Manitoba Clean Environment Commission
Hearing for the Vivian Silica Sand Extraction Project (Project)

Sio Silica Corporation (SSC) Responses to DLN February 13, 2023 CEC Submissions for Vivian Silica Sand Extraction Project

February 20, 2023

Sio Silica has reviewed the submission made by Mr. LeNeveu. The vast majority of the topics and items contained within this submission have already been addressed in previous filings by Sio Silica, ignored or mischaracterize responses provided by Sio Silica, or are outside the scope of assessment of the CEC for the Extraction Project. Sio Silica will not provide any reply to these portions of Mr. LeNeveu's submission. Sio also notes that Mr. LeNeveu's submission is not expert or peer reviewed, and it was not prepared by individuals that are specialized, accredited or licensed to practice in the fields addressed in the submission, nor regulated by any professional practice such as Engineers and Geoscientists Manitoba.

There are a few new and additional topics outlined in Mr. LeNeveu's submission that Sio will address herein.

1.0 New Topics

1. ***Carslaw and Jaeger Modeling:***
   While it is acknowledged by Sio that the equations governing heat flow and groundwater flow are similar, the analytical equations and numerical solutions have advanced with the state of academic knowledge to allow for application to real world problems. Analytical solutions including the Carslaw and Jaeger equation are limited in their application to problems that do not violate their underlying assumptions. The equations are limited in their ability to handle complex boundary conditions that may be present in natural settings. For the Project, it was judged by Sio's technical experts that a numerical solution to the governing groundwater flow equations was required to simulate the spatial and temporal effect of project operations on the regional groundwater flow system. As such, analytical solutions were judged to be incapable of simulating the fundamentals of the sand extraction operation. Operational experience suggests that reinjection of water is possible and has been successfully completed by Sio. In the opinion of Sio's technical experts, direct measurements and observations are more definitive than theoretical calculations and equations accompanied by simplifying assumptions and do not reflect the complexities observed in the natural world or at the Project Site.

2. ***Fluoride:***
   The X-ray diffraction test conducted on nine samples taken from the Red River Carbonate, Winnipeg shale and Winnipeg Sandstone did not identify the mineral listed (i.e., CaF_2 and $Ca_5(PO_4)_3F$) in the Project area. Fluoride may be present as a trace element in fluoride-bearing minerals such as aluminosilicates (i.e., muscovite) or calcite. The concentrations of fluoride in the Red River Carbonate (average 0.3 mg/L), Winnipeg Shale (average 0.4 mg/L) and Winnipeg Sandstone (average 0.4 mg/L) are not elevated as Mr. LeNeveu suggests. These data indicate

that the Red River Carbonate, Winnipeg Shale and Winnipeg Sandstone hydrostratigraphic units are not likely sources of elevated fluoride. Fluoride data taken before and after a pumping test show that the concentration actually decreased slightly in most cases.

Mr. LeNeveu's statement that "widespread sulphuric acid formation from the oxidation of sulphide in the sandstone, shale, concretions and oolite could release more fluoride into groundwater" is hypothetical and not supported by any data or evidence. Acid generation in the subsurface due to the re-injection of water creating sustained sulphide oxidation is unlikely because of:

- Low solubility and diffusion of oxygen in water. The re-injected water is likely to contain a small amount of oxygen because extracted water is stored in water tanks with little exposure to atmospheric oxygen pressure.
- Lack of sulphides in carbonate and sandstone formations and low sulphide content of shale in the Project area.
- Lack of micro-organisms to catalyze and accelerate sulphide oxidation in the subsurface.
- Exposure of sulphide minerals to oxygen. If present, sulphide minerals may be completely occluded within minerals resistant to weathering such as abundant aluminosilicates.

Calcite dissolution is not a known driver for increased fluoride concentration in groundwater. The opposite is true (Nordstrom and Smedley 2022).

Reference:
Nordstrom, D.K and P. Smedley, 2022. Fluoride in Groundwater. The Groundwater Project, Guelph, Ontario, Canada.

3. Lab Result Validity and Reliance:

As discussed previously in Round 2 DLN-IR-002 (Response 26) and DLN-IR-011, geochemical sample collection was collected in accordance with industry standard protocols for the evaluation of the potential for acid rock drainage and metal leaching. Laboratory analysis was conducted by trained staff utilizing standard methods and was subject to a Quality Assurance and Quality Control Program, with the results judged by qualified professionals to be acceptable for the intended purposes.

