Memorandum

Subject	MINE WATER MANAGEMENT STRATEGIES FOR EA REGISTRATION		
Date	6, December 2023		
To	Robert Booth, P.Eng., PMP Alasdair Federico	From	Mario Zapata, P.Eng. Jeff Crofton, P.Eng.
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Project	Great Atlantic Salt Project		

1. Introduction

Atlas Salt Inc. (Atlas) is currently developing an Environmental Assessment registration for the Great Atlantic Salt Project, an underground salt mine with decline access and an initial production capacity of 2.5 million tonnes of rock salt per year. Baseline hydrology conditions for the project site have been studied and reported on previously (GEMTEC, 2023; SLR, 2023), but a clear approach for the management of water in the project site has not been provided so far.

The goal of this memorandum is then to present a reference document with clear objectives for mine water management and mitigation strategies for purposes of the Environmental Assessment (EA) Registration of the project.

2. Water Management Components

Based on a review of the mine configuration and process, the project will be comprised of a combination of surface infrastructure and underground infrastructure where the deposit will be directly mined. In consequence, an effective way to look at the management of mine water is by grouping the sources and sinks of mine water in each of the project components, as proposed below.

2.1 Underground Mine Water

This grouping contains any water that may seep into the underground workings from fissures or fractures in the geological formation, water that originates from process uses, such as cooling, lubricating, dust control, and others, or water that enters the underground space from the mine portal.

2.2 Surface Contact Water

Surface contact water will contain any water that is used on the surface for process needs, including dust suppression or mineral processing, as well as any rainwater that falls within the project boundaries. This water will be collected within a central area for treatment, monitoring and release/reuse as needed.

2.3 Surface Non-contact Water

This category of water typically relates to rainfall that falls outside the project footprint and migrates or is conveyed overland toward the project boundaries. This type of water can be handled in one of two ways: 1) diverted away from the boundary using a diversion or berm so that it does not interact with the industrial site, or 2) allowed to enter the site and then treated as contact water as defined above. The basis of design in the existing studies indicates that the preferred option is diverting the run-on before it reaches the site to existing natural water courses, such as Man O' War Brook.

3. Mine Water Management Approach

Table 1 below (Concordance Table) presents a summary of the stated objectives and proposed mitigation strategies for the management of mine water in each of the mine components and stages.

Table 1. Concordance Table for Mine Water Management

Water Management Component	**Stage**	**Mine Water**		**Management Objective(s)**	**Proposed Monitoring and Mitigation Strategies**
		Sources	**Sink(s)**		
Underground Mine Water	Construction	• Groundwater seepage • Surface water inflows	Temporary treatment areas	Underground workings dewatering	• Aquifer depressurization • Sediment traps/ponds • Surface water diversions
	Operations	• Groundwater seepage • Process water • Incoming surface water	Centralized water treatment system		• Aquifer depressurization • Centralized water treatment system • Surface water diversions • Creation/maintenance of water balance
	Closure/Post-closure	• Groundwater seepage • Surface water inflows	Underground workings	Closure of portals to minimize ingress	• Flooding of underground workings • Closure of portals to prevent ingress • Monitoring wells in proximity of mine long-term.
Surface Contact Water	Construction	• Contact water	Temporary treatment areas – Surface sumps	Prevent discharge of non-compliant water to the natural environment until treated, monitored and accepted for release Established liners in areas where water is collected for treatment or conveyance Establish diversions to prevent mixing of non-contact and contact runoff	• Sediment traps/ponds • Surface water diversions
	Operations	• Contact water • Process water	Centralized water treatment system		• Centralized water treatment system • Surface water diversions • Creation/maintenance of water balance • Water quality monitoring: discharge water quality will comply with Newfoundland and Labrador Regulation 65/03 (Environmental Control Water and Sewage Regulations), e.g., total dissolved solids (TDS) ≤ 1,000 mg/L and total suspended solids (TSS) ≤ 30 mg/L
	Closure/Post-closure	Runoff water	Natural environment	Remediation of soils and landscape to remove contamination	• Erosion and sediment control • Established vegetation

				and limit long term soil loss and erosion	• Erosion control blankets - biodegradable
Surface Non-contact Water	Construction	• Precipitation • Surface runoff	Natural environment	Minimize the water volumes in contact with mine components	• Surface water diversions – although allowing clean surface runoff to enter the project site to be treated in the centralized water treatment system may increase dilution and improve feed water quality, the resulting sizes of the water treatment components may be less cost-effective than the construction and maintenance of diversion structures
	Operations	• Precipitation • Surface runoff	Natural environment		
	Closure/Post-closure	Runoff water	Natural environment	Remediation of soils and landscape to remove contamination and limit long term soil loss and erosion	• Erosion and sediment control • Established vegetation • Erosion control blankets – biodegradable • Monitor diversions for long-term stability and erosion

4. Mine Water Mitigation Strategies and Methods

In accordance with the above table the following describes the methods to mitigate mine water impacts on the surrounding environment.

