



Jericho Diamond Mine

Waste Water Treatment Plant Design Plan

**(As required under Part D – Item 8 of Nunavut Water Board
License NWB2JER0410)**

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1. INTRODUCTION

The Jericho Diamond Mine camp consists of pre-fabricated modules supplied by Shanco Camp Services Ltd. of Grande Prairie, Alberta. The camp is designed to accommodate approximately 92 people in a single occupancy arrangement. If required to run double occupancy the maximum would be 184 in the main camp and another 20-30 people in the existing Carat Camp exploration accommodations.

P.J. Hannah was subcontracted by Shanco Camp Services to design a modern waste water and sewage treatment facility capable of handling at least 200 people. The sewage treatment plant is not intended to handle waste from the exploration camp which will be decommissioned and relocated to another site.

2. TREATMENT FACILITY

The waste water treatment plant (WWTP) will be housed in a stand alone metal clad, insulated building next to the accommodation complex (Attachment 1). The building will be founded on a prepared pad of crushed rock under rig mats for ground insulation and will be supplied heat from baseboard electrical heaters. The WWTP will be installed by the camp supplier and operated by the camp services contractor. The installed facility will be a rotating biological contactor (RBC) to treat domestic sewage and grey water. The model is a P.J. Hannah Biodisc DS10H BFP (Attachment 1). The waste water treatment plant will be installed at the same time as the camp in the early construction phase. Initially effluent will be pumped directly to the Processed Kimberlite Containment Area (PKCA) through a dedicated pipeline (from initial use for the balance of 2005). Once the diamond plant is constructed and operational, sewage will be pumped to the tailings box in the diamond plant where it will mix with fine PK prior to discharge to the PKCA (2006, forward).

2.1. Plant Operation

The WWTP employs aerobic digestion of raw sewage to reduce the biochemical oxygen demand (BOD) and total suspended solids (TSS) in the treated effluent concentration. In the normal biological cycle bacteria plays a vital role by converting soluble organic compounds into bacterial cells and inorganic materials. Algae and other plants use the inorganic compounds for new cells which become part of the cycle.

In addition to aerobic digestion, the clarified plant effluent stream is subjected to UV light ensuring the complete destruction of any pathogens and bacteria prior to its discharge to the environment.

Raw camp effluent is gravity fed through piping to a small volume aluminum lift station placed below the camp outfall height. The effluent collects within the lift station and is transferred to the RBC system via a level activated submersible solids grinding pump.

The lift station tank is also equipped with a submersible heating element for winter operations.

The raw effluent enters the plant through the primary treatment chamber. This chamber is designed to provide an adequate volume storage buffer so the treatment system is not shocked with a sudden volume of influent quality change. Air is blown into the primary chamber to initiate the biological destruction process using a small regenerative blower.

An overflow line from the primary tank feeds into a small volume biozone feed tank leaving the collected inlet solids within the primary tank. A bucket wheel assembly, connected to the end of the biorotor drive shaft rotates through the feed tank delivering a measured volume of influent to the biozone tank.

The biorotor sitting within the biozone tank rotates continuously through the delivered influent. Through this rotating action, the naturally occurring bacteria within the influent, are alternately exposed to the air and the wastewater. This alternating sequence provides the environment required for the biological digestion of the wastewater, resulting in the formation of a biological mat formed on the rotor itself.

A direct correlation exists between treatment efficiency, retention time within the biozone, and surface area available to the biological digestion. To maximize surface area, decrease the overall size and retention capacity of the system, the biorotor media is comprised of several 3.8 cm solvent-welded PVC tubes. To further reduce the overall outside dimension of the entire treatment process the biozone tank is placed on stilts within the primary tank.

Waste water flows through the biozone tank in an equilibrated pattern. This simply means that a gallon of influent flow to the biozone equals a gallon of treated effluent out. The treated effluent from the biozone tank flows into a conical clarifier tank where the contained biomass particles settle out of suspension. On a timed basis a return pump within the clarifier delivers the collected biomass particles to the primary tank. This ensures an adequate supply of bacteria in the primary tank to initiate the digestion process.

In the RBC process at the Jericho site the package plant configuration contains the aerated equalization tank; a rotating bucket feed mechanism; a rotor with plastic media; a final clarifier tank with sludge and scum removal mechanism; a tertiary filter and an ultraviolet (UV) disinfection system.

