AMARUQ GOLD PROJECT

WWTS Operation and Maintenance Plan

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DOCUMENT CONTROL

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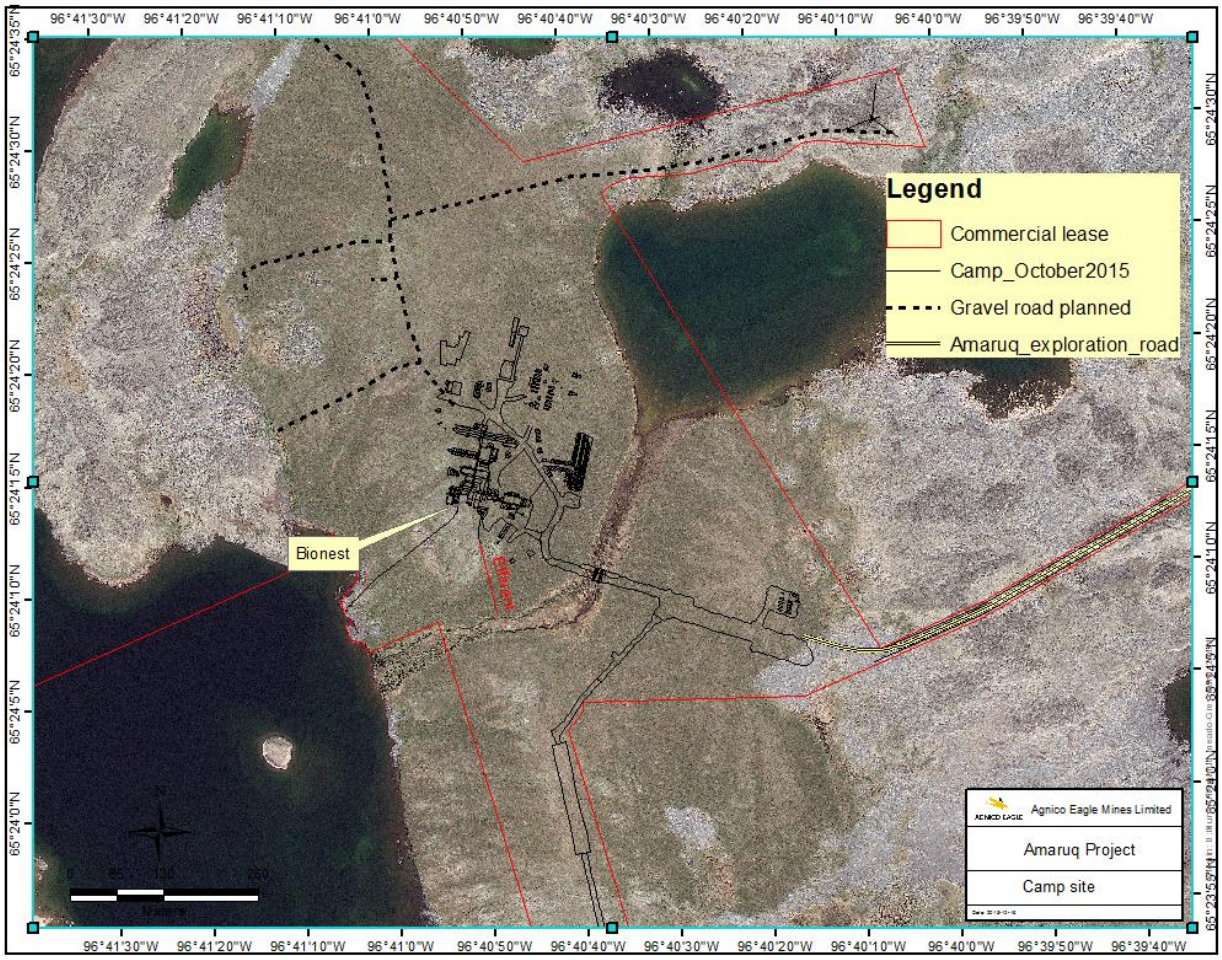
Table of contents

1.0 Introduction

This Operation and Maintenance plan is designed to give information regarding the used water treatment system installed at the Amaruq Gold Project's exploration camp. This plan includes general information on the treatment, but doesn't replace the consultation of the Bionest Operator's Manual which includes details on the system's functions and the methods of operation. The plan is designed to comply with the terms and conditions for water use and waste management outlined in the Nunavut Water Board Licence 2BE-MEA1318.

A site plan showing the general layout of the Amaruq Gold Project's exploration camp and associated infrastructure is given in Figure 1.