4.1 Temporary Underground Mine Water Treatment Area

During development of the underground mine, care should be taken to separate as much as practical, seepage from groundwater into the mine, as well as drilling water or other process water that may be high in TSS. Both of these water sources will likely be high in TDS due to the nature of the salt deposit. Based on initial review of packer test data for the mine, the hydraulic conductivity of the deposit is relatively low and should not transmit significant volumes of seepage water into the underground workings. It is our understanding that the water management strategy for the mine is to intercept groundwater inflows above the decline into the salt body thereby capturing the water before contact and prior to attaining elevated TDS levels. It is not anticipated that there will be significant water seepage into the salt body and therefore very low volumes of water that could be elevated in TDS concentration.

Through separation of the capture of water above the salt body, the majority of the water is expected to have very low TDS levels (below 1000 mg/L) and will be acceptable for discharge to fresh-water surface water bodies within Newfoundland (Reg 65/03). Underground water should be captured in sumps created within the mine workings decline and then pumped to the surface for final treatment. The underground sumps can be constructed to promote initial settling of suspended solids with sufficient settling time through length to width ratios approaching 5:1. From the far end of the sumps, temporary or permanent pumps can be installed to convey the collected water to the surface infrastructure. If settling within the underground area is not feasible, then surface based TSS removal can be managed in a number of ways. The guidelines (65/03) indicate that in order to be released, TSS should be 30 mg/L or less. While there is no effective field-based testing method for TSS, a site-based correlation for turbidity should be developed based on a series of sampling events (8 minimum). Turbidity can then be used as a proxy at the site level to measure compliance for treated site water release.

4.2 Centralized Water Treatment Area

For managing both underground and surface water, it is anticipated that a central water treatment area will be required. Water in contact with mine workings as well as process areas must be treated and monitored prior to release. It is expected that treatment will consist of the following:

- pH control

- temperature controls – ensure discharged water does not create a temperature gradient or change in the natural environment that will encourage predation, extraneous vegetation growth, algae blooms or other deleterious impacts.
- Removal of oils and grease – oil / grease separators or similar
- TDS controls – dissolved salts management
- Seepage management – It is anticipated that the majority of runoff from the mine site will be uncontaminated and from non-contact sources. If there is the potential that water will be collected from contact areas that is above discharge guidelines, it is recommended that storage areas be lined to prevent seepage to the soil. Typical liners would include LLDPE and HDPE. Liners can also be textured to provide additional safety for personnel walking on lined slopes.
- Discharged water should meet the water quality requirements (Reg 65/03) as well as quantity. Ensure that the mine water balance and discharge to natural areas does not increase baseflows and downcutting of existing channels or increase long-term erosion and sediment transport.

4.3 Closure and Reclamation

At the time of mine closure, the surface components of the mine should be removed and land surfaces remediated and reclaimed to match the local natural landscape as part of a Mine Closure and Reclamation Plan. Long term runoff from the site should mimic pre-condition aspects of the natural surrounding topography. Vegetation should be designed to include natural species of the area, and densities that create similar runoff coefficients to pre-development conditions.

A hydrological model should be developed to model the long-term hydrological response of the reclamation area to ensure that it is stable, mimics pre-condition hydro-periods for wetlands and other surface water features, base flows and surface to groundwater interactions.

Erosion and sediment control measures, such as silt fences, vegetation planting, erosion control blankets (biodegradable) should be established to limit soil losses while vegetation is establishing and control erosion and sediment transport to natural waterbodies.

A period of on-going monitoring of these devices should be established until such time as the devices can be removed and the natural landscape is re-established to control runoff processes for quantity and quality.

5. Design Criteria - Water Management Facilities

The design of water management facilities for the project should follow the criteria shown below or local regulatory requirements as appropriate.

Storage Ponds – Designed for the 100 year – 24 hours runoff event with sufficient freeboard to prevent overtopping. For TSS removal, length to width ratios should meet 5:1 standard to allow Stokes settling of particles. Storage ponds should have a emergency spillway with appropriate outlet channel to convey storm events larger than the design event safely.

Conveyance systems – conveyance systems should be designed for a higher intensity event that the pond systems. Typically, this is a 5-year 1-hour event. The increased intensity of the event will ensure safe conveyance of the runoff to the storage pond for attenuation.

Climate Change and Potential Impacts – Depending on the design life of the facilities, the impacts of climate change should be factored into the above design return period events. The final decision on this can be made once the overall project design life is established and the impact to hydrology can then be established in accordance.

