Critique of CanWhite Sands Minor Notice of Alteration, Jan. 22, 2021

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On Behalf of What the Frack Manitoba
Feb. 23, 2021

1. Inadequate information for the French Drain style system minor alteration

The CanWhite Sands Corp. (CWS) minor notice of alteration posted Feb.16, 2021 on the Manitoba public registry 6057.00 states,

"*To address the runoff of water from the wet sand stockpiles, CanWhite will install a French drain style system to capture all runoff water from the stockpiles including rain and snow This water will then be returned to the loop system for recycling within the processing facility so that no system water is discharged to the natural environment at any point during Project operation.*"

No design engineering specifications are given for the "French drain style system". To prevent discharge of system water to the environment an impermeable membrane underlay would be required but none is specified. An impermeable underlay would be prone to overfill and spillage out the edges in a heavy rain. Without an underlay some runoff would be expected to infiltrate to the water table with potential undesirable environmental effects.

The French drain should be designed to catch runoff from up to a 500 year rain event. Rainfall records show that over 100 mm can fall in less than an hour in southern Manitoba. For example on June 24, 2016, 138 mm of rain fell during thunderstorms in southern Manitoba.[1] The collection area for the French drain is not given. The CWS EAP gives the total area of stockpile A and B to be 27,000 square meters. To gather water that runs off beyond the edges of the stockpiles, the French drain would have to have a capture area larger than the area of the stockpiles. For a 100 mm rain and a capture area of 30,000 square meters, the total volume of captured water would be 3000 cubic meters. This would be an underestimate of the largest rainfall capture event. If the event lasted an hour the capture rate of the French drain would be 50 cubic meters a minute. The flow through the clarifier tanks is given in the CWS EAP as 24.416 cubic meters per minute. Certainly the recycle water closed loop would not accept 50 cubic meters per minute, over twice the design volume flow of the loop. The French drain would have to send collected water to the onsite storage tank.

The storage tank water would have to be gradually drained into the recycle water loop. The tank would have to accept at least 3000 cubic meters. This would require a tank of the order of a radius of 10 meters and a height of ten meters. The onsite tank has to be designed to hold the water from the French drain and all the wash water from the wash plant and most likely the slurry line water during winter. During the winter shutdown waste is likely to be generated from the cleaning of clarifier tank, wash plant vessels and slurry lines. The capacity of the onsite storage tank is not given in the EAP. The tank capacity should be given as part of the required design specifications for the alteration.

The CWS EAP specifies that the stockpiles will contain 15% water. The water in the sand stockpiles is the only water loss in the closed recycle loop. The EAP does not state if this is water loss by weight or volume. The sand entering the loop from the extraction wells contains water. To match the loss in the sand stockpiles the water entering the recycle loop must be on average 15% of the sand. Excess water is to be returned to the formation. CWS has stated in online presentations that sand entering the recycle loop can be up to 90% sand, 10% water. The water deficit on entry with respect to the 15% loss in the stockpiles would be likely no more

than 5%. 5% water by weight of sand would result in 68,000 tonnes of water loss per year for the stated sand production rate of 1.36 million tonnes per year. At a density of one tonne per cubic meter 68,000 cubic meters could be lost per year or 0.129 cubic meters water loss per minute. To empty the storage tank containing 3000 cubic meters to replenish an ongoing 5% water deficit at 0.129 cubic meters per minute would take 16 days. If another large rainfall event occurred during this time the system could not keep up. A large tank would be required. To properly determine the French drain design and water tank storage capacity detailed information is required for the sand and water extraction rates. The extraction and processing are necessarily interconnected and should not be assessed in two separate approval processes. The minor alteration does not contain the necessary design parameters to specify the French drain for environmental licensing.

Without detailed project specifications including the expected discharge to be collected in an extreme rainfall or snowmelt, the effectiveness of the drain from preventing discharge to the natural environment cannot be determined.