On the topic of lab results, Sio would like to note the following items in the submission:

1. The NI 43-101 Technical Report referred to is for a different project outside the Sio Silica Project area. Sio Silica is not related to Claim Post Resources Inc. as shown in Figure 27. The Claim Post Resources sand is not of the same geologic member as Sio Silica, and is therefore not relevant to this application.
2. Figure 28 again is for another project, outside the project area and from a different geological member than Sio Silica's target sand.
3. Figure 30 contains a previously circulated ALS laboratory summary referenced in Sio Silica's IAAC review and the Public Comments received for the Extraction project. The report is incomplete and not adequate to support the claims made. In particular:
    a. The report clearly shows two sand samples (#4 and #7). However, the complete data results for each sample are missing.

b. The chain of custody (COC) form, which contains important sample collection and analytical request information, is not provided with the report. The COC form is a standard accompaniment to analytical laboratory reports .
c. Several constituents are present at or slightly above the Limits of Detection (LOD), including barium, which has been reported as 10 ppm (which equivalent to the LOD) and is unreliable. There is insufficient confidence in a reported value when the reported concentration is at or near the LOD. So not only is the reported barium concentration barely detectable, but the actual reported concentration cannot be stated with confidence because it falls within the Limit of Quantification, which is typically taken as three to five times the LOD, but may be up to ten times the LOD.
d. The report lacks QA/QC data and has no replicate or surrogate analysis.
e. Complete characterization of solid and aqueous phases is required for interpretation of geochemistry. As noted in the Hydrogeology and Geochemistry Assessment, industry standard practice involves sample collection by appropriately trained individuals, logging of sample characteristics in the field, shipping to the laboratory under standard chain of custody procedures and analysis of total metals, ABA, mineralogy and SFE. This does not appear to have happened with this report.

4. ***Relating Re-injection to Fracking***

As discussed previously in Round 2 DLN-IR-002, water injected by Sio will not be re-injected under any pressure. Water will be returned to the aquifer on open gravity feed to a well that is actively producing. Sio does not intend to apply any pressure to reinject water and therefore increased fracturing as a result of excess injection pressure is not possible.

Compressors that Sio uses from the water well drilling industry do not exceed 350 psi in capabilities. Those compressors are usually only operated no higher than 100 psi and do not need to be operated even at this level. Sio can extract sand below 100 psi. For context, a road bike tire is usually between 80 and 130 psi. The pressure from a compressor at 100 psi could not possibly reach fracturing capabilities for several reasons:

1. Well fracturing operations require the well to be contained to build pressure. Sio's wells are not sealed at the top to contain pressure. If they were, there would be no way to return the water to the aquifer.
2. 'Overpressuring' the formation in an uncontained well would not be possible because the re-injected water would just be rejected and additional pressure would escape out the annular space where the re-injection occurs. The air/pressure will take the easiest path of escape which is out the annular space of the well.
3. Finally, the use of Nitrogen in Coal Bed Methane fracturing, can utilize pressures in the vicinity of 8700 psi. This is orders of magnitude higher than the capabilities of the compressors that will be used by Sio.

<u>Reference:</u>

1. McCormack, L., Lindsey, J. 2021. How to Achieve the perfect Bike Tire Pressure. Bicycling. Accessed at: https://www.bicycling.com/repair/a20004232/how-to-achieve-the-perfect-bike-tire-pressure/

2. Tian, Q., Hao, C., Li, J., Wang, W. 2020. Application of Nitrogen Shock Fracturing Technology on Coalbed Methane Well. Research Fund of State Key Laboratory of Coal and CBM Co-mining.

2.0 Additional Comment to Recurring Topics

1. ***Microbial Contamination and Sterilization of Air Injection***

In Section 1, page 8 of Mr. LeNeveu's submission, he states that "Sio Silica has not given methods to sterilize air injection". He then provides additional comment regarding the introduction of microbes in Section 14, page 80 of his submission. This topic has been repeated in other submissions provided by Mr. LeNeveu including DLN-IR-001 submitted during Information Requests (IRs) Round No. 1 and a dispute letter submitted on January 30, 2023. Sio has previously responded to these questions, but would like to add the following evidence that further discredits Mr. LeNeveu's comments.

i. In his attempt to support his claim that sterilization of injected air is required, Mr. LeNeveu references two sources of information: "How to Get Clean, Dry, Oil Free Compressed Air From Any Compressor, A White Paper By Mark White" and "Controlling Micro-organism Growth in Compressed Air, A White Paper by Mark White". Sio and AECOM have reviewed both documents and have come to the conclusions that they are informational brochures prepared by Parker, a global company that manufactures a multitude of industrial products, including specialty compressors. There is no evidence to suggest that either of these articles have been peer reviewed or published in any reputable scientific journals.

ii. Upon review of the white papers referenced by Mr. LeNeveu it has been determined that the white papers have been prepared in the context of evaluating the purity of air that is used in the biomedical, pharmaceutical, and food processing industries, which require ultra-pure air in their manufacturing and operation. This is evident by the reference to the ISO 8573 international standard within the white papers, a standard which applies to the testing of compressed air for micro-organisms in applications that require special compressed air purity classification. ISO 8573 is not applicable to air injection used in the water well industry.