Figure 1: Camp and related infrastructures



2.0 Waste Water Treatment System, Kodiak Bionest

AEM is presently using two Kodiak Bionest Wastewater Treatment Systems (WWTS) designed to handle both black and grey water and produce effluent in compliance with NWB water license 2BE-MEA1318. Sewage wastes at the Amaruq Gold Project exploration camp were at first incinerated but this practice was phased out with the Kodiak Bionest commissioning. The grey water from the laundry and kitchen facilities passed through a sump before being released into the environment, but now all grey water is also directed to the Kodiak Bionest. The Kodiak Bionests are now handling all the black and grey water produced by the Amaruq camp giving a completely monitored effluent.

2.1 Location

The two Kodiak Bionests have been positioned on the south side of the camp in a location amenable to the plumbing of influent piping from the kitchen, the showers and toilets.

Discharge plumbing delivers used water from these facilities to a storage tank adjacent to the Kodiak Bionest treatment plant. A grinder pump within the lift station delivers a sewage/grey water slurry to the Kodiak Bionest and is operated by a system of floats.

2.2 Kodiak Bionest Operation and Maintenance

2.2.1 General Description of Operation

The primary treatment consists in the removal of floating material and settling of heavier particles. This is carried out in the septic tank portion of the Kodiak Bionest unit. This step also plays a role in the advanced treatment process. The septic tank is divided into 2/3 and 1/3 sections by a partition wall. This helps to separate the solids from the liquid in the first section, allowing the liquid to flow to the second section, which is equipped with an effluent filter. It is important that routine maintenance be carried out. AEM has to pump out the sceptic tank at frequencies established on a recommendation from the Kodiak Bionest maintenance technician. Please note that the pumping of the septic tank must be performed by a specialised firm and the tank must be filled with clean water after pumping.

2.2.2 Effluent filter

The septic tank is equipped with an effluent filter with openings of 1.6mm or less. The effluent filter must be cleaned every time the septic tank is inspected and pumped out.

Figure 2 : Effluent filter

2.3 Advanced treatment system

The primary effluent leaves the septic tank and flows to the second section of the Kodiak Bionest unit: the BIONESTMD reactor. the wastewater is then put in contact with microbiological cultures naturally fixed on a synthetic material. This synthetic material is a Bionest patented non-biodegradable media called «BIONESTTM Media».

2.3.1 BIONESTTM bioreactor

The BIONESTTM bioreactor is a tank similar to the septic tank divided into 2/3 and 1/3 sections. The first section is aerated with fine air bubble diffusers while the 1/3 section is not aerated to create a nonturbulent environment where biosolids will be degraded and filtered out. The very low volume occupied by the media reduces the risk of unlikely blockage: less than 2% of the BIONESTTM bioreactors' volume is occupied by the media while it still offers a huge surface for bacteria development. The media is distributed evenly in the tank. A surface of 92,5m2 of the media is used per cubic meter of wastewater. The texture of the BIONESTTM media, as developed after several years of research by Bionest, provides strong adhesion and allows for faster growth of bacterial mass. The synthetic media is a non-biodegradable polymer and therefore, it does not deteriorate over time and does not need replacement.

Figure 3: Media

2.3.2 Aeration

Air is an essential element in any biological treatment system (BIONESTTM, biofilter, sand filter, leaching field, etc.). Temperature and winds vary continuously during the year, thus varying performances of systems using passive aeration. The BIONESTTM system provides consistent air quality and temperature year round, regardless of the season, allowing the performance of the system to be constant. Aeration in the first compartment of the bioreactor is made possible with air pumps and fine air bubble diffusers. The air comes from air pumps which are inside the mechanical room.

