

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

Sio Silica Corporation (SSC) Responses to Information Requests (IRs) Round No. 2

- IR Number:** MSSAC-IR-001
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** General EAP
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/
Preamble:** SIO SILICA IR Round 1 Response
- “The extraction method at this time is proven and repeatable as tests have been conducted and successfully carried out. Separating the Project into 4-5 year groupings, with Notices of Alteration to be filed as needed, will allow for improvements in methodology as well as any changes in environmental impact that might arise from relocating the specific sites of extraction activities. Improvements could include, for example, potential efficiencies in the extraction method to reduce the overall number of wells needed per year. Additionally, land ownership and uses do change over time, and therefore site selection for a full 24 years would not be efficient or appropriate.”
- Also refer to Responses to the Technical Expert Reports – Geotechnical, filed November 29, 2022 issue 3.
- Request:**
1. The extraction method is repeatable based on the small number of single well tests, and not on a full well cluster, such as will be active during commercial operations. Elaborate please on your confidence and/or risk perspective on how these small numbers of single well tests will translate to what you expect a well cluster, then multiple well clusters, will look like over the 24 year life of the project. The strategy of working on shorter timeframes with Notices of Alterations (if needed) along the way is understood to perhaps help manage at least some of this risk, however what is the project approach if the initial assumptions fall short during the first window of time during commercial extraction?
- Response:**
1. As previously stated in the response to MSSAC-IR-010 (b), *“Stantec recommended conducting multi-well testing after issuance of an Environment Act Licence while operations begin with a smaller number of wells and then increase over time. This staged approach will allow Sio Silica*

to confirm expected conditions before a larger multi well extraction and make adjustments that may be required.” The CEC Technical Experts, Arcadis, agreed with this geotechnical approach in their Technical Review of Sio Silica Corporation’s Environmental Act Project Proposal, on page 15: “Arcadis agrees with the assessments, recommendations and conclusions provided by Stantec (2022). The report presents a technical analysis of potential geotechnical failure modes that, in the opinion of Arcadis, is generally appropriate for a project that is undergoing Environmental Assessment.”

This approach is considered a conservative and reasonable industry standard approach. Based upon current information which is believed to effectively characterize site geotechnical conditions, it is not expected that the results of the multi-well testing will vary markedly from previous assumptions.

IR Number: MSSAC-IR-002

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: General EAP

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
“A comprehensive conceptual Closure Plan is not an EAP requirement, as per the Information Bulletin - Environment Act Proposal Report Guidelines. However, based on AECOM's experience it is expected that Sio will be required to prepare a comprehensive Closure Plan as a condition of the EAL.”

Request: 1. In some cases, where requested by the Director of Mines, closure plans such as this are requested prior to issuance of the EAL, in part, to finalize and obtain the License. While the language within the EAP does not suggest the closure plan is an EAP requirement, it is can be asked for as part of the licensing process, and in many ways by providing this early it provides additional assurance to the public during the granting of the EAL, that the project closeout will be done properly. Why would SIO choose to wait on this on such a sensitive project?

Response: 1. As stated in the request, a Closure Plan is not required prior to the issuance of a Licence. Typically, the Closure Plan must include requirements set out in the Licence and is therefore usually composed after.

Sio has commenced a draft Closure Plan and will be providing this draft to the Manitoba Natural Resources and Northern Development – Mining, Oil and Gas Branch prior to the closing of the hearing.

IR Number: MSSAC-IR-003

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: General EAP

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

“As per Information Bulletin – Environment Act Proposal Report Guidelines, which was prepared by the Province of Manitoba and applies to all Environment Act Proposals (EAPs) prepared under The Environment Act, the completion and inclusion of a cumulative effects assessment is not an EAP requirement. Therefore, by the standard set by the province, the exclusion of a “cumulative effects assessment” from the EAP is not a deficiency. It should be noted that although a section on cumulative effects was not included in the EAP, cumulative effects were considered in the Hydrogeology and Geochemistry Assessment Studies that were completed in support of the EAP and the noise assessment which considered cumulative effects in the form of ambient noise. The Hydrogeology and Geochemistry Assessment Studies completed by AECOM considered presence of historical and existing water wells and impact on existing users; a diverse range of groundwater usage including domestic, industrial, irrigation, and livestock; expanded spatial Project boundary; and impact of pumping and development on the aquifer structure, all of which are aspects commonly considered within a cumulative effects assessment.”

Request: 1. Please specify and detail these analyses within your submission within a "Cumulative Effects" section/discussion separate from other discussions in the submittal, such that they may be properly evaluated as such.

Response: 1. Sio maintains that the environmental assessments conducted for the extraction proposal meet or exceed applicable regulatory requirements and allow the CEC and interested parties to reasonably understand and assess the potential environmental effects of the proposal. As discussed in Round 1 MSSAC-IR-003, the environmental assessments that have been conducted by Sio to date include consideration of cumulative effects where appropriate. For these reasons, Sio declines to conduct the additional work set out in this request.

IR Number: MSSAC-IR-004

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: General EAP

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

“Currently, AECOM is preparing draft plans that will be circulated prior to the CEC hearing. This issue was previously addressed in the EAP and in our Vivian Sand Extraction Project (File# 6119.00) - Environment Act Proposal Review Responses to the Public table submitted to Manitoba Conservation and Climate, Environmental Approvals on January 14, 2022, and posted on the Public Registry on January 25, 2022. Please refer to our response to Key Issue / Question # 234 in our Responses to the Public which includes the following: “It is best and common practice for mitigation and monitoring plans, and operating procedures, to be prepared in association with or on completion of detailed design of the Project, and for these plans to be reviewed and updated periodically. In this manner, continual environmental planning is built into both the commencement and on-going operation of the Project, and environmental management reflects current operational, legislative and permitting requirements. Thus, it is essential that such plans and operating procedures be handled as 'living documents' to ensure that they will be subject to ongoing and periodic revisions to capture operational refinements that are acquired through experience, monitoring and inspection, compliance review, equipment upgrades, and follow-up assessments. Plans and procedures will also be reviewed and revised when there are any changes to licensing and permitting conditions, applicable legislation, or roles and responsibilities within Sio. Maintaining current plans and procedures will allow for continuous operational improvement and further protection of the environment. Where required revisions to these documents will be prepared with the cooperation of the applicable regulatory authority and will be provided for regulator review.”

Request:

1. When will the Management Plans be available for review? They must be made available with sufficient lead times to facilitate reviews prior to the CEC hearing. It is understood that having the detailed design in hand helps optimize the management plans, and that they very much must be living documents to adapt to conditions or outcomes that are realized during operations. However, there is a great deal of analysis done thus far to allow for SIO to put together a strong basis for the management plans required.

As such there is an expectation that the plans made available prior to the CEC hearing will be comprehensive.

Response:

1. The Groundwater Monitoring and Mitigation Plan has been developed in draft with the intention that it will be modified to address comments received from regulatory agencies, landowners and groundwater users. This plan will be provided in draft prior to the Hearing.

Please refer to CEC-IR-011 (3) for further information.

- IR Number:** MSSAC-IR-005
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** General EAP
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/
Preamble:** SIO SILICA IR Round 1 Response
“The redacted information in the Geotechnical Assessment is commercially sensitive information that could be used by Sio’s competitors to gain a competitive advantage over, and therefore prejudice, Sio Silica. Nonetheless, Sio has provided the full unredacted report to the regulator, CEC Commission and the Technical Experts hired by the CEC. Sio has also offered to provide the unredacted version of the report to hearing participants if they sign a Non-Disclosure Agreement. Therefore, the full, unredacted, report will be considered in the EA decision-making process.”
- Request:** 1. It is unclear if the redacted report only excludes commercially sensitive information, since much of the detail regarding the geotechnical analyses is also censored. The expert reviewers (Arcadis) also determined that there was not a need to designate the geotechnical analysis as confidential. Based on this, why is SIO forcing participants in the CEC process to sign an NDA when the root of what is being looked for here for review and assessment is the geotechnical analysis, and not SIO's commercially sensitive information?
- Response:** 1. Large portions of the geotechnical analysis in the Geotechnical Assessment were released in the Arcadis report already. The redacted information that has not already been disclosed is commercially sensitive. Sio maintains that a copy of the full report can be reviewed by any interested party if an NDA is signed. As per the Arcadis report, *“Arcadis agrees with the assessments, recommendations and conclusions provided by Stantec (2022). The report presents a technical analysis of potential geotechnical failure modes that, in the opinion of Arcadis, is generally appropriate for a project that is undergoing Environmental Assessment.”*

IR Number: MSSAC-IR-006

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: General EAP

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response

“Sio rejects Arcadis's claim that "the level of public engagement in this case appears to be less than we would have expected". It is unclear to Sio what information about Sio’s public engagement Arcadis reviewed, but Sio has been following the process of public engagement that is required by the EAB and Rural Municipality of Springfield, and other provincial agencies. There have been multiple advertised public engagement opportunities and local events designed to provide information to, and obtain input from, the public regarding the extraction Project specifically, including a virtual public open house on August 24, 2021 which included a question and answer period; an in-person community information session on November 29, 2021 in Anola, Manitoba; the EAP public review process; and a pending Clean Environment Commission Hearing. Sio has also engaged in several other meetings focused on the Facility project or general updates and individual and group meetings with the intent of sharing project information and obtaining feedback from the public and interested stakeholders. Other public meeting dates included: May 26, 2020 virtual meeting; December 15, 2020 virtual meeting; April 9, 10 and 11th 2019 in person meetings in La Broquerie, Anola and Richer; as well as a May 2017 in person meeting in Anola.”

Additional information about public engagement was provided in Sio’s response to CEC-IR-001.

Request: 1. Additional detail is given in CEC-IR-001 regarding consultations with First Nations. No information is provided regarding First Nations perspectives and concerns/feedback to SIO regarding the Project. Where is this information available?

Response: 1. The specific feedback that has been provided by Indigenous groups to Sio to date was provided on a confidential and without prejudice basis. As such, Sio is unable to disclose any details beyond what was provided in the response to CEC-IR-001.

IR Number: MSSAC-IR-007

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Air Quality

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
"Although it has not been stated in the EAP, Sio expects that the Environmental Approvals Branch (EAB) will include requirements for air quality monitoring during Project operations within the terms and conditions of the EAL, and Sio will comply with any air quality monitoring requirements as stipulated."

Request: 1. Why has SIO not taken a proactive approach in identifying and/or dispelling any air quality issues/concerns that may arise due to the project?

Response: 1. Sio/AECOM has considered the potential for air quality issues or concerns resulting from the extraction proposal, and Sio/AECOM believes any air quality issues or concerns to be unlikely. As previously stated in various IRs, the sand remains wet or completely submerged in water throughout the extraction process. Therefore, there is no risk of silica dust dispersion in this process.

As previously stated, in MSSAC-IR-007 Round 1:
"It is our opinion that the quantitative analysis proposed by Arcadis, including the development of an air emissions inventory and air dispersion modelling, is not warranted given the scope and scale of the Extraction Project. The vehicles and equipment used for Project activities (listed in Table 2-1 of the EAP) would not all be operating simultaneously and will move around the Project Site as extraction wells are drilled and progressively decommissioned. This equipment is also not all concentrated in one small location, nor is there a large volume of equipment. Where possible, equipment will be electrified thereby further reducing the potential for emissions. For these reasons, Sio concluded that this equipment and activity would not cause significant air quality impacts.

The greenhouse gas (GHG) calculations for the EAP (Section 6.3.2) are based on guidance in Canada's Greenhouse Gas Quantification Requirements (Environment and Climate Change Canada, 2019). The annual calculations reflect the full numbers of diesel equipment types, expected engine Tier (i.e., age of equipment), hours of operation (detailed

in the EAP, Table 6-3) and fuel consumption during extraction operations. The calculation also includes all electrical power consumed for extraction activities.