Impacts of Monitoring Prior to Release – If regulatory requirements indicate that water quality must be tested and approved prior to release, then additional modeling of the pond should be undertaken. To address these conditions, the pond should be modeled under continuous simulation for the entire record of climatological events for the surrounding area. The long-term continuous modeling will consider back-to-back events that increase the storage volume prior to release taking place. These back-to-back smaller events can result in larger overall storage volumes. Therefore, statistical analysis of the overall storage requirements should be undertaken under this modeling approach when release from the pond is limited to either evaporation only, or for a time period between testing events to receive laboratory results (typical 5-7 days).

6. Surface Water Mitigation Strategies

The development of the Atlas Salt project has considered the following strategies for water management. These strategies, along with the additional recommendations below, will allow the project to effectively protect the environment from adverse harm related to the discharge of water from site to local fresh-water bodies.

6.1 Interception of groundwater in the decline

The design approach is to capture the groundwater inflow to the underground workings before it reaches the salt deposit. This inflow is expected to be low in TDS and within the guidelines for release to the environment. There is the potential for elevated TSS levels that will be addressed either below ground in capture sumps, or above ground in surface impoundments.

6.2 Removal of Total Suspended Solids

Surface collection and storage of runoff is anticipated to have elevated TSS levels at certain time and will need to be treated prior to release. The project will use a combination of the following to address elevated TSS and lower the concentration prior to release.

- Settling within impoundments prior to release using length to width ratios that promote good settling and non-resuspension.
- Straw wattles and / or bales within ditches and release channels
- Flocculation to promote settling of smaller particles that tend to stay in suspension due to Brownian motion.
- Stormceptor style oil/grit separators to promote removal of TSS and separation of floatable contaminants.

6.3 Total Dissolved Solids Management

The site design has promoted concepts that will limit the amount or potential for runoff to contain elevated levels of TDS. These include:

- Enclosed or covered conveyor systems, thereby inhibiting rainfall from contacting mined salts on the transport conveyors.
- Enclosed conveyors will also inhibit the release of dust to the air which could settle throughout the site and promote elevated TDS levels in future runoff.
- Capture of groundwater seepage into the underground workings above the level of the salt deposit.

All of these design interventions will inhibit the elevation of TDS within the water management systems. However, there is still a potential that TDS spikes could be noted during certain activities or in certain areas of the project footprint. If this does occur, the recommended approaches to dealing with this are as follows:

1. If the site water management impoundment areas are large enough, the high TDS water can be sent there for storage. Since the expected highest TDS values are only anticipated to be approximately 1500 mg/L, it is anticipated that release water from these storage areas would be below the 1000 mg/L threshold for release.

2. The potential for a small tank to be dedicated for storage of elevated TDS runoff could be investigated with a local company providing emptying and removal services for disposal offsite to an approved location.

3. If impoundments are not large enough, bring in local portable water treatment units on a rental basis to manage the release stream until the TDS is below guidelines again. Portable RO and Desalination units are available within the industry and may be an effective short-term solution during TDS spikes.

4. If the length of the TDS spikes continues to the point where rental treatment options are not viable, look at the potential for a small skid mounted RO treatment plant to be brought in more permanently.

5. As a last resort, if elevated TDS is expected to remain, and concentration are low enough to be discharged to a marine environment, an option of a pipeline to the coast with a diffuser in the coastal area could be considered.

7. Other examples

As an example of a similar process that is used within Canada, the salt mine in Goderich, Ontario was researched to understand the water management policies that occur there. The mining process at Goderich is essentially the same as will be employed at the Atlas Salt project, whereby, salt will be mined without the use of solution mining and using water to dissolve the salt body to produce a brine. Instead, continuous mining will be done mechanically without the introduction of water. This process will be completed using a room and pillar mining concept.

At Goderich, runoff from the site is sent through a treatment process using stormceptors to remove oil/ grease and TSS prior to discharge into fresh-water bodies such as the Maitland River and Lake Huron. This discharge is permitted through a certificate of approval and environmental compliance approval issued by the Ontario Ministry of Environment, Conservation and Parks.

Any other water that is encountered below ground within the mine, remains underground within the mine workings and is not brought to the surface. It will remain there in closure are well.

While the two operations are essentially the same from a process and mining perspective, the Atlas site will also intercept water above the salt body in order to limit the water in contact with salt. This is an improvement over the Goderich example, in that, less salt will become dissolved within the water media and overall TDS concentrations will be limited. In addition, Atlas Salt is planning to have a sizable stormwater retention pond on-site that will further address elevated TSS whereby the Goderich site is not currently employing the use of retention ponds to our knowledge.