2. Fouling of the French Drain

Analysis of sand from Vivian collected by local residents showed the iron oxide content to be 0.49%. Iron oxide presence on the sand is verified by oxide content in the Vivian sand given on a slide from an online presentation by Mr. Somji at the Noble conference in 2019. The documentation for the iron content of Vivian sand is given in the submission to the CWS Vivian Sand Facility Project by D. M. LeNeveu, Aug. 20, 2020. Iron oxide on the sand must be removed in the wash plant for the silica sand to be useful for most glass making operations and for solar panels and electronics, the stated uses in the CWS EAP. Iron oxide would be present in the 15% water in the sand stockpiles as specified in the CWS EAP. The iron oxide would be in the runoff captured by the French drain. Iron bacteria are known to proliferate in wet surface environments rich in iron. Prolific growths of filamentous iron bacteria in water supply systems have been called "water calamities." The gelatinous growth of iron bacteria and their associated deposits of ferric hydroxide have resulted in discoloured water, unpalatable taste and odours and reductions in flow through pipes.[1] Figure 1a shows a drain pipe clogged with deposits from iron bacteria. Figure 1b shows gelatinous deposits around CWS sand piles extracted at the Centre Line Road site in the spring of 2020. The gelatinous deposits at Centre line Road are consistent with iron bacteria activity. Such deposits would be expected to clog the on-site French drain.

Figure 1. a. Deposits from iron bacteria plugging a drain pipe (from DiStart.com) **b**. Gelatinous deposits consistent with iron bacterial activity at the base of CWS sand piles at Centre Line Road

Chlorination treatment to reduce bacterial growth can cause acidic conditions that mobilize heavy metals in the runoff particulate.[3] Waste may be generated from cleaning of bacterial sludge and deposits in the storage tank and associated piping. Preventing fouling is not necessarily a simple matter that can be addressed with chlorination or some other process that could cause other adverse environmental effects.

The contamination in the run off from the stockpiles could include acids from the oxidation of pyrite in shale fragments and oolite nodules in the sand reject pile, and from oxidation of marcasite coating on the sand grains in the sand stockpiles. Acid would mobilize heavy metals such as arsenic, barium and chromium found in shale and in the sand. The analysis of the sand from Vivian documented in the project submission of D.M. LeNeveu of Aug. 20, 2020 verifies the presence of arsenic, barium and chromium in the sand. According to a report from Friesen Drillers in southeast Manitoba, concentrations of barium have been reported to exceed the Maximum Acceptable Concentration (MAC) of 1.0 mg/L.[4] Oxides of iron, manganese and aluminum would be present in the sand stockpiles from wash plant water. Polyacrylamide used in the clarifier tanks and the highly toxic acrylamide monomer would also be present.[5] These soluble contaminants would accumulate in the water of the recycled loop and the sand stockpiles. All of these contaminants could enter the carbonate aquifer and the Brokenhead River from a fouled and overflowing French drain.

The onsite water storage tank and the recycle water loop system are wastewater storage facilities that must be registered with the Approvals Branch according to a letter submitted in the TAC comments of Aug. 22, 2020 and according to the Hazardous Waste Regulation M.R. 195/2015.

According to the Manitoba Conservation and Climate Licence Alterations information website,

"*Information on the alteration is needed so that the Branch can determine whether the alteration involves significant environmental effects. If significant effects are anticipated, the proponent or licencee will be required to file a new proposal, providing the public and the Technical Advisory Committee with an opportunity to review the altered project.*"
(from: https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/licence-alterations/index.html)

Insufficient information has been supplied by the proponent to determine the potential for adverse environmental effects from the French drain. The information supplied here demonstrates that adverse environmental effects from the French Drain are anticipated. The anticipated adverse effects and the requirement for registration of the onsite storage tank and recycle water loop as wastewater storage facilities require the filing of a new proposal.