Although it has not been stated in the EAP, Sio expects that the Environmental Approvals Branch (EAB) will include requirements for air quality monitoring during Project operations within the terms and conditions of the EAL, and Sio will comply with any air quality monitoring requirements as stipulated.”

- IR Number:** MSSAC-IR-008
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Climate Change
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
“As per Information Bulletin – Environment Act Proposal Report Guidelines, which was prepared by the Province of Manitoba and applies to all Environment Act Proposals (EAPs) prepared under The Environment Act, the completion and inclusion of an assessment of impacts that climate change could have on the environmental performance of the Project is not an EAP requirement. However, it should be noted that the impact of climate change, most notably the potential effects on groundwater/aquifer during drought conditions, has been discussed in Responses to the Public table submitted to Manitoba Conservation and Climate, Environmental Approvals on January 14, 2022 (Key Issue / Question # 32).”
- Request:** 1. Climate change, and the effects climate change may have on projects is undeniable. Why would SIO not address this issue only because it is not a requirement of the EAP? Please comment on your effects analysis regarding the potential effects on groundwater/aquifer during drought conditions, with reference to the following publication: Wang, J., and Betcher, R.N. (2011) "Groundwater, drought/wet cycle and climate change, Southern Manitoba, Canada" Geohydro 2011 Conference.
- Response:** 1. The publication referenced in the request could not be located by AECOM and does not appear to be publicly available. However, a previous publication by Wang J., R.N. Betcher and G.C. Phipps (2008) “Groundwater resource evaluation in southeastern Manitoba” GeoEdmonton ’08 was reviewed during completion of the Hydrogeology and Geochemistry Assessment (AECOM 2021). AECOM would be glad to review the document cited in the request and provide additional comment if the publication is made available.

With reference to components of the water balance that may be affected by climate change, Wang et al. (2008) presented “*a very preliminary estimation shows the lateral recharge from Sandilands area to bedrock aquifers only occupy 7.2% of the groundwater usage. The vertical recharge will play a bigger role on groundwater sustainable development. Most of the area shows the development is sustainable, only a small area to the*”

west of Steinbach has shown some development pressure and the groundwater level will need more time to reach the new equilibrated condition.” They noted that “It is very difficult to estimate vertical recharge component because it is related to the hydraulic conductivity of the overburden materials which has not been well characterized, the thickness and area, the head difference between surficial layer and bedrock aquifer etc.” They postulated that groundwater levels followed “a 60-year climate cycle. Regionally, groundwater level declines from 1960s to 1990 due to deficit in precipitation, and then it increased from 1990 after higher precipitation is recorded in the region.”

It is acknowledged that climate change is important to understand and consider during evaluation of projects that have the potential to impact groundwater and surface water resources. Climate change predictions suggest Manitoba will see warmer and wetter winters and longer, warmer and drier summers. Precipitation is likely to vary more from year to year. Extreme heat waves, droughts, floods and intense storms will likely become more common. Warmer winters may increase groundwater recharge if the ground is thawed for a greater proportion of the year. Variability in groundwater recharge was evaluated in the Hydrogeology and Geochemistry Assessment (AECOM 2021), with the results presented in Table 6-2. Results indicate that when recharge is increased or decreased by 20% relative to the Base Case, simulated drawdown in the carbonate aquifer would decrease or increase by up to 0.4 m, respectively. In the sandstone aquifer, drawdown was also simulated to decrease or increase by up to 0.4 m. These values are less than the magnitude of seasonal variability in groundwater elevations and are not anticipated to significantly affect the availability of groundwater in the area for private or public use.

Historical observations suggest the system is affected by changes in meteoric inputs, namely groundwater recharge, but that impacts are reversible over time. Even in recent years, seasonal drought has affected well yield, but those impacts were judged by others to be primarily related to the elevation of pump installation in private wells rather than limited by the availability of groundwater. It was suggested that lowering of pumps was a viable solution to managing lower groundwater elevations in response to seasonal changes in groundwater elevations. Most importantly, the project proposes to extract sand and the associated groundwater during the spring, summer and fall months, when groundwater elevations in both the Red River Carbonate aquifer and Winnipeg Sandstone aquifer are highest. Monitoring of groundwater levels and the quantity of sand and groundwater extracted and reinjected to the aquifer will be an important component of project operations. The Trigger Action Response Plan (TARP) will include provisions for management of low groundwater elevations induced by drought, and may involve curtailment of operations in extreme cases.

IR Number: MSSAC-IR-009(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
"The well cluster layout was originally developed utilizing a previous geotechnical model and operational efficiency level per well. Since the EAP filing the geotechnical model has been updated and was filed with the responses to public comments filed January 14, 2022 in Attachment A. The confidential version was also filed to the Approvals Branch and the CEC. Additionally, new efficiencies have also been developed to reduce the overall number of wells needed. The cluster configuration will now be required to follow the new geotechnical model. A project update letter will be filed with this new configuration prior to the CEC hearing. The Stantec model predicts that if the extraction disturbance is kept limited to the allowable dimensions provided in the geotechnical review report, the intact sub-horizontally layered limestone in the caprock will provide sufficient support for the overlying strata."

Request: 1. When will the update letter outlining the new cluster configuration, that aligns with the new geotechnical model be available for assessment?

Response: 1. The update letter with the Extraction Plan was filed January 24th, 2023 with the IR responses.

- IR Number:** MSSAC-IR-009(b)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
“The shape is derived from the shape measured by the side scan sonar survey completed on wells after or during a paused extraction, where the walls are left close to vertical in the short-term. Geotechnical analysis predicts further collapse of the immediate cavity wall, but the stability analysis considers the long term expected cavity expansion including this collapse. In the long-term, the collapsed sand would settle to a natural unconsolidated sand angle of repose of 31 degrees in front of a less disturbed cavity wall.”
- Request:** 1. What is the diameter and depth (geometry) of the voidspace applied in the long term geotechnical analysis for the collapse scenario where the angle of repose is "31 degrees in front of a less disturbed cavity wall."? How do you know in the long term exactly what this configuration will look like? What were the sensitivity analyses applied here to assess risk of different voidspace geometries and presumably increased crown span lengths?
- Response:** 1. The short-term disturbed cavity shape and Long-term Allowable Limestone Unsupported Span (Diameter) (m) are provided in Table 9 “Allowable Extraction Disturbance Zone Dimensions”, in the Geotechnical Analysis Report dated January 14, 2022. The long-term allowable limestone unsupported span (diameter) in the geotechnical report is the estimated long-term cavity shape considering the zone in the cavity wall that will fail in the long term. The void is estimated to be partially backfilled by the loose failed sand from the sandstone wall. The backfilled sand will fill the cavity with an estimated angle of repose of 31 degrees in the cavity. The failure of the cavity wall in the long term is estimated based on a numerical strain-softening Fast Lagrangian Analysis of Continua, (FLAC) model with the sandstone strength parameters calibrated with observations from the side scan sonar data. The long-term propagation is limited to the areas with a factor of safety less than 2 (undisturbed sandstone strength is less than twice the estimated stress) in the wall. The factor of safety of 2 is selected based on the case histories of stable cavities reported in the literature (Carter 2014) that showed that

cavities with a factor of safety higher than 2 are stable longer than 100 years. The FLAC model results show that propagation is 5 m (areas of a factor of safety less than 2). This approach considers sensitivity to risk of different void shapes by using a conservative estimate of void dimensions and a high target Factor of Safety (FOS) of 2.

Please also refer to the response to Round 1 MSSAC-IR-009(b).

- IR Number:** MSSAC-IR-009(c)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
“There is some potential for interconnection from well to well (which is managed by allowable span) and very limited potential for connection between well clusters when employing geotechnical design recommendations. The geotechnical model accounted for sand to settle out to its natural angle of repose of 31 degrees and a 100 year time frame. Therefore, no further movement is expected. The total allowable span may contain more than one well, and these wells within the same cluster area may interconnect in the sandstone. The distance between adjacent well clusters is set to eliminate interconnections between adjacent well clusters.”
- Request:** 1. What is the detailed geometry of the voidspace in the geotechnical analysis when allowing for the sand to settle out to the natural angle of repose of 31 degrees, and on a 100 year timeframe? Without having run a field extraction test on a full well cluster, is this configuration representative?
- Response:** 1. The Extraction Disturbance Zone Dimensions presented in Table 9 of the Geotechnical Assessment report (Stantec 2022) are the short-term cavity diameter assumptions in the models. FLAC analysis predicts that the cavity walls may further fail over time and increase cavity radius by 5 m. The failed sand is expected to be loose in the cavity and settle out to its natural angle of repose of 31 degrees in the long term (a 100-year time frame). The void space is representative of full well cluster void spaces as FLAC modeling of the void space uses conservative assumptions for caprock strength and stress conditions and assumes no additional support from previously failed sand that will partially fill the cavity.
- Also refer to the response to MSSAC-IR-9(b) above.

IR Number: MSSAC-IR-009(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

The approach, assumptions and calculations as part of the model are outlined in the Geotechnical report. An excerpt of the assumptions made are outlined below:

- Selection of controlling failure scenarios: The geotechnical assessments consider the potential failure scenarios (modes) including shear failure mode, bending (tensile) failure mode, cross-joints failure mode and other failure modes (Caving and Chimneying failures).
- Stability Factors of Safety: A factor of safety of 2.0 is deemed to be reasonably conservative for stability analysis to verify that subsidence will not occur.
- The lifetime of the project: For geotechnical stability design, the design life expectancy for post-extraction stability is set as long-term (quasi-permanent) with a lifetime of 50 to 100 years. It is assumed that if the adverse stability effect is not observed during this time frame, there is minimal risk for the development of adverse effects in the longer term.
- Use of Site data to develop design parameters for BRU property: Stantec assumed that the results of geotechnical borehole logging, point load testing, laboratory testing and ABI/OBI as well as supporting information from other boreholes geological logging are representative of the site-wide rock mass characteristics, with the exception that the thickness of lithologic units varies. Although borehole logging indicates that conditions are relatively consistent, there remains some potential for local variability of rock strength and structure to occur which may contribute to the local settlement.
- Use of monitoring data to develop design parameters: Stantec assumes that the results of settlement monitoring to date, which indicates no apparent early-term settlement, is representative of probable settlement during full-scale mining and the long term. There remains some potential for changes in local support conditions to generate settlement in the short or long term.
- Use of downhole side scan sonar data to develop design parameters: Stantec assumes that the results of downhole side scan sonar of the cavity (void) after mining is representative of the probable behaviour of the void during full-scale mining. There is some potential that additional changes to the cavity and the area of influence of sand extraction may change over the long term.
- Development of operational-level monitoring systems: The geotechnical design includes recommendations for operational monitoring systems to confirm the design assumptions and performance during the extraction process.
- Development of operational-level

mitigation options: The design includes operations-level recommendations for mitigation options should monitoring data show changes in design assumptions or if less favourable conditions are observed during operation.

Request:

1. This list of assumptions does not answer the question, nor does the redacted geotechnical report. Please answer the questions asked, showing the calculations/analyses.