Mr. LeNeveu's claims regarding requirements to sterilize injected air and implement microbial monitoring programs are based on inappropriate references and standards that do not apply to compressors used in water well drilling, further demonstrating that his claims have no merit.

2. ***The Winnipeg Aquaduct***

In Section 19.2, page 98, Mr. LeNeveu discusses the potential for contamination of the City of Winnipeg Aquaduct. According to Mr. LeNeveu:

> *"Project alterations after 2025 such as crossing the Winnipeg aquaduct could be approved by an alteratoin request under the Environment Act with no consultation with the City of Winnipeg or the federal government. Sio SIlica has failed to consider the potential detriment of the extraction project on the Winnipeg aquaduct. Sio Silica has failed to notify the City of Winnipeg of this*

eventful disturbance of the aquaduct and has not participated in or initiated a legal agreement with the City of Winnipeg for the Sio Silica slurry operations to cross or be in the vicinity of the aquaduct. Failure to consider the eventual risk to the Winnipeg aquifer and to devise a method to avoid notification and approval by the City of Winnipeg for aquaduct crossing is deliberate avoidance of responsibility by Sio Silica."

Sio outright rejects all aspects of this claim. Future crossing of the Winnipeg Aquaduct, including requirements for engagement with the City of Winnipeg prior to submitting a Notice of Alteration, is addressed in Key Issue / Question # 119 in Sio's "Table 2: Responses to Public Review Comments" which was posted on the Environmental Assessment and Licensing Public Registry on January 25, 2022, and "public_comments_2.pdf" posted to the Public Registry on November 15, 2021, the content of which is summarized below.

On November 1, 2021, the Environmental Assessment and Licensing Branch received an email from a Senior Project Engineer with the City of Winnipeg as a response during the public review period. In the email, the City of Winnipeg engineer expresses no concerns with the project:

"Based on the separation distance of approximately 4 km between the extraction sites and the City's water supply infrastructure, the City does not have concerns with the currently proposed Vivian Sand Extraction Project. However, as the extraction area included in the 24-year life of the Vivian Sand Extraction Project is adjacent to the Shoal Lake Aqueduct and Greater Winnipeg Water District Railway, the City's water supply infrastructure may be impacted by expansion(s) of the Vivian Sand Extraction Project ."

In the next paragraph, the engineer requests that:

"Any activities associated with the Vivian Sand Extraction Project that may affect the City's water supply infrastructure should be carefully planned and undertaken in consultation with the City to ensure the water supply infrastructure is protected and there are no impacts to the delivery of water to the citizens of Winnipeg. As such, the City requests that CanWhite consider the Shoal Lake Aqueduct and Greater Winnipeg Water District Railway and consult with the City in the planning stages of future expansion(s) of the Vivian Sand Extraction Project, as applicable".

In response to this request, Sio provided the following:

"Any future Notice of Alteration for operations that might fall within the proximity of the aqueduct will consider potential environmental effects on the aqueduct."

Based on this information it is clear that Mr. LeNeveu's claims related to impacts on the City of Winnipeg aqueduct and inadequate consultation with the City of Winnipeg on this issue are entirely false.

3. ***Cumulative Effects Assessment and Greenhouse Gases***

Sio disputes Mr. LeNevue's statement in Section 15, page 82 that GHG emissions for the project would rise over 100 kT CO2e/yr and that the project would rank as number five on the Manitoba

Large Final Emitters (LFEs). This claim is entirely false. Mr. LeNeveu has included a number of false assumptions and unsubstantiated values attributed to cumulative effects. In reality the project will generate substantially less GHGs (approximately 14 kT CO2e/yr) and will be well below the LFE threshold of 100 kT CO2e/yr.

4. Slurry Line Contamination

In Section 16, page 5, Mr. LeNeveu states the following:

> *"The assertion that the slurry lines will contain only sand and water and no toxic contaminants is not supported by any measurements of direct evidence".*

Sio has refuted Mr. LeNeveu's claim of slurry line contamination on numerous occasions throughout the permitting process, including responses in "Table 2: Responses to Public Review Comments" posted on the Environmental Assessment and Licensing Public Registry on January 25, 2022, and in response to IR questions put forward in both rounds of questioning (for an example please refer to Sio's response to Round No. 2, DLN-IR-003). Sio's responses were prepared by persons qualified to review and assess the available information and supporting data.

It should also be noted that none of the technical reviews completed on behalf of the CEC or the participants have identified slurry line contamination as an issue of concern.