The addition of too much organic matter could upset the cycle and initiate pollution. The disruption can increase the growth rate of bacteria which, in turn, consumes dissolved oxygen faster than can be replaced by the stream. Continuing the organic load will cause anaerobic conditions. This will become apparent by the death of animal life and accompanying odours.

The use of a secondary biological treatment is to duplicate the natural purification of the stream by assisting in adding oxygen and restarting the aerobic cycle. Aerobic treatment systems are designed to provide enough oxygen for biochemical oxidation of the waste. A properly designed and operated plant helps by relieving the burden placed on the receiving waters by removing oxygen-demanding organic matter.

A gravity flow pipeline system is used to collect the sewage in sumps. From the sumps it is pumped to the WWTP. The kitchen has a grease trap that will be used to collect the material.

An aerated equalization tank has been designed just ahead of the RBC treatment process. The tank will dampen the surge effect of the three main periods when the waste flows are at their peak. An add benefit of the tank is to help remove some of the biochemical oxygen demand (BOD) of the waste.

The RBC process provides a surface media which the bacteria and other simple life forms can attach to and grow into a larger biomass. The rotating media provides a continuous supply of nutrients and oxygen. When the biomass becomes large enough, the shearing forces generated from the rotation cause it to slough off and fall into the liquid media. The RBC rotating action keeps them in suspension by the mixing and the wastewater flow carries it out for separation in a downstream final clarifier.

The final clarifier is a settling tank that allows for the collection and removal of the sloughed biomass. It is equipped with four hoppers containing sludge pumps and piping for transferring the material to the aerobic digester.

Sludge digestion is a batch process that provides aeration to the biomass to maintain aerobic conditions. The sludge in the digester tank must be removed periodically and disposed of. It is estimated that the removal will be required 3-4 times per month. Sludge removal will take place with a pumper (vacuum) truck. The sludge will be used as part of the environmental reclamation program if possible. Sludge will be placed on the overburden stockpile in a segregated area. In winter it will be windrowed to enhance thawing in the summer. Sludge will be used as a soil amendment in reclamation trials. If it is not useful then it will be disposed of in the waste rock dump. Alternatively, solids could be removed and incinerated. Incineration is less desirable because it will increase the use of fossil fuel and emissions from the incinerator.

Pursuant to Jericho Water Licence, Part K, Section 12g, the volume of sewage sludge disposed of will be recorded.

2.2. Effluent Discharge

On a discharge tank level signal the digested, clarified and UV-treated effluent is discharged to the PKCA.

A single 5 cm drain line runs the length of the system. Each tank segment of the system is isolated from the drain line by a ball valve. This allows for each segment to be drained individually when required. The drain line is completed with a 5 cm camlock connection allowing a vacuum truck to connect and drain the system.

Liquid flow from the clarifier passes to a filter feed tank and onto a tertiary filter. After the liquid has been filtered it passes through the UV disinfection system. Water from the WWTP will be discharged directly, or from the diamond plant through a heat-traced HDPE pipe of sufficient diameter to carry peak discharge loads, to the PKCA. Surface discharge will be the base case because, as the sewage water is heated it will not likely freeze until exited from the outfall pipe. Should winter freezing be problematic, the discharge will be modified to be subaqueous.

Very strong raw sewage is occasionally encountered ($BOD_5 > 700 \text{ mg/l}$) which can result in a temporary organic overload condition and subsequent reduction in treatment efficiency.

2.3. Effluent Characteristics

Under normal operating conditions the system will produce effluent quality of:

- $\leq 10 \text{ mg/liter of } BOD_5$
- $\leq 10 \text{ mg/liter of suspended solids}$
- $\leq 10 \text{ MPN/100 liters faecal coliform, and}$
- $\leq 1 \text{ mg/liter phosphorus}$

based on manufacturer's specifications.

The waste water treatment plant operation is illustrated schematically in the drawing in the Attachment.

The PKCA is part of the water licence and is permitted as a receiving body for effluent discharge.

3. CONSTRUCTION SCHEDULE

The current construction schedule has the camp modules being shipped on the 2005 winter road. Camp pad preparation should be complete by March 8th with the modules being placed and connected together. The camp is anticipated to be ready for occupancy on May 1st, 2005.