Response:

1. Sio maintains that its response to MSSAC-IR-9(d) answered the questions that were posed.

IR Number: MSSAC-IR-009(e)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

The analysis considered overburden thickness variation between 25 and 35 m in the extraction area. Caprock strength was adopted based on the tests on areas with limestone thickness between 10 and 25 m in the extraction area. Shale and limestone/shale rock (which may be fractured) were excluded from the caprock strength (not relied on for caprock strength). Cross-bedded limestone was also excluded from the caprock strength. Design was based on the sequence of competent (predominantly unfractured) caprock which was found to be present. The average Geological Strength Index (GSI) for the competent limestone rock mass was estimated to be 60.8 for the five boreholes in the BRU property and its vicinity. The design GSI value for competent limestone was selected as 60 (i.e. equivalent to the lower quartile of the estimated GSI). Limestone tensile strength was estimated based on laboratory tests on 19 specimens from five different wells. To consider the effect of larger bedding size than the tested samples, a factor of 0.8 was applied to the 3.8 MPa to estimate the limestone tensile strength tests. In addition, to estimate the long-term (100 years) degradation of the tensile strength, a reduction factor of 0.5 was applied. Therefore, a limestone tensile strength of 1.5 MPa was used in the analysis.

Request:

1. The carbonate bedrock in the region of the project is an aquifer system that has a series of vertical joint sets, and predominant horizontal bedding planes, which form conduits for groundwater flow. This is well documented and is characteristic of the aquifer system. The estimate of GSI was made on core collected at 5 boreholes. The GSI is intended for rock masses that behave as homogeneous isotropic rock masses. The rock mass has very regular bedding planes and bedding plane partings (periodically infilled) and also was subject to paleokarst processes that impart irregularity to the rock mass as well. As such, how were these characteristics accounted for when determining the GSI of the rock mass?

Response:

1. The GSI values were identified for equivalent homogeneous rock mass parameters. The portion of carbonate limestone that is considered for stability evaluation of the cavity is the horizontally bedded portion (cross

joints and weak areas are excluded). The shear failure mode analysis uses a GSI of 60 representative of Good joint surface conditions and “Very blocky-interlocked, partially disturbed rock mass with multifaceted angular blocks formed by four or more discontinuity sets”. Therefore, the GSI of 60 is considered to be conservative for the competent layered limestone.

- IR Number:** MSSAC-IR-009(f)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response

Stantec estimates that the limestone beddings will behave as a multi beam supporting system for the combined load from overburden and limestone. Although the lower beams can be unsupported and damaged (and potentially collapse into the cavity), a portion of the beam will remain stable and act as a cantilever beam to support the upper stratigraphy. This will result in a progressively smaller unsupported beam span upward. The cavity opening size is limited such that the expected damaged caprock does not reach the upper layers of the caprock and the undisturbed caprock layers are thick enough to support the overburden load.
- Request:** 1. This is a very general answer to a very critical question. The described mode of strata collapse, resulting in cantilever beam support and a progressively smaller unsupported beam span upward in the crown of the cavity is of critical importance. What will stop the progressive collapse from happening? What is the minimum thickness of remaining "unsupported beam" caprock necessary to maintain the crown? The rockmass is characterized by vertical jointsets that are typically at spacings less than the crown span that may occur with sand extraction within a well cluster, and the horizontal bedding planes are pervasive, often at less than 1.5 m +/- spacing. More detail is necessary here to demonstrate that the crown of the cavities formed with sand extraction will remain intact.
- Response:** 1. Progressive collapse is stopped by limiting the allowable long-term cavity diameter. The allowable long-term cavity diameter is defined such that at least two full intact beam spans remain at the top of the cavity and additional partially intact cantilever beams below support the remaining cavity opening. The zones of carbonate limestone with vertical joints are excluded from the beam system evaluation (they are not relied upon to provide support).

- IR Number:** MSSAC-IR-009(g)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response

Sio will be drilling and coring wells regularly in areas of extraction prior to drilling the extraction wells to confirm overburden and limestone thickness. Core samples will be taken and analyzed to confirm limestone competency. Subsidence monitoring will be ongoing. Once extraction is complete monitoring will continue. There are effective high resolution subsidence monitoring approaches available which Sio Silica has investigated and for long term subsidence monitoring of large areas, one of these, such as aerial drone LiDAR or InSAR, may be used. Monitoring frequency begins with frequent monitoring and frequency increases or decreases based upon monitoring results (more frequent monitoring if subsidence is measured, less frequent if no subsidence is measured).
- Request:** 1. This is far too general an answer to the question. The monitoring and mitigation plan requires development in full and in a timely manner to allow for review and assessment, within the CEC process. In addition, the rate of subsidence may or not follow a "linear" progression; depending on the design of the monitoring and mitigation program, warning signs leading into unacceptable subsidence scenarios may be completely missed, with no time to apply mitigative measures.
- Response:** 1. At this stage of the project the monitoring program level of detail in the Stantec report is appropriate and conservative. The current plan emphasizes the importance of monitoring to identify warning signs. A detailed monitoring and emergency response plan will need to be developed after issuance of a licence for the project.

- IR Number:** MSSAC-IR-010(a)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-009(b). The short-term cavity shape is based on side scan sonar data. The sonar shape shows even some reverse angle (hanging) sand above the filled area. The shape was then used in a stress-deformation model (FLAC) to identify the stress condition for this short-term shape. This FLAC model helps to identify areas where stress is greater than half the sand strength. These areas are expected to slough into the cavity. The resulting stress/strength ratio contour then suggests a 65-degree shape. The sand over time may re-distribute within the cavity to a natural angle of repose of 31 degrees.
- Request:**
1. Short term (immediate post sand extraction) sonar on a small number of wells (i.e. not a completed well cluster) to determine voidspace geometry is not representative of the long term condition described and acknowledged here. As in MSSAC-IR-009 b): What is the diameter and depth (geometry) of the voidspace applied in the long term geotechnical analysis for the collapse scenario where the angle of repose is "31 degrees in front of a less disturbed cavity wall."? How do you know in the long term exactly what this configuration will look like? What were the sensitivity analyses applied here to assess risk of different voidspace geometries and presumably increased crown span lengths?
- Response:**
1. See the responses to MSSAC-IR-009 (b) and (c) above.

- IR Number:** MSSAC-IR-010(b)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
Results of two side scan sonar surveys were used to estimate the cavity shape for the analysis at this stage. Stantec estimated that the findings from these two side sonar surveys provided the range of expected conditions at the site as the stratigraphy and strength properties of caprock and sand deposits were observed to be relatively uniform. Stantec recommended conducting multi-well testing after issuance of an Environment Act Licence while operations begin with a smaller number of wells and then increase over time. This staged approach will allow Sio Silica to confirm expected conditions before a larger multi well extraction and make adjustments that may be required. Arcadis's review agreed with the use of side scan sonar. See also the response to MSSAC-IR-012 (b) and DLN-IR-009(f).
- Request:** 1. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.
- Response:** 1. Sio maintains that its response to MSSAC-IR-010(b) answered the question that was posed. As noted in the response to MSSAC-IR-010(b), Sio is committed to Stantec's recommendation to, *"conducting multi-well testing after issuance of an Environment Act Licence while operations begin with a smaller number of wells and then increase over time. This staged approach will allow Sio Silica to confirm expected conditions before a larger multi well extraction and make adjustments that may be required."*

- IR Number:** MSSAC-IR-010(c)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/
Preamble:** SIO SILICA IR Round 1 Response

Subsurface sand cavern imaging in real-time is not a technology that currently exists for this application. Sonar surveys were taken during paused extraction, then resumed extraction and survey was re-ran after the extraction was complete to see if there was a difference in the shape of the cavern. Generally, the shape remained the same.
- Request:** 1. Real time measurements are not the ask here. It is an expansion upon what was done; imagery taken in wells during pauses in extraction, however for all wells within a development cluster. Temporally, data collection is needed at all wells in a cluster during pauses in the extraction process, and thereafter in time post sand extraction to monitor how the voidspace develops, and whether there are any well interconnections that occur within a cluster either during sand extraction or post extraction as the voidspace comes to equilibrium. Please provide a plan that reflects this kind of data collection, to allow for proper evaluation of the project.
- Response:** 1. According to the Geotechnical Design recommendations, there is a recommendation according to the void space geometry which is *“Complete side scan sonar survey after each borehole completion and assess results against cavity extraction assumptions”*. This recommendation acknowledges that Sio is aware of the importance of completing monitoring. Sio will conduct this monitoring during extraction operations.

IR Number: MSSAC-IR-011(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to DLN-IR-009(f), MSSAC-IR-010(b) and MSSAC-IR-012(b). Stantec recommended multi-well testing after issuance of the EAL to confirm and refine design assumptions. Based upon current information which is believed to effectively characterize site geotechnical conditions, it is not expected that the results of the multi-well testing will vary markedly from expectations. There is limited geotechnical risk associated with this approach. The multi-well testing will be monitored at the surface and subsurface. Monitoring data from the multi-well testing will be utilized to confirm design assumptions. Relatively minor adjustments might be required to design for operational assumptions.

Request: 1. Disagree. A full test-scale extraction of a well cluster could be executed, measured, and monitored to demonstrate the expected results. This is necessary to evaluate this project properly. Please advise with respect to the SIO commitment to conduct full scale quantitative testing and measurement on a full well cluster. See also MSSAC-IR-010 round 2 requests.

Response: 1. There is no question in this Information Request. Sio maintains that its response to MSSAC-IR-010(c) and MSSAC-IR-011(a) answered the questions that were posed.

IR Number: MSSAC-IR-011b

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the responses to MSSAC-IR-010(c) and MSSAC-IR-011(a).

Request: 1. Disagree. A full test-scale extraction of a well cluster could be executed, measured, and monitored to demonstrate the expected results. This is necessary to evaluate this project properly. Please advise with respect to the SIO commitment to conduct full scale quantitative testing and measurement on a full well cluster. See also MSSAC-IR-010 round 2 requests.

Response: 1. There is no question in this Information Request. Sio maintains that its response to MSSAC-IR-010(c) and MSSAC-IR-011(a) answered the questions that were posed.

IR Number: MSSAC-IR-012(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response

Due to the parameters of the geotechnical model that were issued after the original 7 well cluster application was made and new efficiencies reducing the number of wells were identified, there will be a reduced number of wells and cluster size. In consideration for concerns about 'full-scale' testing, Sio has elected to start its operations at a location that allows for a reduced number of wells in a cluster, some as small as 1-2 wells. Sio will also conduct a multi-well test after the issuance of an Environment Act Licence while starting with single well production. Therefore, a ramp up period will occur with the initial phase of operations limited to smaller well clusters, where the design assumptions and Stantec's modeling will be confirmed by monitoring and minor adjustments might be required to the design. Should results of testing yield requirements for parameter changes, Sio will provide this to the Approvals Branch for review. Also see the response to DLN-IR-009(f).

Request:

1. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response:

1. Sio maintains that its response to MSSAC-IR-012(a) answered the question that was posed.

IR Number: MSSAC-IR-012(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response

The Stantec model is considered to be conservative and is designed to achieve little to no subsidence in the immediate extraction area and no subsidence beyond the immediate extraction area. The limestone design GSI value is the lower band of the measured GSI values from boreholes. Reduction factors are also applied to the measured tensile strength tests values for selection of the limestone design tensile strength value to consider variation of the tensile strength due to spatial variation of limestone conditions at site and also changes with time and layering thickness in the extraction area. In addition, any horizontal stress in the caprock was ignored in the model (an additional conservative assumption). Subsidence monitoring will occur before, during and after extraction activities and will continue long term. Additionally, the first year of activities are on an old highly disturbed gravel quarry, with no homes in the area. Due to the parameters of the geotechnical model that were issued after the original 7 well cluster application was made and new efficiencies reducing the number of wells were identified, there will be a reduced number of wells and cluster size. In consideration for concerns about 'full-scale' testing, Sio has elected to start its operations at a location that allows for a reduced number of wells in a cluster, some as small as 1-2 wells. Sio will also conduct a multi-well test after the issuance of an Environment Act Licence while starting with single well production. Therefore, a ramp up period will occur with the initial phase of operations limited to smaller well clusters, where the design assumptions and Stantec's modeling will be confirmed by monitoring and minor adjustments might be required to the design. Over time, the number of wells per cluster will increase as the extraction activities move farther away which will allow for additional confirmation of the Stantec model as recommended by Stantec. Should results of testing yield requirements for parameter changes, Sio will provide this to the Approvals Branch for review.