3.0 Additional Comments

Sio points out the following additional inaccuracies, misinterpretations, and misrepresentations in Mr. LeNeveu's submission. Sio also presents a selection of references the Sio team has reviewed and does not believe are appropriately used either in context and/or credibility.

1. Mr. LeNeveu infers that the images in Figure 31 (page 51) are "consistent with bacterial action of the marcasite in the Vivian sand" without any supporting evidence, including chemical and/or biological testing. The location of sites where the photographs were taken have not been specified, therefore it cannot be confirmed that these sites are on any Sio property. The properties Sio Silica has operated on have also been subject to theft, vandalism and unauthorized access. Reports of these activities have been filed with the RCMP to preserve the record of these illegal activities. Digital photo manipulation has been evident on pictures circulated by Sio critics. Sio has never experienced a gelatinous deposit in its operations as shown in Figure 31 and questions the picture validity and reported observation.

2. In Section 11, page 30, Mr. LeNeveu requests that groundwater monitoring plans include measurements for "*...nitric acid, carbonic acid, and sulphuric acid...*". This request is unrealistic. Testing for nitric, carbonic, and sulphuric acid in water samples is not a service provided by environmental analytical testing laboratories, and Sio and AECOM are not aware of any regulatory requirement that includes testing for these compounds in groundwater.

3. In Section 13, page 76, Mr. LeNeveu states that pilot testing must include measurements of the process water quality, including "*...acid...*" and "*...fungi and fungal spores...*". Again, this request is unrealistic. As stated previously "acid" is not a standard test provided by environmental analytical testing laboratories. Although the presence of fungi and fungal spores can be analyzed in some sample types (air, soil, swab samples), analysis of fungi and fungal spores in water is not a standard test nor is it a known regulatory requirement.

4. In Section 13, page 76, Mr. LeNeveu discusses the management of "*effluent*" and "*overs*" for "*acid drainage potential*", stating:

   "Should the effluent and overs have acid drainage potential specialized disposal such as for the waste ore at Snow Lake that is deposited into Anderson Lake".

   Mr. LeNeveu does not appear to understand the management of drilling waste nor the function of "*Anderson Lake*", which is a licensed tailings disposal facility designed and operated to manage mine tailings, not "*waste ore*" or drilling waste. There is no basis to suggest that a similar facility should be designed and operated for the Vivian Sand Extraction Project.

5. **Reference #26** - Best Practices for Shale Core Handling: Transportation, Sampling and Storage for Conduction of Analyses. February 2020, Journal of Marine Science and Engineering 8(2):136,S. Basu, Adrian P Jones, Pedram, Mahzari.
   a. This reference is about core handling for paleo-environmental and hydrocarbon studies and is not applicable to the Vivian Sand project.

6. **Reference #28** - Iron oxidation in sediment cores (Site 1062) during six months of storage in the Ocean Drilling Program archive, September 2000, Proceedings of the Ocean Drilling Program: Scientific Results 172:1-11, I. König et al.
   a. This reference is about the process core collected during Deep Sea and Ocean drilling below seabed (>4,000 m depth) to understand the history of late Neogene climate change. This method of core preservation is not applicable to the Vivian Sand project.

7. **Reference #49** – This is a website for Premier Water Technologies, a supplier of commercial water softeners and filters in Minnesota. Sio could not find a reference that iron bacteria "proliferate in sediment from acid mine drainage" as stated by Mr. LeNeveu in his submission. Sio also notes that Mr. LeNeveu excludes the statement on the website that acidophilic bacteria (iron bacteria) are rarely found in drinking water supplies.

8. **Reference # 115** - The paper "Stability of Chitosan—A Challenge for Pharmaceutical and Biomedical Applications"
   a. This reference was used for the instability of chitosan considered chitosan derivatives for medical purposes with a high concentration under human body conditions (i.e.: 36^{o}C and the presence of enzyme such as lysozyme), while the proposed water treatment system for the Project will work under lower temperatures and the absence of enzymes. As an example, it is mentioned in the reference that "For instance, physical methods—high pressure homogenization, extensive shearing, or centrifugation—frequently used for preparation of biomedical chitosan devices, were noticed to decrease the polymer

MW and were responsible for the fluctuations of the PDI [43]. It should be also noted that the compression force during tablet preparation is responsible for heat generation and might influence the chitosan MW distribution [44].” Those conditions do not apply to the water during or after the proposed treatment process for the Project.

b. As mentioned in section 3.2.3 of page 1831 of the reference, the first stage of thermal decomposition started at $30^{O}C$. Neither the treatment system for the Project nor the aquifer temperature would reach $30^{O}C$ under normal circumstances. Therefore, it is safe to assume that thermal decomposition will not cause chitosan depolymerization and produce glucosamine in the water.