The Process Plant is schedule for construction to start April 18th, 2005 and be completed by February 11th, 2006.

The schedule is shown schematically below:



4. CONTINGENCY PLAN

If the RBC suffers a stoppage the upper half of the disc will quickly lose water allowing the biomass to dry out. If this occurs the rotor will go out of balance because the lower half of the disc is heavier than the upper half.

If the stoppage is more than one day and up to three days in winter (or two in summer), the rotor must be turned manually through 180° to try to equalize the weights of the biomass. After a period of two hours the balance should be close enough for the system to be restarted. A procedure is available for re-balancing should the stoppage last longer.

Short-term remedial action may include using the vacuum truck to prevent the system from overflowing. The sewage waste would be trucked directly to the head of the PKCA and discharged into the rock fill that forms the East and / or Southeast dyke system.

**ATTACHMENT
WASTE WATER TREATMENT PLANT
SITE LOCATION AND
TECHNICAL SPECIFICATIONS**

Item 1
Disinfection

< 10 mg/l BOD₅, < 10 mg/l TSS, < 1.0 mg/l Phosphorous, UV

ITEM	QTY	DESCRIPTION	UNIT PRICE
1	1	<p>P.J. HANNAH BIODISC® sewage treatment plant model BS9F-BFP. Rated for a daily flow of 22.7 m³ of camp strength sewage, to produce an effluent quality of < 10 mg/l BOD₅, <10 mg/l TSS, and less than 1.0 mg/l Phosphorous average. Drive motor 1/2 hp, 110/1/60 TEFC. Media area 1098 m².</p> <p>This is a complete corrosion protected steel package plant complete with primary clarifier, rotor treatment zone, final clarifier, filter feed and backwash chambers and effluent pumping chamber.</p> <p>Also includes the following if √</p> <ul style="list-style-type: none"> √ Internal flow balancing system. √ 25 mm spray foam insulation on all external walls and bottom. √ 25 mm spray foam insulation on underside of cover. √ UV disinfection system. √ Tertiary filter. √ Control panel. √ Phosphorus removal system. √ Effluent pumps √ Intrinsically safe heaters and lights within treatment plant. √ Flow meter. √ Grating and handrailing within treatment plant. 	

Client Ref#: AMEC Earth and Environmental
17550- ITEM 1

P.J. HANNAH REF#: K

Job Name Tahera Corp.

DATE June 13, 2003

INFLUENT CONDITIONS	DESIGN CRITERIA	SUMMER	WINTER
	Design Flow m ³ /day (avg)	22.7	22.7
	Design Flow m ³ /hr (peak)		
	To be flow balanced to m ³ /hr (design)		
	Anticipated Flow m ³ /day (avg)		
	Anticipated Flow m ³ / (peak)		
	To be flow balanced to m ³ /hr (Anticipated)		
	PH	Assumed 6.5 to 8.5 all year round	
	BOD ₅ mg/ℓ (total)	375	375
	SS mg/ℓ (total)	450	450
	Fats, oils & grease mg/ℓ	50 (max)	50 (max)
	NH ₃ -N mg/ℓ		
	T.K.N. mg/ℓ		
	Phosphorous mg/ℓ	13	13
	Sewage temperature °C	>12.5	> 9
	BOD ₅ mg/ℓ (total)	< 10	< 10
<u>EFFLUENT REQUIREMENTS</u> (All Average Values)	SS mg/ℓ (total)	< 10	< 10
	NH ₃ -N mg/ℓ		
Nitrification	NH ₃ -N mg/ℓ		
Dentrification	T.K.N. mg/ℓ		
	Total Nitrogen mg/ℓ		
	Phosphorous mg/ℓ	< 1.0	< 1.0

Disinfection

Fecal Coliform M.P.N./100
mℓ

**SOURCE OF
WASTEWATER:**

< 10 CFU

< 10 CFU

Mine Camp

TWS

Electrical Engineering Ltd.