Request:

1. Does your assignment of the GSI value account for anisotropies such as the regular horizontal bedding planes within the rockmass and any paleokarsticity? Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction

voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

- Response:**
1. See the response to MSSAC-IR-009(e). Sio also maintains its response to Round 1 MSSAC-IR-012(b) answered the question that was posed.

IR Number: MSSAC-IR-012(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-012(b). Current testing is understood to be representative of most likely case full scale extraction performance and the conservatism built into the Stantec model is understood to further reduce the geotechnical risk.

Request: 1. Testing is based on single wells; a model is a prediction that may or may not be representative. The geotechnical work is difficult to discern in the redacted report. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-012 (b) and (c) answered the question that was posed.

IR Number: MSSAC-IR-012(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-012(b).

Request: 1. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-012(b) answered the question that was posed.

- IR Number:** MSSAC-IR-013(a)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
1. Distances were selected based on preferred locations that allowed for mobile equipment to move around the monitoring instrument without damaging or interfering with the results of the measurements. This would not be an issue in a regular operation, however due to the nature of testing, there is more mobile equipment around the monitoring instrument. Distances were also based on the ability for the land surveyors to install the monument locations. Monitoring points which are located as much as 15 m from the wells are expected to measure subsidence if it occurs. This behavior was predicted by the geotechnical FLAC analysis.
- Request:**
1. The well bore and voidspaces created during single well testing would not have a 15 m radius, from information provided. Thus, a monitoring point 15 m away would not be expected to subside. In addition, time and downhole voidspace geometry/void performance are factors in the progression of subsidence. Please explain in detail why closer monitoring points were not used to determine deformation above the cavity and explain why the settlement data collected to date is considered adequate, when the distribution of settlement measuring points used to date are not adequate to measure actual deformations?
- Response:**
1. Sio maintains that its response to MSSAC-IR-013(a) answered the question that was posed. As previously described in the response to MSSAC-IR-013(a), the 15m distance was selected with consideration of limitations imposed from the moving mobile equipment and interfering with the measurement result.

IR Number: MSSAC-IR-013(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the responses to MSSAC-IR-012(b) and DLN-IR-009(f).

Request: 1. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-012(b) and DLN-IR-009(f) answered the questions that were posed.

IR Number: MSSAC-IR-014a

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See response MSSAC-IR-012 (b) and DLN-IR-009(f). Sio Silica plans to complete multi-well testing after issuance of the EAL, as operations start out with smaller number of wells and increase. Sio Silica will be installing measurement devices for subsidence at a high level of accuracy equal to or less than 1mm. A Trigger Action Response Plan (TARP) will be developed with defined protocols to respond to subsidence issues. Subsidence monitoring devices include underground extensometers anchored to the caprock top surface, and piezometers within the overburden and at top of caprock surface within 5 m of the centre of extraction.

Request: 1. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-014(a) answered the question that was posed.

IR Number: MSSAC-IR-014(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See response A and response to MSSAC-IR-009c. Well clusters and allowable spans of varying size have been investigated and requirements to achieve stable design are understood and will be used for varying thicknesses of overburden, caprock thickness and strength, void behavior and number and location of wells.

Request: 1. Void behavior has been measured only in single well tests and otherwise predicted in the geotechnical modeling, which is impossible to evaluate within the redacted report. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-014(b) answered the question that was posed.

IR Number: MSSAC-IR-015(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the responses to MSSAC-IR-012(b), MSSAC-IR-014 (a) and DLN-IR-009(f).

Request: 1. Void behavior has been measured only in single well tests and otherwise predicted in the geotechnical modeling, which is impossible to evaluate within the redacted report. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-012(b), MSSAC-IR-014(a), and DLN-IR-009(f) answered the questions that were posed.

IR Number: MSSAC-IR-015(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the responses to MSSAC-IR-012(b), MSSAC-IR-014 (a) and DLN-IR-009(f).

Request: 1. Void behavior has been measured only in single well tests and otherwise predicted in the geotechnical modeling, which is impossible to evaluate within the redacted report. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction voidspaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-012(b), MSSAC-IR-014(a), and DLN-IR-009(f) answered the questions that were posed.

- IR Number:** MSSAC-IR-015(c)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Geotechnical
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal Appendix A - Review of Geotechnical Analysis of Sio Silica Extraction Project Near Vivian Manitoba; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
Sio is willing to share its modeling results with the CEC experts, yes. However, these results contain confidential information and will only be shared with those CEC technical experts who have signed an NDA.
- Request:**
1. It is impossible to evaluate and assess the geotechnical work in the redacted geotechnical report. The model results must be shared for assessment and proper evaluation. Without the sharing of these results, the work cannot be properly evaluated, and without sharing of these results, the licensing process will be flawed. It is confounding that geotechnical analyses such as these are considered confidential information that is unique to SIO's operations, when SIO is a sand producer in the materials industry and not a geotechnical engineering firm. The ARCADIS review of the geotechnical work highlighted the fact that an NDA is unnecessary to view the geotechnical work. Why does SIO continually deflect the sharing of critical, key geotechnical modeling information and analysis that is the basis of the entirety of this project, by imposing an unnecessary NDA to view the materials?
- Response:**
1. Large portions of the geotechnical analysis in the Geotechnical Assessment were released in the Arcadis report already. The redacted information that has not already been disclosed is commercially sensitive. Sio maintains that a copy of the full report can be reviewed by any interested party if an NDA is signed. As per the Arcadis report, *"Arcadis agrees with the assessments, recommendations and conclusions provided by Stantec (2022). The report presents a technical analysis of potential geotechnical failure modes that, in the opinion of Arcadis, is generally appropriate for a project that is undergoing Environmental Assessment."*

IR Number: MSSAC-IR-016(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response

The extraction process was fully described in Supplemental Filing #1 – Extraction Method filed June 3, 2022 to the CEC and hearing participants. In addition, As stated in the Responses to the Technical Expert Reports – Geotechnical, filed November 29, 2022 issue number 2: “Air lifting is a method that is used regularly in the water well drilling industry. It is used locally and internationally to drill wells in various formations. Sio’s extraction method combines the traditional method of airlift used to develop water wells and a dual rotary set up usually used to drill wells in unconsolidated formations to extract sand. Combining all of the collected information, pilot testing results, modelling and design, the environmental effects associated with the proposed extraction methods are generally well-understood.”

Request: 1. Can you clarify what environmental effects with this method are "generally well understood?"

Response: 1. Air lifting refers to the use of compressed air to remove drill cuttings and/or water from boreholes and water supply wells during or following their installation. Dual rotary is a drilling methodology that utilizes compressed air to remove drill cuttings and/or water from boreholes during drilling, and a casing system that allows for rotation of the casing and the drill string during drilling. It is very similar to air rotary drilling which uses compressed air with a casing hammer to drive the casing into the ground to maintain borehole integrity during drilling.

Both air lifting and rotary drilling are, individually, relatively common practices, and these methodologies have been subject to prior environmental assessment on other projects (in addition to the assessment completed for the sand extraction project EAP). This prior experience and knowledge has resulted in a general understanding of the potential for environmental effects associated with each methodology. This would include the potential for impacts on each of the environmental and socioeconomic components considered in the environmental assessment completed for this project, including:

- Geology/topography
- Soils
- Air quality
- Climate/GHG
- Noise
- Surface water
- Fish and fish habitat
- Vegetation
- Wildlife
- Species of special concern
- Labour force and employment
- Infrastructure and services
- Land and resource use
- Indigenous and Treaty Rights
- Heritage resources
- Aesthetics

The combined proposed air lift methodology, based on our understanding of the individual methodologies, would not be expected to have an adverse impact on each of these environmental components. Where additional data and study proved to be valuable in improving our understanding of the extraction methodology was in the assessment of the potential impact of the project on groundwater and human health. Because the sand extraction method is unique in that it combines the air lifting and dual rotary drilling methodologies, the hydrogeology and geochemical modelling, monitoring data, and pilot testing completed and compiled for this project were important in informing our assessment team on the potential environmental impact that may result from the interaction of these two methodologies. These studies provided valuable information for the successful evaluation of potential environmental impacts of the project on groundwater (and subsequently human health), supplemented our prior understanding of the drilling methodologies, and allowed for the completion of the overall environmental assessment for this project.

IR Number: MSSAC-IR-016(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

10 US gpm was the anticipated effective pumping rate at the time that the assessment was conducted, however this rate does vary. During operations, actual rates will be measured and documented to confirm assumptions and allow for refinements of the extraction process. The water loss is accounted for by the wet sand that will move from the extraction, be dewatered and then enter the slurry loop because the sand is not 100% dry when it moves from the wellbore to the slurry loop. Please note that the 270 US gpm and 260 US gpm referenced is per cluster, not per well. Well flow rates vary over time from approximately 40 - 120 US gpm.

Request: 1. Is it correct that the net aquifer loss is estimated at 10 Usgpm? Individual wells will be airlifted between 40 and 120 Usgpm? Total flows for a cluster of wells will be between 260 and 270 Usgpm? How are multiple wells planned to be airlifted concurrently?

Response: 1. The flow varies for each well, as flow may be lower at the start of a well and higher near the end of a well's operation. Wells in clusters will not all be operating on the same schedule. They will be staggered. One or two wells may be finished or being set up, while others might have just started or nearing the end of their operation. Thus, the total flow rate was estimated per cluster to be 270 US gpm of water.

IR Number: MSSAC-IR-016(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response
10 US gpm is not the rate of extraction. Well flow rates vary over time from approximately 40 - 120 US gpm (as stated in Section 2.4 Groundwater Use During Extraction of the Hydrogeology and Geochemistry Assessment) All the water except the approximate 10 US gpm is re-injected in the active well. This is the basis for the 10 US gpm effective rate. Also refer to the response to MSSAC-IR-016(b).

Request: 1. Is it correct the 10 Usgpm is a net loss to the aquifer? Individual wells will be airlifted with flows estimated between 40 and 120 Usgpm, with approximately 10 Usgpm lost from the aquifer (between approximately 8 and 25% of produced water then lost from the aquifer)?

Response: 1. This is the estimated net loss on the aquifer, yes.

IR Number: MSSAC-IR-016(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response
This question is based on an incorrect understanding of the extraction process. Please refer to the response to MSSAC-IR-016(b) and (c) and MSSAC-IR-009(a), (b) and (c).

Request: 1. The flow rate is inconsequential. If sand is able to be produced with airlift producing flow rates of between 40 and 120 USgpm the formation is likely poorly consolidated. How then can the void space created below surface everywhere have an angle of repose of 65 degrees, especially in the longer term when it is acknowledged it will trend toward the natural angle of repose?

Response: 1. The void space has been imaged using sonar technology to confirm the steep angle of the cavern after extraction which occurs because it is relatively undisturbed, and particles remain interlocked. The void space is expected to slough to angle of repose of 31 degrees.
Also refer to the responses to Round 2 MSSAC-IR-009 (b) and (c).