3. Omitted alterations

The soluble contamination from the French drain and from the clarifier tank such as barium, arsenic, acid, acrylamide monomer and polyacrylamide would accumulate in the water of the recycle loop. The clarifier would only remove suspended solids not dissolved contaminants.[5] The CWS EAP states the water will be stored over winter in the onsite storage tank and not discharged. Storing and continued use of the recycled water for the project lifetime of 24 years with the continual accumulation of contaminants is not possible. For instance the EAP states that the sand is stockpiled with 15% water before the water is treated at the clarifier tank. Oxides removed from the sand in the wash plant would be in the water of the sand stockpiles. The oxides and other soluble contaminates such as polyacrylamide would be baked onto the sand in the dry plant. This would compromise the sale for high purity markets such as glass making and solar panels. As well accumulated acid from oxidation of pyrite in the slurry loop and wash plant would eventually compromise equipment.

Reverse osmosis, evaporation or other methods for removal of the accumulated soluble contaminants in loop water would be required. One example of reverse osmosis is for the water supply project for Beausejour, Manitoba as described in Manitoba public registry 6059.00. In Beausejour, the concentrated brine waste from reverse osmosis is to be discharged into the Brokenhead River. A discharge of concentrated effluent from the Vivian Sand Facility would likely contain pyrite, acid, heavy metals and the toxic monomer acrylamide all of which would adversely affect fish habitat.

Without contaminant removal the recycled loop water would have to be disposed of in bulk and replenished with fresh water from the aquifer. This would generate a very large waste effluent stream and constitute a further unsustainable draw on the sandstone aquifer. Other draws on the aquifer include the 15% water in the sand stockpiles, slurry and wash plant leakage, and potential return to the carbonate aquifer of excess water withdrawn with the sand. The required project alteration for disposal of the effluent stream from removal of contaminants in the water loop is not included in the proponent letter.

Not included in the notice of minor alteration is another project alteration given in the CWS public meeting report in Manitoba public registry 6057.00, posted Dec. 29, 2020. The meeting summary states,

"*All the material that is too small for sand processing will be captured in the clarifier water treatment process. The resulting material will pass through a belt press to remove remaining water and press the material into mud cakes for storage, sale or disposal.*"

The mud cakes would contain acid generating pyritic material, heavy metals, acid, metal oxides such as iron oxide, polyacrylamide and the highly toxic acrylamide monomer.[5] The EAP states that the clay/silt content of the sand is about 0.46%. This clay/silt plus fines, shale fragments and other sediment would be in the mud cakes. 0.46% of the 1.36 million tonnes of sand per year would constitute 6000 tonnes. Given the other constituents, the mud cake waste would be well in excess of 6000 tonnes per year. The presence of the contaminants and acid generating pyrite would prevent sale. A project alteration is required for the disposal of the mud cakes.

The EAP states,

"*The processing activities described above result in approximately 38,600 tonnes/year of 'overs' and 'fines' that are either too large or too small, respectively, for the target sand buyer markets and will be directed to alternate markets for use*."

The overs/fines would contain heavy metals such as barium and arsenic and pyritic waste such as shale fragments, oolite nodules and marcasite coating sand grains. The heavy metal contamination and the acid generating pyrite would render the overs/fines unsalable. The overs/fines would require disposal. The disposal of overs/fines requires a notice of alteration.

Drill mud and cuttings from the numerous extraction wells drilled per year would contain pyrite from the shale in the aquitard, shale layers in the formation and from marcasite in the sand. The drilling waste must be disposed of according to the Manitoba Drilling Regulation, 1992, waste on drill site, and site cleanup upon abandonment. Disposal of drilling waste requires a notice of alteration

The overs/fines, mud cakes, recycled waste water effluent and drilling waste would require an effluent disposal facility designed for acid generating waste as required under the Manitoba Mine Closure Regulation 67/99, section 10, Mining Effluents Regulations.

In Sept. 14, 2020 comments to the Impact Assessment Agency of Canada Environment and Climate Change Canada (ECCC) stated,

"*It is understood by ECCC that nearby projects have pyrite present in the mined material, potentially leading to ARD/ML issues. However, the EAP does not provide a discussion of the potential for acid generation within the extracted sands as they are mined, stockpiled, and exposed to air and water*."