HEAD OFFICE

#102, 9433 - 47 Street
Edmonton, Alberta T6D 2R7
Ph: (780) 468-5177
Fax: (780) 465-5368

BRANCH OFFICE

#605, 5920-1A Street S.W.
Calgary, Alberta T2H 0G3
Ph: (403) 254-2541
Fx: (403) 254-2121

www.twsengineering.com
E-Mail: office@twsengineering.com

April 8, 2005

File No: 04-1205-001

Shanco Camp Service Ltd.
10340 - 140 Avenue
Grande Prairie, Alberta
T6V 8A4

Phone: 780-539-6601
Fax: 780-538-3093

Attention: Ken Francis

Dear Ken:

Re: Jericho Mines Camp Life Safety (M & E), Nunavut, N.W.T.

We have reviewed the drawings and design material as submitted by P.J. Hannah for the sewage treatment plant (Drawing A1-K17550-10455 and email attachments of April 4, 2005).

The mechanical aspects of the system as designed (i.e.: pumps/piping/valves) comply with applicable codes and as such are approved.

This approval letter does not cover process, health or actual treatment of the sewage and is restricted to the mechanical aspect of the facility.

Yours truly,

TWS ENGINEERING LTD.



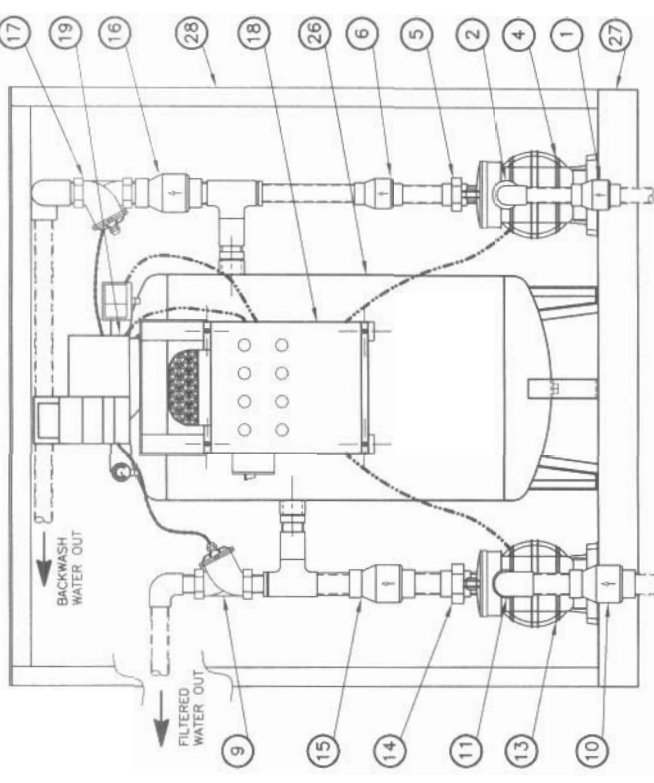
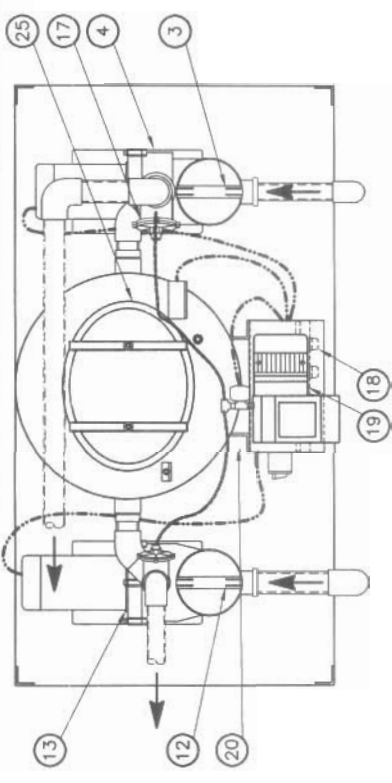
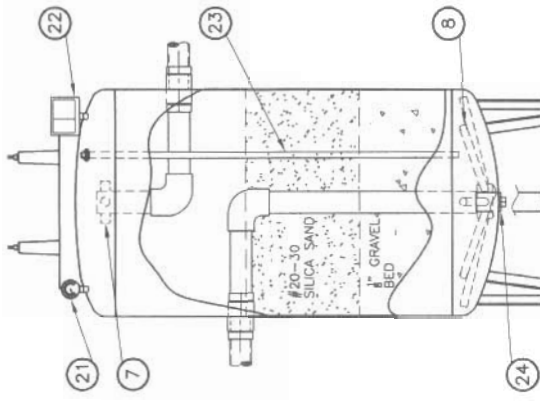
Terry W. Smith, P. Eng.