IR Number: MSSAC-IR-016e

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

The referenced schematic is an example only and not to scale. A permanent casing will extend into the sandstone aquifer to provide the ability to properly seal the well around the casing in the annulus. This casing will also provide guidance to the extraction tubing which is installed temporarily from an extraction rig to extract the sand. The extraction tubing is 2 pieces, one is a casing and inside is the airline. The airline is the source of the air and this stays inside the production tubing casing that is outside. This depth can be adjusted as required to allow for removal of sand and does not stay close to the shale. This is the basis for the ability to remove the sand; as the air comes out of the airline it does not have anywhere to go because it is inside the production tubing, therefore, it travels to the surface, and this provides the flow mechanism for the sand. Please also refer to Supplemental Filling #1 – Silica Extraction Method filed June 2, 2022 where the extraction process is described in detail. In the event that a trace amount of air escapes from the production pipe to the sandstone aquifer, the majority of the trace amount of air will move in the direction of groundwater flow and eventually escape to the atmosphere. In addition, a small amount of air will dissolve in water, and the solubility of air in water follows Henry's Law. Under the atmospheric condition and T=25oC, the solubility of air (21% O2 and 79% N2) is about 23 mg/L, and air solubility increases with pressure. Therefore, the trace amount of air will either move with groundwater flow, dissipate up the wellbore or remain in dissolved phase, and will not have an adverse impact on the permeability of the sandstone aquifer. Also refer to the Hydrogeology and Geochemistry Assessment Report – Section 8.3: “In many cases, the impact was simulated to be positive due to reduction of concentrations of iron and manganese when oxygen is introduced into the aquifer or is allowed to mix with water containing lower concentrations of those elements.”

Request:

1. Air within voidspaces will tend to become trapped, depending on the geometry of the crown of the voidspace. Please elaborate, in particular how air will eventually escape to the atmosphere when trapped below a shale aquitard zone.

Response:

1. A very limited volume of air will interact with the aquifer. It will be injected into the extraction tubing and the buoyancy effects will cause it to rise and draw behind it groundwater and entrained sand. Because groundwater (and sand) will flow toward the extraction well, any air that escapes the production pipe will tend to be report to the well and be removed during extraction. As previously stated in the response to Round 1 MSSAC-IR-016 (e), *"In the event that a trace amount of air escapes from the production pipe to the sandstone aquifer, the majority of the trace amount of air will move in the direction of groundwater flow and eventually escape to the atmosphere."* This would be the same for any water well drilled with air or developed after. Once on surface, air will largely exsolve from the sand slurry. Therefore, air is not expected to build up in the aquifer. Water returned to the wellbore may be slightly oxygenated, however the quantity of oxygen would be very low and finite and will dissipate over time. Any residual oxygen would likely be rapidly consumed by dissolved (reduced) iron or manganese in the aquifer.

IR Number: MSSAC-IR-016(f)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Geotechnical

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response
Please refer to the response to MSSAC-IR-016(b) and (c).

Request: 1. Is it correct that the net aquifer loss is estimated at 10 Usgpm? Individual wells will be airlifted between 40 and 120 Usgpm? Total flows for a cluster of wells will be between 260 and 270 Usgpm? How are multiple wells planned to be airlifted concurrently?

Response: 1. Please see the response to MSSAC-IR-016(b).

IR Number: MSSAC-IR-017(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Regarding regulatory implications please refer to CEC-IR-009. Also refer to Responses to Technical Expert Reports – Hydrogeology – filed on November 29, 2022, response to Issue #7 and Responses to the Technical Expert Reports – Geotechnical, filed November 29, 2022, issue 6.

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to MSSAC-IR-04(a), MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

- IR Number:** MSSAC-IR-017(b)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
- Due to the parameters of the geotechnical model that were issued after the original 7 well cluster application was made and new efficiencies reducing the number of wells were identified, there will be a reduced number of wells and cluster size. Sio has elected to start its operations at a location that allows for a reduced number of wells in a cluster, some as small as 1-2 wells. Sio will also conduct a multi-well test after the issuance of an Environment Act Licence while starting with single well production. Therefore, a ramp up period will occur with the initial phase of operations limited to smaller well clusters, where the design assumptions and Stantec's modeling will be confirmed by monitoring and minor adjustments might be required to the design. Over time, the number of wells per cluster will increase as the extraction activities move farther away which will allow for additional confirmation of the Stantec model as recommended by Stantec. Should results of testing yield requirements for parameter changes, Sio will provide this to the Approvals Branch for review.
- Request:**
1. Void behavior has been measured only in single well tests and otherwise predicted in the geotechnical modeling, which is impossible to evaluate within the redacted report. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not ony for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.
- Response:**
1. Sio maintains that its response to MSSAC-IR-017(b) answered the question that was posed.

IR Number: MSSAC-IR-017(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the response to MSSAC-IR-017(a).

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to MSSAC-IR-04(a), MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-017(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As stated in the responses to public comments Key Issue/Question #32: “In accordance with Sio’s Groundwater Monitoring and Impact Mitigation Plan, water quality in the sandstone and carbonate aquifers will be monitored before, during and following operations to confirm that water quantity and quality is preserved in both aquifers. The results will be evaluated by a professional hydrogeologist or geochemist with experience evaluating water quality, with results provided to regulatory agencies for review. In summary, the Project will not contaminate the sandstone or carbonate aquifers, and water quality is not anticipated to be materially affected by Project operations.” Please also refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue 7 and issue 8.

Request: 1. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to MSSAC-IR-04(a), MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-018

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As stated in the Responses to the Technical Expert Reports – Geotechnical, filed November 29, 2022, issue 7: “It should be noted that the use of UV is purely precautionary, as contamination is not expected during the sand extraction process. UV will be utilized in an abundance of caution. Based on the available technology, and the work done to date, Sio is confident that water can be effectively treated utilizing UV and filtration, and that reinjection of water into the aquifer will not cause any significant impacts to water quality. At the time of submission of an EAP, applicants are not required to have completed their detailed engineering and design. Detailed engineering and design is typically completed during and after the regulatory review process, incorporating input from government agencies and other interested parties. Sio is working with industry leading ultraviolet (UV) treatment specialists and a certified laboratory to determine appropriate equipment selection for UV treatment and filtration. UV systems are widely used to disinfect industrial and municipal water for potable and non-potable uses and the systems being considered by Sio are all proven, commonly used, and available from many established suppliers. To support the design of the UV treatment system, Sio will be undertaking additional water quality testing. Several parameters will be monitored in the field and verified by the analytical laboratory to guide system design.” As indicated in Table 1, Response #11 in Sio's 'Response to the Technical Advisory Committee (TAC) Review Comments', posted on the Public Registry on December 20, 2021, Sio also stated: "Regarding technical specifications of the UV treatment system, a design dose of 25-30 mJ/cm² is typical for waste water treatment systems designed to meet 200 MPN/100mL fecal coliform limit, but a higher dose may be required based on local water quality and UV lamp fouling estimates. At this preliminary stage, the final design criteria for the UV treatment system are being developed. The final system design may also include a system that provides a target of 3-log (99.9%) inactivation of both Giardia and Cryptosporidium in accordance with local drinking water standards, although this is a higher level of treatment than is typically used in other applications when returning treated water back to the environment. An upstream filtration system may be required." "The control narrative related to pumping operation is still in the preliminary design stages, but will include industry-standard operational fail safe requirements such as: alternating Duty/Standby UV disinfection units, the inability

for the UV system to be bypassed, separate alarms to indicate lamp failure, low UV intensity and other causes of UV disinfection unit failure. A dedicated programmable logic controller (PLC) may be provided given the mobile nature of the systems, and multiple PLCs may be provided as necessary to ensure continuous treatment, depending on the final controls design."

- Request:**
1. Are there any other water quality parameters to treat prior to reinjection?
 2. If not, what is the basis for your interpretation?

- Response:**
1. There are no listed requirements to Sio's knowledge for water to be treated before it is returned to the aquifer. Injection well permits do not list any requirements for water to be treated prior to re-injection.

Sio has elected to take this approach out of an abundance of caution and has committed to returning the water to the aquifer in the same or better quality than it was when it was extracted.

Sio will ensure that its final design of the filtration system and UV system adhere to Sio's commitment that, *"The quality of the water returned to the aquifer following the sand extraction process will be similar to or better than the water removed from the aquifer during the extraction process."* This has been documented and committed to by Sio in its Public Comment Response to issue #24. Sio will also adhere to any requirements included in a licence.

Additionally, samples of produced water have been provided to water treatment system vendors and testing was conducted to confirm that filtration and UV treatment are able to effectively treat the produced water.

2. See response #1 above.

IR Number: MSSAC-IR-019

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 13 September 2022 Arcadis Technical Review of Sio Silica Corporation's Environment Act Project Proposal; and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As stated in the responses to public comments Key Issue/Question #32: “In accordance with Sio’s Groundwater Monitoring and Impact Mitigation Plan, water quality in the sandstone and carbonate aquifers will be monitored before, during and following operations to confirm that water quantity and quality is preserved in both aquifers. The results will be evaluated by a professional hydrogeologist or geochemist with experience evaluating water quality, with results provided to regulatory agencies for review. In summary, the Project will not contaminate the sandstone or carbonate aquifers, and water quality is not anticipated to be materially affected by Project operations.” As stated in the Responses to the Technical Expert Reports – Geotechnical, filed November 29, 2022, issue 8: “For the reasons outlined below, water quality at nearby water wells would be unchanged or possibly marginally improved as a result of the Extraction Project. Concerns regarding the impact of introducing oxygen into an anaerobic aquifer has been previously addressed in Sio's Responses to the Public table submitted to Manitoba Conservation and Climate, Environmental Approvals on January 14, 2022.” As explained in response to Key Issue / Question # 33, it is unlikely that dissolved oxygen will facilitate the proliferation of iron bacteria and other microbes. Most of the air utilized during the extraction process will not interact with the aquifer but will return to surface with the sand slurry and return to the atmosphere. The groundwater returned to the aquifer after treatment will contain only a very small volume of dissolved oxygen. Extraction activities will not introduce any biological contaminants into the aquifer. Also refer to DLN-IR-001 (b), public comments responses Key Issue / Question # 36, and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue 8.

Request:

1. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
2. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open

borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the responses to MSSAC-IR-04(a), MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.
2. Prior to drilling, the area will be visual inspected to determine if the ground may be contaminated. If the inspection indicates signs of potential contamination, samples will be collected and analyzed for contaminants suspected based on observation (pathogens, hydrocarbons, metals, nutrients, pesticides). If laboratory testing confirms the presence of contaminants remedial action (removal of contaminated material and contaminants source) will be undertaken prior to the initiation of drilling operations. This may involve relocation of boreholes to establish a safe distance from agricultural waste piles. Drilling operations will be carried out as per industry standards and best practice which include measures to prevent contamination. Surface water will be managed in a way that encourages positive drainage away from boreholes during drilling. The Progressive Well Abandonment Plan will ensure boreholes are sealed to prevent contaminant migration from ground surface into the underlying aquifers following sand extraction activities.

- IR Number:** MSSAC-IR-020(a)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
As stated in the Hydrogeology and Geochemistry Assessment Report – Executive Summary: “Based on the findings of the hydrogeology and geochemical assessment, groundwater quantity will be largely preserved within the project area due to the seasonal operation of sand extraction wells and reinjection of surplus groundwater following separation of solids. Based on the results of field testing, water levels were simulated to recover relatively rapidly, with approximately 80% recovery approximately two days following the end of production at each well cluster. Groundwater levels are anticipated to return to static water level conditions approximately 20-80 days after production ceases at each well cluster. Groundwater model simulations indicate that groundwater users of the Red River Carbonate aquifer and the Winnipeg Sandstone aquifer beyond a radial distance of approximately 2.2 km from the active extraction wells are unlikely to experience any effects due to extraction activities”.
- Request:**
1. Please comment on your effects analysis regarding the potential effects on groundwater/aquifer during operational conditions, with reference to the following publication: Wang, J., and Betcher, R.N. (2011) "Groundwater, drought/wet cycle and climate change, Southern Manitoba, Canada" Geohydro 2011 Conference.
- Response:**
1. Please refer to the response MSSAC-IR-008.