Core logs from Manitoba Groundwater for CWS wells show that pyrite is present in the sandstone aquifer throughout the CWS claim area not just in nearby projects. A pyritic shale aquitard overlies the sandstone aquifer over the entire area.[7] As a cavity develops from sand extraction, the aquitard would crumble from the unbalanced overburden pressure above and from the process of shale slaking.[8,9] Core logs show two wells in the CWS Centre Line Road site have multi shale layers more than 60 feet thick immediately below the aquitard. Four wells at the CWS Vivian site penetrate a 10 foot thick shale layer about 65 feet into the sandstone aquifer. Shale fragments were visible in extracted sand at both the Centre Line Road and Vivian sites verifying the presence of pyritic shale in the extracted sand. The CWS public meeting held Dec. 15, 2020 and AECOM's subsequent project alteration notification have not addressed the serious concerns brought forward by the ECCC for the handling and disposal of acid generating material and wastes from the Vivian Sand Project. Contamination entering the water loop from the French drain proposed alteration further necessitates the removal and disposal of such contaminants.

In the CWS Dec. 15th open house Mr. Bullen states,

"*although there is flocculent within the loop it does degrade naturally and we will actually encourage the degradation of the flocculent through using high intensity UV lighting*"

This statement introduces another major project alteration that has not been notified to the Manitoba Environmental Approvals Branch. Mr. Bullen's statement acknowledges that there will be contamination such as polyacrylamide flocculent in the loop. Because the degradation time is longer than the recycle time, polyacrylamide and the acrylamide monomer will accumulate in the loop.[5]

The high intensity UV lighting has not been properly researched or designed.

A Masters thesis by Peiyao Cheng, (2004)[10] states,

"*In summary, it has been generally accepted that UV irradiation can lead to molecular weight reduction of polyacrylamides, however, there is still disagreement on the degradation possibility of polyacrylamides to acrylamide monomer, which should be clarified further*."

A study by Guezennec et al. (2015)[11] states,

"*A study leaded by Caulfield et al. (2003) has reported that strong UV radiation at 254 nm released AMD from solutions of a nonionic PAM. However, the release was very small*."

Ultraviolet light could cause some degradation or chain length shortening of polyacrylamide but would not remove degradation products or the shorter chains. UV could create some highly toxic acrylamide monomer

that would continually accumulate in the recycled water. The inclusion of the potentially detrimental, ill thought through alteration of UV irradiation introduced in a CWS online public meeting is unacceptable. This inadequate research and design is apparent in the EAP, the inadequately specified alteration for the French drain, and in the omission of the major project alterations for the disposal of mud cakes, over/fines, contamination for the water loop, and UV irradiation. The UV light proposal is an attempt to disguise the requirement for a major project alteration to deal with contamination of loop water by polyacrylamide and other contaminants including acid generating pyrite and heavy metals. CWS refuses to acknowledge the need for disposal of the acid generating and contaminant waste streams despite overwhelming evidence that has been presented in the public review, to the IAAC and elsewhere.

4. Conclusion

The inadequately specified "French drain style system" alteration must be revised and incorporated into a major project alteration that addresses all waste streams including contaminants removed from loop water, waste from cleaning of vessels and pipes, drill waste, overs/fines, and mud cakes. An effluent waste disposal facility must be designed and specified for acid generating and contaminant waste. The required major project alteration of an effluent disposal facility would have significant environmental effects including potential discharge detrimental to fish habitat in the Brokenhead River. The major project alteration would require a new proposal submitted to the Manitoba Environmental Approvals Branch that must be reviewed by the TAC and the public. The lack of necessary detail and information provided for this project and the potential irreparable project detriment to two major aquifers of southeast Manitoba mandate independent hearings under the Clean Environment Commission of Manitoba.

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