CASE STUDY – EVANS HEAD STP : THE CASE NOT TO SHUT DOWN TRICKLE FILTERS AND INSTALL EXPENSIVE ALTERNATIVES

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THE CASE NOT TO SHUT DOWN TRICKLE FILTERS AND INSTALL EXPENSIVE ALTERNATIVES

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ABSTRACT

Virotec Global Solutions' first commercial project, applying its chemical treatment technology for the treatment of sewage, operated for over 20 months at the Evans Head Sewage Treatment Plant. This Paper presents the process objectives, scientific methodology, analytical results and the commercial benefits that resulted for the Richmond Valley Council and discussions on the difficulties encountered and the advantages and disadvantages of applying such a technology. This Paper details the economic comparison between implementing such a technology at existing sewage treatment plants which require either a major upgrade or the implementation of a future developmental plan which includes the construction of a new sewage treatment plant and necessary associated infrastructure. Either approach involves substantial capital expenditure, increased operating expense, re-training of operators to enhance their skills set, etc. The case study will include numerical data to illustrate the comparisons.

1.0 KEY WORDS

Sewage Treatment, Sustainable Technology, Nutrient Removal, Phosphorus, Nitrogen, New Technology, Chemical Treatment

2.0 INTRODUCTION

The Evans Head Sewage Treatment Plant is owned and operated by Richmond Valley Council, treating sewage generated from the townships of Evans Head and Woodburn. The equivalent population for the STP is 3,700 but during the summer months and vacation periods (coinciding with school holidays) it is not unusual for the population to increase to 10,000. The STP has been operating at its peak design for some time now with treated effluent quality consistently approaching the discharge licence limits, and occasionally exceeding them.

In order to ensure that EHSTP consistently met it's EPA discharge licence conditions for Biochemical Oxygen Demand and Suspended Solids, Council looked at several treatment technologies including one offered by Mess Industries (which was still on the drawing board) and another promoted by BioRemedy. This second technology was trialed for six months but achieved little success in meeting the targets. Council then decided to trial ViroSewage™ Technology offered by Virotec Global Solutions, an Australian company based in Queensland.

3.0 EVANS HEAD SEWAGE TREATMENT PLANT

EHSTP is a trickling filter (bio-filter) plant that treats sewage to secondary effluent quality. The process layout is depicted in Figure 1 and current ADWF varies between 1.3 to 1.5 MLD, about 2 to 3 times the original design flows.

Infiltration is also a major problem at this STP. Both primary sedimentation and secondary humus tanks are grossly overloaded. Some 50% of the treated flow is re-circulated to the siphon chamber for additional treatment. The treated effluent is then disinfected using ultra-violet treatment system before being discharged to the nearby wetlands.

The range of average monthly analyses taken of the treated effluent between March 2003 and January 2004 is tabulated below to characterize EHSTP's plant performance before the application of ViroSewage™ Technology:-

Table 1: ***EHSTP treated effluent results without ViroSewage™ Treatment***

pH	BOD5 mg/L	SS mg/L	O&G mg/L	TN mg/L	TP mg/L	Faecal Coliform Cfus/100 mL
6.89 - 7.38	21 - 49	15- 57	1 – 2	11 - 37	1.7 – 7.3	110,000 – 1,950,000

4.0 VIROTEC TOTAL SOLUTION

The Virotec Total Solution approach included design, engineering, installation, commissioning, monitoring and evaluation of its ViroSewage™ Technology. ViroSewage™ Technology is a chemical treatment system which works in conjunction with, and does not displace, biological treatment of sewage. The addition of ViroSewage™ reagents at specific locations in specific dosages and in a specific manner are an integral part of the technology.

The actual chemical reactions taking place will not be described here but the ViroSewage™ reagent consists of a myriad of very fine grained minerals which can have a positive or negative surface charge depending on the pH conditions they are exposed to. The very fine grain size of the mineral particles gives them a high surface area to volume ratio and a high surface charge to mass ratio. These properties make the reagent extremely surface active, giving them the ability to attract and hold charged particles or polar molecules. The reagent, acting together with other reagents, enhances precipitation, co-precipitation, and coagulation and improves flocculation, resulting in denser agglomerates which settle rapidly. Both suspended solids and organic matter are removed in this way in the liquid stream.