IR Number: MSSAC-IR-020(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
As stated in the Hydrogeology and Geochemistry Assessment Section 8.3 – Groundwater Quality: “Overall, material impacts to groundwater quality within the Project Area are unlikely because both the Red River Carbonate and Winnipeg Sandstone host fresh and relatively dilute groundwater. Based on the results of geochemical modelling, the activities associated with project operations and post-closure phases of the project were determined to have only a minor impact on groundwater quality. In many cases, the impact was simulated to be positive due to reduction of concentrations of iron and manganese when oxygen is introduced into the aquifer or is allowed to mix with water containing lower concentrations of those elements.” Please also refer to the responses to MSSAC-IR-017 and MSSAC-IR-019.

Request:

1. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
2. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the responses to Round 2 MSSAC-IR-004, MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.
2. Please refer to the response to MSSAC-IR-019.

IR Number: MSSAC-IR-020(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the response to MSSAC-IR-017.

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004, MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-020(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Sio will be developing and implementing a Groundwater Monitoring and Impact Mitigation Plan that includes monitoring the water quality in the sandstone and carbonate aquifers before, during and following operations to confirm that water quantity and quality is preserved in both aquifers. The results will be evaluated by a professional hydrogeologist or geochemist with experience evaluating water quality, with results provided to regulatory agencies for review.

Request:

1. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
2. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).
2. Please refer to the response to MSSAC-IR-019.

IR Number: MSSAC-IR-020(e)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the responses to MSSAC-IR-020(b) and MSSAC-IR-017.

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004, MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-021(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the responses to MSSAC-IR-017 and MSSAC-IR-020.

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004, MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-021(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the responses to MSSAC-IR-017 and MSSAC-IR-020.

Request: 1. The responses here refer back to the facts that the shale does not provide any geotechnical support to the caprock strata, which is agreed, and that the water quality impacts with enhanced interconnection will be monitored under the Groundwater Monitoring and Impact Mitigation Plan. This management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004, MSSAC-IR-023(b), CEC-IR-011 (3) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

IR Number: MSSAC-IR-021(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the responses to MSSAC-IR-017 and MSSAC-IR-020.

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004 and MSSAC-IR-019, and CEC-IR-011 (3).

IR Number: MSSAC-IR-021(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the responses to MSSAC-IR-017 and MSSAC-IR-020.

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response: 1. Please refer to the responses to Round 2 MSSAC-IR-004 and MSSAC-IR-019, and CEC-IR-011 (3).

IR Number: MSSAC-IR-021(e)
Submitted by: MSSAC
Date Submitted: January 10, 2023
Subject Matter: Hydrogeological
Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As indicated in the Hydrogeology and Geochemical Assessment Report, water quality is not anticipated to be materially affected by Project operations. In situations where water quality impacts are observed, there are many examples of sites where water quality impacts can be reversible. This would depend on the type and extent of impact, source of the impact, and general conditions of the water receiving the impact. Groundwater flow mechanisms including dilution, dispersion, sorption, decay, dissolution and precipitation may serve to limit or restore any water quality impacts. Many of the governing processes are equilibrium reactions that serve to stabilize concentrations in the absence of other forcing parameters. Determining how to reverse the impact will be specific to the compound under consideration, and therefore a definitive answer to this question cannot be provided.

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-022(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

At this time, the purpose of any full-scale test would be to refine the monitoring and efficiency levels of the extraction process, it would not be to assess environmental effects. To date, substantial data has been collected to assess the potential effects of the project. It is not normal practice to build a full scale mine to test before approval. Sio is confident in the assessments that have been conducted to date and operations would be confined to the conservative geotechnical model. As is normal practice, the issuance of any licence will set acceptable and safe parameters in addition to what has been set out by Stantec and AECOM's reports. Operating outside of these parameters would not occur. Due to the parameters of the geotechnical model that were issued after the original 7 well cluster application was made and new efficiencies reducing the number of wells were identified, there will be a reduced number of wells and cluster size. In consideration for concerns about 'full-scale' testing, Sio has elected to start its operations at a location that allows for a reduced number of wells in a cluster, some as small as 1-2 wells. Sio will also conduct a multi-well test after the issuance of an Environment Act Licence while starting with single well production. Therefore, a ramp up period will occur with the initial phase of operations limited to smaller well clusters, where the design assumptions and Stantec's modeling will be confirmed by monitoring and minor adjustments might be required to the design. Over time, the number of wells per cluster will increase as the extraction activities move farther away which will allow for additional confirmation of the Stantec model as recommended by Stantec. Should results of testing yield requirements for parameter changes, Sio will provide this to the Approvals Branch for review.

Request:

1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical work in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)?

Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response:

1. Sio maintains that its response to MSSAC-IR-022(a) answered the question that was posed.

IR Number: MSSAC-IR-022(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-022(a).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical woprk in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-022(a) answered the question that was posed.

IR Number: MSSAC-IR-022(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-022(a).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical woprk in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-022(a) answered the question that was posed.

IR Number: MSSAC-IR-022(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
For groundwater quantity, groundwater levels at select monitoring wells within the zone of influence will be monitored continuously using pressure transducers or automated dataloggers. A barometric logger with a same time interval setting will be deployed above the water table in a select well to monitor barometric pressure fluctuations. Groundwater levels will be corrected to remove the influence of barometric pressure fluctuations and converted to geodetic groundwater elevations to produce hydrographs and evaluate groundwater elevation fluctuation. For groundwater quality, groundwater quality samples in extraction wells and monitoring wells within the zone of influence will be collected before, during and after sand extraction events to enable a robust analysis of the impact of sand extraction on groundwater water quality for all parameters under consideration. Real-time groundwater quality measurements could also be collected for some parameters such as pH, temperature, conductivity and DO. From a geotechnical perspective, please refer to the response to MSSAC-IR014(a).

Request: 1. This is a generic answer. The groundwater management plan requires submission and review. The management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).

IR Number: MSSAC-IR-022(e)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the responses to MSSAC-IR-022(a) and (d), MSSAC-IR-014(a), and MSSAC-IR-020(d).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical work in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post 2 sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-022(a), MSSAC-IR-020(a) and MSSAC-IR-014(a) answered the questions that were posed.

IR Number: MSSAC-IR-022(f)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Yes, as well as before extraction starts. This is standard practice as with any pump test and would be applied for extraction operations, not just testing. Also refer to the response to MSSAC-IR-022(a).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical work in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-022(a) and MSSAC-IR-022(f) answered the questions that were posed.

IR Number: MSSAC-IR-022(g)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-022(a).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical work in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its response to MSSAC-IR-022(a) answered the question that was posed.

IR Number: MSSAC-IR-022(h)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the response to MSSAC-IR-022(a) and MSSAC-IR-014(a).

Request: 1. This request is not about a full scale mine - it is to test a well cluster and verify performance. The geotechnical work in the redacted report cannot be assessed adequately as part of this hearing process. Where is the commitment by SIO to actually conduct multi well testing, and all associated measurements, to measure and quantitatively capture how exactly multi-well (cluster) sand extraction void spaces will develop in the subsurface, relative to geotechnical performance, stability, crown span length development (in time, not only for short term post sand extraction)? Monitoring and mitigation plans are needed here as well. This is a must to allow for licensing of this project.

Response: 1. Sio maintains that its responses to MSSAC-IR-022(a) and MSSAC-IR-014(a) answered the questions that were posed.

IR Number: MSSAC-IR-023(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As stated in the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue 4: “The report is unclear as to the basis for the assertion that “analysis of the data suggests that the pump test need [sic] to be redone”. As a point of clarification (and as discussed in detail in Section 3.7.2 of the Hydrogeology and Geochemistry Assessment Report), it is acknowledged that the pumping well would have benefited from additional development efforts to improve its hydraulic efficiency. However, several methods were utilized to analyze the pumping test data, many of which do not rely on a hydraulically efficient connection between the pumping well and the aquifer. The pumping well was pumped at a rate that was judged to be representative of an operational scenario, and responses were measured in several observation wells completed in the Red River Carbonate, Winnipeg Shale and Winnipeg Sandstone aquifers, and several distances from the pumping well. The solution that was selected for determination of aquifer properties was able to simultaneously fit drawdown measured in several wells and at a variety of distances. The data from the pumping well was not relied upon for determination of aquifer properties, placing focus on the observation well data. As noted in Sections 1.2 and 1.3 of the Hydrogeology and Geochemistry Assessment Report, a significant number of hydrogeological investigations have been conducted within the Local Project Area and Regional Project Area by a variety of groups, including well drillers, consulting hydrogeologists, academic researchers, and the provincial government. Many of these studies were regional in nature and compiled extensive hydrogeological information from a variety of data sources, in an effort to characterize the heterogeneity of the aquifer and estimate aquifer properties. A comprehensive summary of hydraulic conductivity measurements was provided in Table 5-1 of the Hydrogeology and Geochemistry Assessment Report and discussed in detail in Section 5.7. Overall, the results indicate that the hydraulic properties of the aquifers are fairly similar over large spatial distances. This comprehensive literature review, and discussions with academic researchers and consultants with extensive experience in the area, formed the basis for this assessment and additional pumping tests for the purposes of determining aquifer properties are not required. Geometric mean values were derived from the comprehensive database of hydraulic conductivity values

presented in Table 5-1 of the report, and used to parameterize the numerical groundwater model. Through the calibration process, aquifer properties were modified following industry-standard practice and the resultant calibrated aquifer properties were similar to measured values. The calibration metrics for the model were well within industry-standard values, as defined by groundwater modelling guidelines produced by provincial government agencies within Canada (British Columbia Ministry of Energy, Mines and Low Carbon Innovation and Ministry of Environment), and internationally (US EPA; Australian Government National Water Commission), further justifying the position that the aquifer systems are well understood, and the hydrogeological properties of the aquifers assigned in the model are reasonable. Further, a robust sensitivity analysis was conducted to evaluate the impact of variability in hydraulic properties and boundary conditions on simulation results.”

Request:

1. Average parameter values were used, and a model calibration was achieved. Could this be a non-unique outcome of the modeling process? In other words could there be other combinations of conductivity values applied to achieve the same calibration status?

Response:

1. Yes, the concept of equifinality is common to all groundwater models and the outcome of the calibrated numerical groundwater model could be non-unique. There are often many combinations of parameters that cannot be easily rejected or ruled out that should be considered in assessing the uncertainty associated with predictions. This area of research generally concludes it is unrealistic to expect a single correct representation of the system given the normal limitations of characterization methods.

To address this known challenge, standard practice in numerical groundwater modelling requires exploration of model sensitivity to a range of input and fitting parameters to understand which parameters the model output is most sensitive to. A robust sensitivity analysis was conducted, but there are practical limitations on the number of simulations that can be conducted to evaluate all possible combinations of parameter values. Through the calibration exercise, greater insight into model sensitivity was gained. After steady-state and transient calibration was completed, the calibrated parameters were compared to measured values and judged to be reasonable. Further, the results are similar to parameter combinations assigned in other modelling investigations (e.g. Kennedy 2002; Ferguson 2003; Wang et al. 2008).

Although the model achieved a mass balance and calibration statistics were well within industry standard values, it is proposed that operational monitoring be conducted as defined by the Groundwater Monitoring and Mitigation Plan and the Water Management Plan, with the results utilized to continuously improve the predictive abilities of the numerical groundwater model. Ongoing evaluation of alternative conceptual models or a range of parameter combinations is integral to groundwater modelling efforts.

