions are exclusively vested in Violo and Saunders, roles independent of academic research, ensuring unbiased commercialization.</p>			
4. What is the market opportunity including the current competitive landscape?			
<p>The Alberta oil sands tailings challenge presents a massive market opportunity, encompassing 1.486 trillion liters of process-affected water across 300+ km<sup>2</sup> of land, with an estimated \$45-130 billion liability. This decades-long problem, compounded by AER Directive 085, demands intervention.</p>			



**Market Opportunity:** Three major oil sands operators are pursuing wetland-based treatment, a strategy where our genomics-derived bioaugmentation can significantly enhance NA degradation efficiency, building on previous Genome Canada-funded success in reducing but not eliminating NAs.

**Competitive Landscape - Non-Genomic:** Current methods are costly and have significant drawbacks:

- Chemical polishing: Energy-intensive, expensive, waste-generating.
- Mechanical treatment: High capital costs, concentrated waste streams, low water recovery.
- Physical adsorption: Expensive, continuous replacement, disposal issues.
- Traditional analytical monitoring: Slow (2-3 weeks), expensive (\$500-1000/sample), reactive.

**Genomics-Based Biological Approach - Competitive Advantages:** Our solution offers a superior alternative:

- Natural degradation: Leverages native, non-GMO bacterial pathways ( $\beta$ -oxidation, specialized metabolism) already abundant in oil sands wastewater.
- Minimal infrastructure: Requires significantly less capital than mechanical systems, integrating with existing wetland strategies.
- Low cost, scalable monitoring: Biosensor technology provides rapid, inexpensive, comprehensive real-time data, complementing traditional methods.

5. Describe the current state of project readiness and how you plan to launch the project by March 31, 2025. Include details on ethics approvals, personnel (HQP), and infrastructure that are in place or will be secured by the project launch or during its implementation.

**Readiness (TRL 6-7):** Our project is mature with lab-validated biosensors (Bookout et al., 2024), characterized NA-degrading bacteria, and patent-pending IP. Our established team combines scientific and business expertise. Infrastructure: Partnerships with InnoTech Alberta (mesocosms, bioreactors) and University of Calgary (microcosm testing) provide immediate access to necessary facilities for scale-up.

**Industry Engagement:** Strong interest exists from Canadian Natural Resources Limited (current biosensor funding), Imperial Oil (biosensor field testing at Kearl wetland), and Pathways Alliance (active discussions for integrated NA solutions).

**Launch by March 31, 2025:** Upon funding, we'll immediately hire 5-8 HQP (bioremediation scientists, post-docs, software developers, field coordinator) and proceed to pilot-scale field validation through existing industry and infrastructure partnerships. Regulatory pathways are established, and no human or animal ethics approvals are required for this project.

**Primary Gap:** Only funding for pilot projects remains to enable immediate launch, as all other elements are secured.

6. What is the pathway to monetization / market (including regulation, social considerations, reimbursement and adoption, as applicable) the Receptor(s) intends to pursue? Consider data privacy, data sharing and IP strategies as appropriate.

Our genomics-based solution is positioned for commercial deployment within 3-5 years, progressing from validated pilot studies to full-scale implementation across multiple oil sands operations.

#### **Monetization & Market Scale**

Our service-based deployment will initially focus on providing monitoring and treatment services to major operators (Years 3-5), evolving into Platform-as-a-Service offerings for integrated remediation management (Years 4-5+). The immense scale of Alberta's tailings challenge 1.486 trillion liters requiring decades of continuous treatment represents a substantial, long-term revenue opportunity. Success with our primary targets (3 major oil sands operators) will establish a foundation for sustained growth throughout their operational and reclamation phases.

#### **Regulatory Pathway**

Our strategy involves validating biosensor accuracy and treatment efficacy with the Alberta Energy Regulator for Directive 085 compliance, ensuring compatibility with potential Federal Fisheries Act requirements, and developing biotechnology-based monitoring protocols for international adoption.

#### **Social Considerations**

We prioritize Indigenous partnerships through data sharing agreements for real-time monitoring, foster community transparency with publicly accessible environmental data, and contribute to workforce development by creating skilled biotechnology jobs in Alberta through training partnerships.

**IP and Data Strategy**

Our IP strategy centers on patents for biosensor methodology and bioaugmentation processes. We ensure data sovereignty, where operator data remains proprietary while our platform provides analytics services. We balance open science through fundamental genomics publications with protection for commercial applications, fostering industry-wide adoption via collaborative technology sharing agreements.

What are the anticipated quantitative and measurable commercial benefits to the receptor and socio-economic benefits to Canada in the near-term (within 3 to 5 years of project completion)?

Addressing Alberta's oil sands tailings crisis, with 1.486 trillion liters of toxic water covering over 300 km<sup>2</sup> and representing a \$45-130 billion liability, is paramount for Canada's energy future, environmental stewardship, and international standing. Our genomics-based solution offers transformative benefits:

**Commercial Benefits to Luminous BioSolutions:**

Within 3-5 years post-project, Luminous BioSolutions anticipates:

- **Dominant Market Position:** Achieving market leadership in biological solutions for industrial environmental remediation, specifically in biosensors and NA treatment. Success with this immense opportunity will establish Luminous as a significantly successful business.
- **Scalable Technology Platform:** Developing a proven genomics approach broadly applicable to other global heavy oil and mining sectors facing similar environmental challenges.
- **Robust IP Portfolio:** Expanding our patent portfolio with breakthrough biotechnology methods in NA detection and bioaugmentation, creating strong international licensing potential.
- **Strategic Industry Partnerships:** Deepening relationships with major energy companies, leading to sustained collaboration and potential for multi-year service contracts and expanded deployment across their operations.
- **Operational Cost Savings for Receptor:** Our rapid, cost-effective biosensor monitoring and improved biological treatment will yield significant operational expenditure reductions for oil sands operators compared to current NA remediation and monitoring strategies.

**Socio-Economic Benefits to Canada:**

Our solution will deliver measurable near-term socio-economic benefits:

- **Accelerated Land Reclamation:** Enabling a path to accelerated reclamation of vast land areas currently occupied by tailings, returning productive ecosystems and addressing one of Canada's largest industrial environmental liabilities.
- **Path to Safe Water Release:** Providing a hopeful and viable pathway for the safe release of treated tailings water, a critical step never before achieved, ensuring environmental protection for downstream ecosystems.
- **GHG Emission Reduction Contribution:** Contributing to significant reductions in fugitive GHG emissions from tailings ponds, supporting Canada's climate commitments and the national goal of reducing millions of tonnes of CO<sub>2</sub>e from the oil sands sector.
- **Indigenous Reconciliation:** Providing real-time environmental data access to affected First Nations communities, fostering demonstrable progress on environmental concerns and strengthening truth and reconciliation commitments.
- **Skilled Workforce Development:** Creating dozens of new, highly specialized biotechnology jobs (e.g., environmental genomics specialists, field technicians, data scientists) in Alberta within 3-5 years, significantly boosting Canada's high-tech talent pool.
- **Global Innovation Leadership:** Positioning Canada as a global leader in environmental genomics, demonstrating a scalable, exportable technology to address similar challenges in international heavy oil markets and potentially influencing international biotechnology-based environmental standards.
- **Sustainable Energy Security:** Enhancing the long-term, environmentally responsible operation of Canada's critical energy infrastructure.