Figure 4: Air pump and diffusers

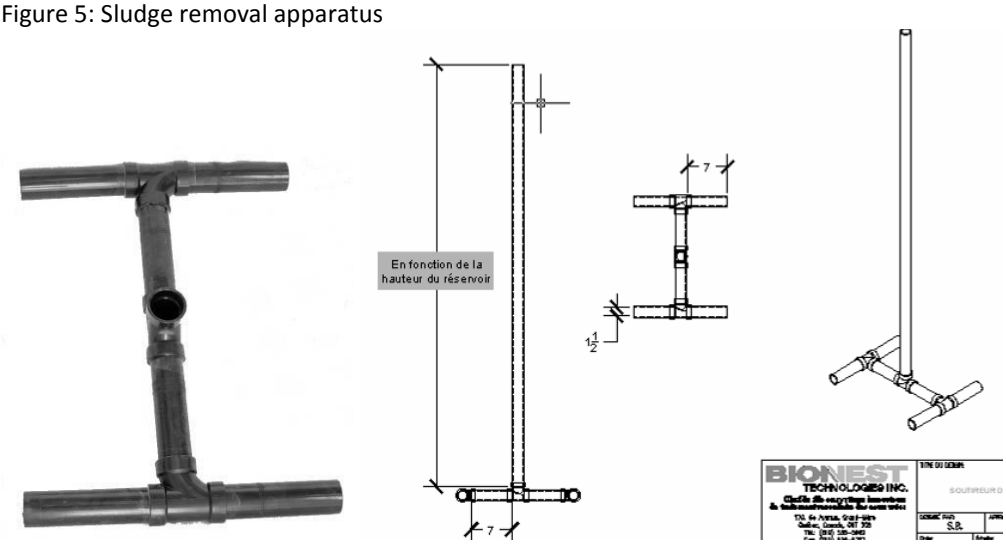
2.3.3 Recirculation

Recirculation of treated water back to the reactor inlet ensures several contacts with bacteria enhancing the transformation of nitrogen. The Kodiak Bionest system reduces not only ammonia, but also nitrates. Treated wastewater recirculating continuously in the treatment chain is beneficial in the treatment of BOD. The reduction pipe is insulated.

2.3.4 Sludge removal apparatus

The BIONESTTM Wastewater treatment system has been designed so that only the septic tank section requires periodic pump-outs. Even though most biosolids generated in the BIONESTTM reactor are degraded, some will accumulate with time. Biosolid removal in the reactor may be required after ± 2000 days of operation or based on a recommendation from the maintenance technician. A sludge removal apparatus has been integrated in both sections of the bioreactor to ensure easy sludge removal or in the event that toxic and/or prohibited products are released in the residence's water facilities.

Figure 5: Sludge removal apparatus



2.4 Sludge Disposal

All solid waste (sludge) from WWTS primary tank will be disposed of in latrine pits that will be located at a distance of at least thirty one (31) metres above the ordinary high water mark of any water body, treated with lime and covered with native material to achieve the pre-existing natural contours of the land prior to abandonment, as is required by the licence 2BE-MEA1318 part D item 14.

2.5 Performance and Monitoring

The final point of control is located at the end of the disinfection treatment (UV) and is noted in the water license as MEA-1. This station is established to monitor the performance of the Kodiak Bionest treatment plant. The parameters monitored include BOD_5, fecal coliforms, TSS, pH, and oil and grease. Weekly samples will be collected to document the performance of the plant vs the effluent requirements set in the water license, with the results submitted to the Nunavut Water Board in the annual report.

Table 1: License 2BE-MEA1318 requirement

Parameter	Maximum Concentration of any Grab Sample
pH	6.0 to 9.5
Biochemical Oxygen Demand (BOD5)	80 mg/L
Total Suspended Solids (TSS)	100 mg/L
Fecal Coliforms	1000 CFU/100mL
Oil and Grease	5 mg/L & No visible sheen

2.6 Set points

Air Pump

Permanent aeration of the first compartment of the bioreactor is assured by linear diffusers fed by small diaphragm air pumps. For 40' units, there are 3 air pumps, Hiblow model HP-200, connected to 18 diffusers. For 20' units, there are 3 air pumps, Hiblow model HP-100, connected to 10 diffusers.

Recirculation Pump

The effluent from the bioreactor is recirculated at a rate of 1.5 to 2.5 times the average daily flow. One recirculation pump will recirculate the effluent.

Devices to maintain temperature

Pipe insert heaters

To maintain wastewater temperature above 12°C, pipe insert heaters (9 kW) are installed in the 1/3 section of the septic tank. There are 2 heaters in the 40' units and 1 heater in the 20' units.

Temperature probes

Three probes are installed in the KODIAK unit. Probes are connected to three different thermostats, which are installed in the mechanical room.

Reactor exit

A probe is installed in the non-aerated section of the bioreactor. It is connected to this thermostat, which is connected to an alarm. A temperature below 10°C will activate the alarm. The thermostat's parameters are presented in the following table:

Thermostat #1 parameters.

Set point 1	Set point 2
°C	
S1 :10	S2 :---
Dif1.: 2	Dif2.: ---
H1	---

Reactor entrance:
A probe is installed in the non-aerated section of the bioreactor. It is connected to this thermostat, which is also connected to the pipe insert heater control panel. A temperature below 12°C will activate a first pipe insert heater. If a temperature below 10°C is detected, a second pipe insert heater will be activated, and in this case, both pipe insert heaters will work at the same time (only for the 40' units). The thermostat's parameters are presented in the following table:

Thermostat #2 parameters.