At EHSTP the technology was applied after the trickling filter but before the humus tanks (see Fig. 1). After careful assessment of the hydraulic loading and daily flow patterns, a series of full scale field trials were conducted on one half of the plant. Following the initial trials and finely tuned adjustments, the ViroSewage™ application successfully treated the sewage to comply with the EPA licence conditions. The humus tanks performance was improved dramatically as a consequence of the enhanced settling brought about by the ViroSewage™ reagents. Treated effluent properties improved significantly in colour, clarity, turbidity and phosphorus content after application of ViroSewage™ Technology.

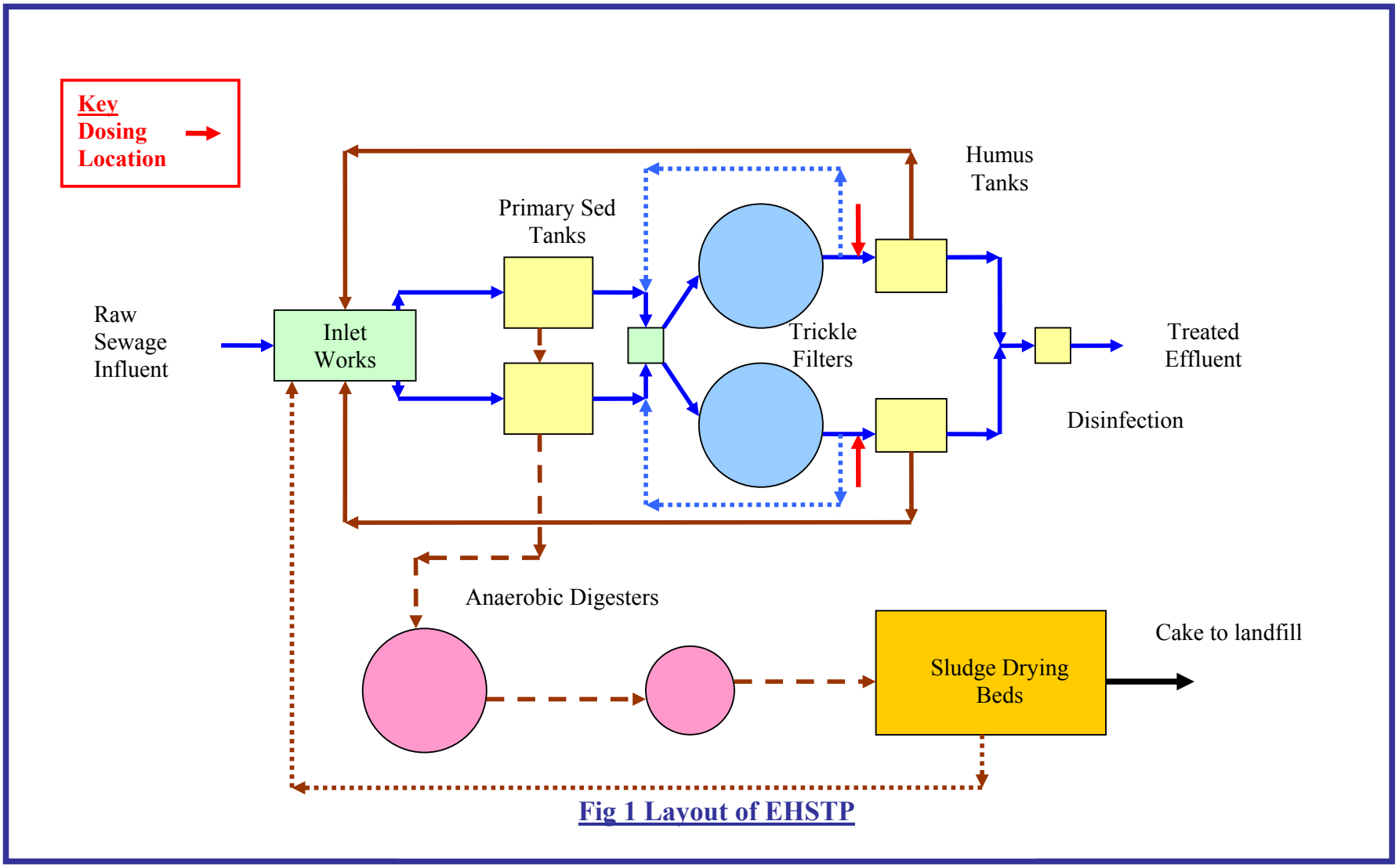

Fig 1 Layout of EHSTP

The table below provides details of the treatment results, which has been averaged over a period of 8 months.