IR Number: MSSAC-IR-023(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As stated in the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue 16: “The primary purpose of the pumping test was to evaluate the extents of drawdown under a pumping rate similar to that which will be employed during operations. Extraction wells will not be developed or operated as pumping wells, and as such, it was decided that well development was less critical. While this comes at a cost of not being able to rely on pumping well drawdown data for determination of aquifer properties, the volume of water removed and water levels recorded in a number of distal monitoring wells and vibrating wire piezometers allowed for determination of aquifer properties at the scale of the test (kilometres). While well efficiency may be important for water supply well design and determination of aquifer properties from single well response tests, it is not important to this assessment as pumping wells will not be installed or utilized during mining (which is from open boreholes). Pumping test data were analyzed using the Theis and Cooper-Jacob solutions without consideration of analytical solutions that accommodate leakage across an overlying confining unit into the pumped aquifer. It is acknowledged that several other analytical solutions are available to evaluate the pumping test data, but a reasonable fit to the distance-drawdown data and displacement-time data was obtained with the Theis and Cooper-Jacob solutions. The results of the analysis were within the range of values reported for other pumping tests within the same aquifer system and are judged to be reasonable. Further, use of a numerical model calibrated to spatially and temporally distributed hydraulic heads was judged to be a more reasonable approach to evaluation of a regional scale problem. The demonstrated ability of the model to simulate hydraulic heads that are a reasonable match to measured values indicates that the model is a useful tool. Slug testing of the shale was limited to one test, but visual observations of a core suggest it is generally a low permeability unit that restricts flow between the Winnipeg Sandstone and Red River Carbonate aquifers. The hydraulic gradients between the two aquifers are relatively small (~0-2m), suggesting that the permeability of the shale is much less important in the study area than previously thought. The relatively small vertical gradients indicate groundwater flow is primarily horizontal through the Project Site Area. The Winnipeg Shale Aquitard is

not the only element that limits the interaction between the two aquifers” Also refer to the response to MSSAC-IR-023(a).

Request:

1. Poorly efficient wells even during testing may not provide adequate information to assess the system. Disagree that " it is not important to this assessment as pumping wells will not be installed or utilized during mining (which is from open boreholes)." Thereafter a calibrated model was compiled using averaged parameters. Will that calibrated result be unique in your view or could there be another configuration of the model that could yield the same calibrated result?

Response:

1. AECOM disagrees that inefficient wells do not provide adequate information to assess the system in situations when there are multiple observation wells at a range of distances from the pumping well to constrain estimates of aquifer properties. If the test was configured as a single well response test without collection of observation well data, AECOM agrees that inefficient well operations would limit the value of testing. However, this was not the case for the pumping test conducted as part of the Hydrogeology and Geochemistry Assessment. Further, the results of testing are consistent with values reported for other tests in wells across the aquifer which indicates the results of testing did provide adequate information to assess the system and can be relied upon. See the response to MSSAC-IR-023(a) for discussion of model uniqueness, the concept of equifinality and how those concerns were evaluated during model calibration and subsequent sensitivity analysis and scenario analysis.

IR Number: MSSAC-IR-023(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the response to MSSAC-IR-023(b), and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

Request: 1. This doesn't answer the question. Poorly efficient wells even during testing may not provide adequate information to assess the system. Disagree that " it is not important to this assessment as pumping wells will not be installed or utilized during mining (which is from open boreholes)." Thereafter a calibrated model was compiled using averaged parameters. Will that calibrated result be unique in your view or could there be another configuration of the model that could yield the same calibrated result?

Response: 1. Refer to the responses to MSSAC-IR-023(a) and (b).

IR Number: MSSAC-IR-023(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2 and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the response to MSSAC-IR-023(b), and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

Request: 1. This doesn't answer the question. Poorly efficient wells even during testing may not provide adequate information to assess the system. Disagree that " it is not important to this assessment as pumping wells will not be installed or utilized during mining (which is from open boreholes)." Thereafter a calibrated model was compiled using averaged parameters. Will that calibrated result be unique in your view or could there be another configuration of the model that could yield the same calibrated result?

Response: 1. Refer to the responses to MSSAC-IR-023 (a) and (b).

IR Number: MSSAC-IR-023(e)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the response to MSSAC-IR-023(b), and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.

Request: 1. This doesn't answer the question. Poorly efficient wells even during testing may not provide adequate information to assess the system. Disagree that " it is not important to this assessment as pumping wells will not be installed or utilized during mining (which is from open boreholes)." Thereafter a calibrated model was compiled using averaged parameters. Will that calibrated result be unique in your view or could there be another configuration of the model that could yield the same calibrated result?

Response: 1. Refer to the responses to MSSAC-IR-023 (a) and (b).

- IR Number:** MSSAC-IR-023(f)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
- Sio will have a stringent Groundwater Monitoring and Mitigation Plan that will monitor aquifer conditions before, during and after extraction activities. A pre-development assessment will be completed for wells near the proposed extraction activities in the area. Groundwater elevations will be monitored in real time so that operations can be stopped if water levels approach pre-determined thresholds that require mitigation. If water levels exceed thresholds, Sio will initiate a Trigger Action Response Plan (TARP) that will initially be aimed at confirming water level measurements, then initiate an investigation into the cause of the exceedance, then determine appropriate mitigation measures and then implement them as required after determining the effect is due to Sio's extraction activities. Should Project activities impact the availability of potable water to nearby residents, Sio will immediately take actions to ensure access to potable water at Sio's cost. Please also refer to the responses to MSSAC-IR-021(e), MSSAC-IR-023(b) and the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and issue #8.
- Request:**
1. This doesn't answer the question. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
 2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
 3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.
- Response:**
1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).

2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-024(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
See the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, Issues #3, #4, #5 and #6 for a discussion of hydraulic testing, aquifer properties and the influence of mining on regional scale aquifer properties. Several pilot test extractions have been conducted over the past several years by Sio Silica. The data and learnings from these tests have been incorporated into the work to date and will inform the follow up plans, such as the Groundwater Monitoring and Mitigation Plan. Also refer to the response to MSSAC-IR-12(b).

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-024(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Yes. See the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, Issues #7, #8 for a discussion of interconnection between the Winnipeg Sandstone and Red River Carbonate aquifers and the implication of a water quality change in response to degradation of the Winnipeg Shale.

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-024(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please see the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and #8, for a discussion of interconnection between the Winnipeg Sandstone and Red River Carbonate aquifers and the implication of a water quality change in response to degradation of the Winnipeg Shale.

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-024(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please see the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 and #8, for a discussion of interconnection between the Winnipeg Sandstone and Red River Carbonate aquifers and the implication of a water quality change in response to degradation of the Winnipeg Shale.

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
3. Please refer to the response to Round 2 MSSAC-IR-019.

- IR Number:** MSSAC-IR-024(e)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
Please see the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #16. It should be clarified that the hydraulic gradients between the two aquifers are relatively small (~0-2m), suggesting that the permeability of the shale is much less important in the study area than previously thought. The relatively small vertical gradients indicate groundwater flow is primarily horizontal through the Project Site Area. The Winnipeg Shale Aquitard is not the only element that limits the interaction between the two aquifers.
- Request:**
1. This doesn't answer the question. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
 2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
 3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.
- Response:**
1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
 2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
 3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-024(f)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

Please see the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issue #7 for a discussion of interconnection between the Winnipeg Sandstone and Red River Carbonate aquifers. Please also refer to the response to MSSAC-IR-023. The aquifer is already interconnected due to termination of both aquifers at the eastern subcrop. Groundwater modelling evaluated the influence of both alternative scenarios, and indicated that the interconnections could reduce the magnitude and extent of drawdown in the Winnipeg Sandstone (i.e. pumped aquifer) and increase the magnitude and extent of drawdown in the overlying Red River Carbonate aquifer if the shale collapses immediately after each extraction well is drilled. This suggests that overall impacts on the quantity of water will be the same, but they will be distributed more evenly across two aquifers rather than one. The impacts on water quality were simulated to be both positive and negative (depending on the element) and minor. In the long term, the aquifers will likely remain interconnected within the Project Site Area. Impacts are anticipated to be similar to those presently observed near the numerous water supply wells that interconnect both aquifers. It is AECOM's understanding that these impacts are negligible to minor in the Project Site Area where the groundwater in both aquifers is fresh.

Request:

1. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.
3. What are the controls in place to ensure that "Extraction activities will not introduce any biological contaminants into the aquifer"? In any open borehole/drilling scenario, the potential exists to introduce various contaminants from the surface environment to the aquifer.

- Response:**
1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
 2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
 3. Please refer to the response to Round 2 MSSAC-IR-019.

IR Number: MSSAC-IR-025(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

AECOM disagrees with the claim that items are missing or misinterpreted/misrepresented. Many of the alleged deficiencies noted in the preamble were, in fact, completed and thoroughly documented in the Hydrogeology and Geochemistry Assessment Report. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #3, #5, #6, #9, #12, #13 for discussion with regard to porosity estimation and aquifer properties. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #10 and #28 for discussion with regard to salinity and density effects in the three-dimensional model. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #5 and #32 for discussion with regard to model calibration approach. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #13 for discussion with regard to model simulation in response to collapse of the shale aquitard. The hydraulic properties of the shale unit after extraction were adjusted in the FEFLOW groundwater model by way of scenario analysis (shale remains intact or degraded) to explore the influence of possible shale degradation in response to mining. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #17 and #33 for discussion with regard to aquifer heterogeneity. Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #5 and #34 for discussion with regard to boundary condition.

Request:

1. SIO acknowledges that the model is an average of regional hydraulic parameters, and not based on test data conducted in the field. It is agreed that natural systems have variability and single well tests provide information at localized scales only. However, is it reasonable that the average model condition is unique?
2. Could this model result be non-unique?

3. Could there be another configuration that would yield the same calibration result?

Response:

1. Much of the hydraulic testing data reported in the publicly accessible literature presents geometric mean values or a range of values for each respective study area rather than the location, magnitude, duration and results of individual aquifer tests. Individual hydraulic tests were completed by numerous different people over several decades using a variety of equipment and test methods. Although the individual test results were not reviewed, the spatial distribution and quality of the data itself is anticipated to be highly variable. Although singular hydraulic conductivity and specific storage values were assigned to each hydrostratigraphic unit represented in the model, a robust sensitivity analysis and scenario analysis evaluated the influence of alternative parameterization. Based on the results, the model parameterization was judged to be reasonable, and it was recommended that a Groundwater Monitoring and Mitigation Plan and a Water Management Plan be developed to confirm the simulated results of the groundwater model and inform the need for updated parameterization. Please refer to the response to Round 2 MSSAC-IR-023(a) for a discussion of model equifinality and uniqueness.
2. Please refer to the response to Round 2 MSSAC-IR-023(a).
3. Please refer to the response to Round 2 MSSAC-IR-023(a).

IR Number: MSSAC-IR-025(b)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and

23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

As discussed in detail in Section 5.6.3 of the Hydrogeology and Geochemistry Assessment, "Several boreholes within the Regional Project Area and groundwater model domain do not report the presence of shale, even where it appears on the geologic map and cross sections. Given the long history of groundwater exploration and development in this area, it is possible that these units were not split out as the upper (Red River Carbonate) and lower (Winnipeg Sandstone) aquifers were historically viewed as one groundwater resource. The presence of an aquitard may not have been viewed as important information historically because the shale is not one of the aquifers targeted by water well drillers. Historical drilling methods may not have observed a relatively thin unit. Even contemporary drilling methods employed to install many of the recent wells (i.e. air rotary, dual rotary or mud rotary) do not produce cuttings that are easily logged due to homogenization as they travel upward through the borehole to surface. Sedimentary sequences are typically deposited in laterally continuous layers and most boreholes report the presence of the Winnipeg Shale, and it is AECOM's interpretation that the Winnipeg Shale is continuous across the study area from the edge of the Williston Basin at the Sandilands subcrop westward (i.e. where it is mapped on the regional geology maps). This interpretation is consistent with most of the literature reviewed for this study." The sensitivity of modelling results to the presence, continuity and hydraulic properties of the Winnipeg Shale has also been evaluated and the impacts of this assumption have been characterized as shown in Tables 6-1 and 6-2 of the Hydrogeology and Geochemistry Assessment Report.