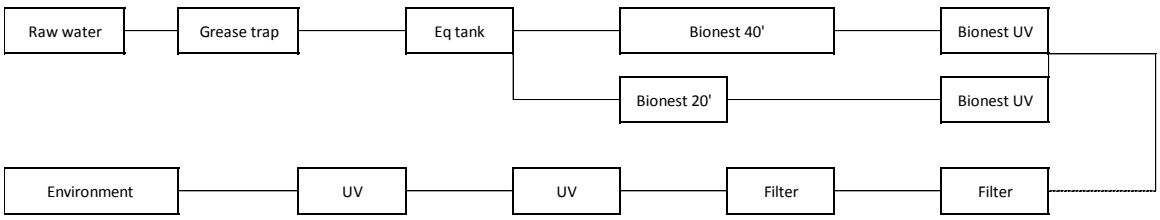
Set point 1	Set point 2
°C	
S1 :12	S2 :10
Dif1.: 2	Dif2.: 2
H1	H2

Mechanical room:
A probe is installed in the mechanical room. The probe is connected to this thermostat, which is connected to an alarm and a ceiling ventilator. A temperature below 7°C will activate the alarm. On the other hand, a temperature over 25°C will activate the ceiling ventilator. The thermostat's parameters are presented in the following table:

Thermostat #3 parameters.

Set point 1	Set point 2
°C	
S1 :7	S2 :25
Dif1.: 2	Dif2.: 2
H1	C2

2.7 Flow path



3.0 Emergency procedures

The section describe the procedures that will be applied if the quality of the effluent released by the Kodiak Bionest treatment system does not meet the water licence 2BE-MEA1318, part D, item 13 requirements.

Quality limits for the effluent released by the WWTS

Parameter	Maximum Concentration of any Grab Sample
pH	6.0 to 9.5
Biochemical Oxygen Demand (BOD5)	80 mg/L
Total Suspended Solids (TSS)	100 mg/L
Fecal Coliforms	1000 CFU/100mL
Oil and Grease	5 mg/L & No visible sheen

The waste water treatment system is constructed with a limited quantity of mechanical parts, thus reducing maintenance. A major part of the treatment uses only gravity, and daily inspections of the system are conducted to assure the proper working condition of the water pumps, air pumps, water filters, UV disinfection lights, etc. These daily inspections reduce the risk of discharging a non-compliant effluent into the environment.

However, a malfunction remains a possibility and the goal of this emergency procedure is to reduce the impact on the quality of the effluent in case of such a malfunction. The major part of the actions are conducted in a proactive way, but reactive actions are also described.

3.1 Proactive actions

To reduce the risk of losing control on the used water treatment quality, AEM uses 2 Kodiak Bionests in parallele. These 2 systems are independent in such way that if one is out of order, the other one will continue to treat the waste water. In this case the capacity of treatment would be reduced, but the camp operation could be continued by reducing the number of workers at the site. To have a better treatment capacity and to reduce the need to slow down the camp in case of issues with one of the Kodiaks, AEM bought a 3rd Kodiak that will also be installed in parallel with the 2 first ones.

To ensure a better disinfection quality of the water treated by the Kodiak Bionest, AEM added supplementary filters and UV systems. The filters are used to catch the remaining TSS that have not settled in the Bionest and the UV kills the pathogen agents. To assure constant disinfection, AEM doubled these componants, so 2 filters and 2 UV systems are present. This system provides a more constant effluent quality.

Weekly samplings are conducted at the Kodiak Bionest to react quickly if the effluent quality were to degrade. These samples are taken at the end of the treatment and sporadically AEM can add sampling points to verify the efficacy of some parts of the chain of treatment.

3.2 Emergency actions

Even if proactive actions are always conducted with the reduction of potential risks in mind, AEM has to develop and apply reactive emergency procedures, should the effluent quality fail to respect the quality depicted by the water licence.

If a weekly water sampling analysis is in exceedance with the water licence limits AEM will:

- start the verification of the various components of the water treatment system:
  Including, but not limited to the set points (section 2.6), air pumps, water pumps, heaters, water temp, Bionest UV light, polishing filters, upstream UV light. These will be inspected thoroughly.
- Contact support Bionest Engineer at: T**.** 819 533-6020 Ext**.** 244 and describe the issue in order to receive distance support, if the problem was not identified during the detailed inspection.
- Resample the effluent as soon as possible to confirm the issue with the effluent. A sample contamination or an isolated event could explain the analysis result.
- AEM will stop using the water toilets if the second sample analysis confirms that the effluent quality is problematic and no rapid action can be taken to correct it. In such a case, the water toilets will be closed and “Pacto” toilets will be used until the situation is resolved.
- When the effluent samples confirm that the situation is back to normal, AEM will authorise the restart of water toilet use.
- AEM also keeps on site a flexible container “Aquadam” with a 45 000 liter capacity to contain contaminated water in case the Bionest needs to be emptied to conduct repairs or cleaning. This flexible container would be installed near the Bionest and the contaminated water returned into the treatment system.