TWS/dh

Delivering Bright Ideas

MODEL No.	20SF500W 500mm	30SF500W 500mm	40SF500W 500mm	40SF750W 750mm	60SF750W 750mm	70SF750W 750mm
RECOMMENDED FOR PLANT SIZE	26.5m ³ /DAY	41.6m ³ /DAY	59.4m ³ /DAY	84.4m ³ /DAY	132.5m ³ /DAY	170.3m ³ /DAY
MAXIMUM FILTER CAPACITY	59.4m ³ /DAY	84.4m ³ /DAY	132.5m ³ /DAY	170.3m ³ /DAY	268.2m ³ /DAY	354.2m ³ /DAY
FILTER TANK DIAMETER	508mm	610mm	712mm	814mm	1067mm	1219mm
FILTER BED SIZE (MM)	0.20m ³	0.28m ³	0.46m ³	0.66m ³	0.89m ³	1.16m ³
DOSING PUMP SIZE	1 h.p.	1 h.p.	1 h.p.	1 h.p.	1 h.p.	1 h.p.
FORWARD FILTER RATE	4.1 L/min	5.9 L/min	8.2 L/min	11.3 L/min	15.2 L/min	20.8 L/min
DOSING TANK SIZE (LITERS)	1365 L	1365 L	2730 L	2730 L	2730 L	3780 L
FILTER PIPE SIZE (MM)	1"	1"	1 1/2"	1 1/2"	2"	2"
BACKWASH RATE	125 L/min	182 L/min	260 L/min	340 L/min	458 L/min	611 L/min
BACKWASH PUMP SIZE	1 h.p.	1 h.p.	2 h.p.	2 h.p.	3 h.p.	5 h.p.
OUTFALL HOLDING TANK SIZE	1365 L	1365 L	2730 L	2730 L	2730 L	3780 L
1" GRAVEL	113kg	141kg	227kg	368kg	523kg	682kg
#20-30 SILICA SAND	91kg	136kg	227kg	318kg	455kg	590kg
OVERALL HEIGHT OF UNIT	1375mm	1550mm	1650mm	1650mm	1700mm	1750mm
OVERALL WIDTH & LENGTH OF UNIT	865mm x 1220mm	1115mm x 1370mm	1270mm x 1525mm	1470mm x 1675mm	1625mm x 1830mm	1830mm x 2035mm
PROPOSED SUPPORTING FLOORING HEIGHT	264kg	275kg	364kg	441kg	623kg	811kg

1. Dosing pump check valve
2. Dosing pump inlet
3. Dosing pump inlet & lift trap
4. Dosing pump
5. Dosing pump coupling
6. Dosing line check valve
7. Distribution head
8. Lateral
9. Hydraulic automatic valve (normally open)
10. Backwash pump inlet
11. Backwash pump
12. Backwash pump inlet & lift trap
13. Backwash pump coupling
14. Backwash pump check valve
15. Backwash line check valve
16. Check valve
17. Hydraulic automatic valve (normally closed)
18. Control panel with alarm light
19. Air compressor
20. Solenoid valve
21. Pressure gauge
22. Pressure relay/switch
23. Waste
24. Drain plug
25. Access port
26. Filter tank
27. Steel base
28. Main shell (optional)



DO NOT SCALE THIS DRAWING		ALL DIMENSIONS IN mm UNLESS OTHERWISE NOTED		DATE	
CLIENT	RV	DATE	REV	DATE	REV
CONTRACT	16	01/01/29	2	12/10/21	2
PROJECT	16	01/01/29	2	12/10/21	2
SFSBV AUTOMATIC BACKWASH FILTER (m ³ /DAY)		A1-9066		REV. 2	
GENERAL ARRANGEMENT		WISSCAN MECHANICAL LTD.		REV. 2	
SFSBV AUTOMATIC BACKWASH FILTER		WISSCAN MECHANICAL LTD.		REV. 2	

NO BACK CHARGES TO US WILL BE ALLOWED WITH OUT OUR PRE-AUTHORIZED WRITTEN PERMISSION
THIS REVISION DRAWING SUPERSEDES ALL PREVIOUS ISSUES