Request: 1. Is there a risk that modeling the shale aquitard this way underpredicts the actual vertical mixing and aquifer pressure re-equilibrations that might occur?

Response: 1. The modelling of the shale aquitard as being continuous at project onset is not likely to significantly underpredict the vertical mixing or aquifer pressure re-equilibration because groundwater gradients between the Red River Carbonate aquifer and Winnipeg Sandstone aquifer are near-neutral in the vicinity of the project area. Some of the hydrographs suggest

historical re-equilibration of groundwater elevations due to the presence of existing wells that interconnect both aquifers. The numerical groundwater model was calibrated based on the conceptualization of a continuous Winnipeg Shale aquitard and achieved a relatively good mass balance and acceptable calibration statistics. The pumping test conducted by AECOM demonstrates the aquitard is leaky and allows for some exchange of groundwater between the two aquifers based on prevailing vertical groundwater gradients.

IR Number: MSSAC-IR-025(c)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response
Refer to the Responses to Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #10 and #28 for discussion with regard to salinity and density effects in the three-dimensional model.

Request: 1. Nothing further.

Response: 1. There is no question in this Information Request.

IR Number: MSSAC-IR-025(d)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the Responses to Technical Expert Reports – Hydrogeology, filed November 29, 2022 issue #17, and #33, for discussion with regard to aquifer heterogeneity.

Request:

1. It will be important to have a Groundwater Monitoring and Mitigation Plan to deal with the uncertainty that is inherent in a project like this. What system will you have in place to measure and monitor for these possible changes, and what are the mitigation strategies?
2. The Groundwater Monitoring and Impact Mitigation management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response:

1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).
2. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).

IR Number: MSSAC-IR-025(e)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issues #5, #18, #31 and #34 for discussion with regard to boundary condition.

Request: 1. None of these discussions refer to the Carman Sand Boundary condition specifically. The question remains same: Why is the Carman Sand Member connected to the Red River boundary condition in the model when in reality they are not interconnected?

Response: 1. A specified head boundary condition was assigned to the Winnipeg Sandstone aquifer below the Red River. However, the specified head was assigned based on measured groundwater elevations in the Winnipeg Sandstone aquifer, which are on the order of 10 m higher than those in the overlying Red River Carbonate aquifer. This is consistent with the conceptualization that there is a hydraulic divide associated with the Red River that induces vertical flow.

IR Number: MSSAC-IR-025(f)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issue #22 for a discussion on the modeled scenarios.

Request: 1. Nothing further.

Response: 1. There is no question in this Information Request.

IR Number: MSSAC-IR-025(g)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issue #5 and #32 for discussion with regard to model calibration approach.

Request:

1. SIO acknowledges that the model is an average of regional hydraulic parameters, and not based on test data conducted in the field. It is agreed that natural systems have variability and single well tests provide information at localized scales only. However, is it reasonable that the average model condition is unique?
2. Could this model result be non-unique?
3. Could there be another configuration that would yield the same calibration result?

Response:

1. Refer to the response to MSSAC-IR-25(a).
2. Please refer to the response to Round 2 MSSAC-IR-023(a).
3. Please refer to the response to Round 2 MSSAC-IR-023(a).

IR Number: MSSAC-IR-025(h)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response

The author is requested to refer to in the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issues #3, #5, #6, #9, #12 and #13, as questions are the same. Evaluation of the influence of sand extraction on the integrity of the subsurface was conducted by geotechnical engineers (Stantec 2021) as part of related studies to evaluate the possibility of subsidence and inform project design.

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011(3).

IR Number: MSSAC-IR-025(i)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

**Background/
Preamble:** SIO SILICA IR Round 1 Response
The author is requested to refer to in the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issues #12 and #13 as questions are the same. See also response MSSAC-IR-025(b) above and MSSAC-IR-023(b).

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).

IR Number: MSSAC-IR-025(j)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Refer to the Public Comments responses key issue/response 185 filed January 14, 2022: “The extraction method at this time is proven and repeatable as tests have been conducted and successfully carried out. Separating the Project into 4-5 year groupings, with Notices of Alteration to be filed as needed, will allow for improvements in methodology as well as any changes in environmental impact that might arise from relocating the specific sites of extraction activities. Improvements could include, for example, potential efficiencies in the extraction method to reduce the overall number of wells needed per year. Additionally, land ownership and uses do change over time, and therefore site selection for a full 24 years would not be efficient or appropriate.” The author is also requested to refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issue #1, as questions are the same.

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).

- IR Number:** MSSAC-IR-025(k)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
- Industry standard methods include utilization of staff with education and experience in hydrogeology and groundwater modelling, application of methods that have a sound theoretical basis, following regulatory guidelines, interpretation of data using sound geological principles, conducting an extensive literature review, following industry guidelines for groundwater modelling (e.g. BC MoE 2012), utilization of peer-reviewed software and codes (AQTESOLV Professional 4.5, PHREEQC, FEFLOW, etc.), analysis of environmental samples at Canadian Association for Laboratory Accreditation (CALA) certified laboratories, and application of professional judgment. Refer to the Responses to Technical Expert Reports – Hydrogeology, filed November 29, 2022, issues #3, #4, #6, #8, #9, #17, #18 and #19 for discussion with regard to characterization of aquifers and incorporation of field data into the three dimensional model. The alleged “misinterpretations of geology” are in fact geological simplifications that were knowingly made as is routine in the field of applied hydrogeology.
- Request:**
1. Simplifications can sometimes lead to non-unique or misleading results. Is SIO confident that its simplification of the model hydrostratigraphy will represent actual conditions?
 2. Would a test scale pilot project of an instrumented well cluster work to support the interpretations made, or identify simplifications that are not valid?
- Response:**
1. The model was constructed following industry standard methods using information collected by Sio and AECOM in the project area, and by a large number of people spanning several decades from across the groundwater model domain. This included water well drillers, private contractors, consultants, government staff and academic researchers. The bulk of the information is consistent and hydrostratigraphic interpretations within the model domain support the simplifications made to facilitate large scale regional groundwater flow modelling. The hydrostratigraphic model was developed based on actual geological observations reported on borehole

and well logs. Models are only as good as the data available to construct them and the methods employed. Subsurface conditions cannot be inferred between boreholes with absolute certainty.

2. Sio maintains that its response to the previous question related to pilot testing answered the questions that were posed. As stated in the response to Round 1 MSSAC-IR-010(b): *"This staged approach will allow Sio Silica to confirm expected conditions before a larger multi well extraction and make adjustments that may be required"*. Also see Sio's responses to Round 1 MSSAC-IR-011(a), and MSSAC-IR-012(a), (b), (c).

IR Number: MSSAC-IR-026(a)

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Please refer to the Responses to the Technical Expert Reports – Hydrogeology, filed November 29, 2022 issue #8. As indicated in the Hydrogeology and Geochemistry Assessment Section 4.2.2 – Stable Isotopes of Hydrogen and Oxygen: Stable isotopes analyses were carried out on numerous samples from different depths, hydrostratigraphic units and before and after the pumping tests. The depth profile fully captures the variability of isotopic composition an effect of recharge period on the isotopic signature. Processes such as latitude, altitude, and evaporation that generally alter the lateral variation of isotopic composition via fractionation are regional and are not expected to impact the isotopic composition at the Project Site.

Request: 1. These issues were measured on very short timeframes, or modeled. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).

- IR Number:** MSSAC-IR-026(b)
- Submitted by:** MSSAC
- Date Submitted:** January 10, 2023
- Subject Matter:** Hydrogeological
- Reference Documents:** 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)
- Background/Preamble:** SIO SILICA IR Round 1 Response
- Refer to the responses to MSSAC-IR-021(e), MSSAC-IR-017 and MSSAC-IR-020a. As stated in the Hydrogeology and Geochemistry Assessment Section 8.3 – Groundwater Quality: “Overall, material impacts to groundwater quality within the Project Area are unlikely because both the Red River Carbonate and Winnipeg Sandstone host fresh and relatively dilute groundwater. Based on the results of geochemical modelling, the activities associated with project operations and post-closure phases of the project were determined to have only a minor impact on groundwater quality. In many cases, the impact was simulated to be positive due to reduction of concentrations of iron and manganese when oxygen is introduced into the aquifer or is allowed to mix with water containing lower concentrations of those elements. Should project operations result in a more interconnected aquifer system comprising the Red River Carbonate aquifer and the underlying Winnipeg Sandstone aquifer, groundwater quality would tend to reflect conservative mixing of the two water types (i.e. limited geochemical reactions). Although the naturally elevated concentrations of dissolved iron and manganese were simulated to decrease in response to aeration or mixing, they may remain elevated above drinking water quality criteria during and following operations. Although the injection of oxygenated water may reduce concentrations of iron and manganese in the vicinity of extraction wells, it is not anticipated to induce ML/ARD reactions due to the very low to absent concentrations of minerals prone to oxidation (i.e. pyrite and pyrrhotite). This is supported by the presence of very good water quality in both aquifers today. The vertical gradients between the two aquifers are downward and near neutral such that the magnitude of any inter-aquifer exchange during and following project operations is likely to be small.”
- Request:**
1. This doesn't answer the question. These issues were measured on very short timeframes, or modeled. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

- Response:**
1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).

IR Number: MSSAC-IR-026c

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
The Hydrogeology and Geochemistry Assessment recommended a Groundwater Monitoring and Impact Mitigation Plan be developed and implemented prior to, during and following operations to establish a robust monitoring program that is able to detect changes in response to operations and guide mitigation measures. It is not a study, but rather an operational monitoring and management plan that will guide implementation of mitigation measures in the event they are required. These are typical of all industrial projects and may be requirements of permits following completion of environmental assessment/permitting. The Groundwater Monitoring and Impact Mitigation Plan will establish a program for monitoring of groundwater levels and quality to confirm the results of the Hydrogeology and Geochemistry Assessment and ensure that operations do not negatively affect the quantity or quality of water in the aquifer. Also refer to the response to MSSAC-IR-017(d).

Request: 1. The Groundwater Monitoring and Impact Mitigation management plan is critical here and it is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).

IR Number: MSSAC-IR-026d

Submitted by: MSSAC

Date Submitted: January 10, 2023

Subject Matter: Hydrogeological

Reference Documents: 19 September 2022 Technical Review of Sio Silica Corporation's (Formerly CanWhite Sands Corp.) Environment Act Project Proposal (Hollander and Woodbury); and
23 July 2021 Can White Sands Corp. Vivian Sand Extraction Project, Environment Act Proposal – Parts 1 and 2, and Appendix A (Public Registry 6119.00)

Background/Preamble: SIO SILICA IR Round 1 Response
Yes, some aquifer water quality parameters can be monitored in real-time. Sio intends to install monitoring wells in the areas where operations will occur and monitor long term. As stated in the response to CEC-IR- 003(a), “These monitoring locations will always be between the operations and any landowner wells.” Also refer to the response to MSSAC-IR-022(d).

Request: 1. This is a generic answer. The groundwater management plan requires submission and review. The management plan is not available for review. When will this be available? Details regarding locations, depths/zones, instrumentation, sampling, assessment, trigger values and mitigation measures, among other details, must be included.

Response: 1. Please refer to the response to Round 2 MSSAC-IR-004 and CEC-IR-011 (3).