Table 2: ***EHSTP treated effluent results after ViroSewage™ Treatment***

BOD_5 mg/L	SS mg/L	TN mg/L	TP mg/L	Faecal Coliform cfus / 100 mL
<2 - 9	7 - 24	21 - 40	0 – 0.67	160 – 125,000

A consequence of the treatment is the production of additional volumes of humus sludge which may affect existing sludge handling facilities, including holding capacity in digesters and sand drying beds availability. Current 20 to 30 days anaerobic digestion times may be reduced; however this may be compensated partly by the stabilized nature of the sludge. It follows that decomposition and consequently generation of noxious odours may be eliminated. This is one of the characteristics of the sludge which is formed as a result of the technology. The sludge wasting cycle may be shortened but drying cycles will be longer as the sludge will be thicker, requiring more time to dry out.

5.0 SUMMARY OF BENEFITS

EHSTP is now operating well within its EPA licence limits. With BOD_5 and SS readings averaging 4 and 15 mg/L respectively ViroSewage™ Technology is a credible approach for producing consistent results. The technology's ability to handle excessive hydraulic and organic loadings is well demonstrated. It could be concluded that the technology is able to handle 2 to 3 times the original design flows.

Richmond Valley Council have been able to progress their plans to build new additional facilities for current and future increased loadings without having to expend excessive capital to address the current problems at EHSTP.

An additional benefit at EHSTP is the absence of obnoxious odours. The humus return from the humus tanks mixes with fresh raw sewage and the ViroSewage™ reagents arrest the formation of odour forming compounds.

The addition of ViroSewage™ reagents improves settling allowing for secondary settling tanks to be designed and constructed more economically.

The ViroSewage™ treatment method is a simple add-on to the existing treatment plant and does not require any significant, capital intensive structural or civil works to accommodate the technology.

6.0 COMPARATIVE ANALYSIS OF THE PROPOSED EXTENDED AERATION SYSTEM FOR EHSTP VERSUS VIROSEWAGE™ TECHNOLOGY

Richmond Valley Council has decided to build a new sewage treatment plant at Evans Head. The project is being built over two stages. Stage 1 is to cater for a population of 5,500 persons and Stage 2 for another 5,500 persons in about 20 years time.

Stage 1 will include an inlet works built for the ultimate population of 11,000, extended aeration tanks, clarifiers, chemical dosing system and tanks, catch balance tanks, sludge holding facilities, office and laboratory buildings, road works etc.

The STP is being designed to treat to the following license parameters:-

BOD – 10 mg/L	SS – 15 mg/L
N – 10 mg/L	P – 0.3 mg/L

Further treatment to recycle / re-use standards will be assessed only after this new plant has been commissioned and operated for a period in time.

In order to meet the targets set out above, ViroSewage™ Technology will be combined with another technology so that ViroSewage™ will reduce BOD, SS and P concentrations whilst the other will reduce Nitrogen concentrations.

It is suggested that a new inlet works is built along with a primary clarifier and a secondary clarifier. The capacities of these clarifiers will be designed to suit the summer peak flows anticipated under Stage 1. The existing trickling filters will be retained and the ViroSewage™ reagents will be dosed after the secondary clarifier. A filtration system will be introduced prior to the Nitrogen removal process. Treated effluent will be disinfected via the existing UV system. The existing sludge handling facilities will be retained.

6.1 *Estimate of Costs*

The costs associated with the two options are as follows:-

New EA Stage 1 STP	-	$10,000,000
Energy Costs – estimated (additional)	-	$50,000 p.a.
Chemical costs – estimated (new)	-	$50,000 p.a.
Operator costs – estimated (additional)	-	$50,000 p.a.
Laboratory costs – estimated (additional)	-	$20,000 p.a.
Virotec technologies capital costs	-	$1,230,000
Virotec technologies operating costs	-	$196,100 p.a.
Energy Costs (additional)	-	$5000 p.a.
Inlet works, two clarifiers (new)	-	$800,000

Assumptions

Annual Inflation Factor	-	3%
NPV Discount Factor	-	6%
Compound Interest	-	5%
Time period for assessment	-	20 years

Year 1 costs include 6 months installation and 6 months operating. Capital and operating costs are not discounted in Year 1. Discounting starts from Year 2.

Table 3: ***Summary of NPV Calculations Results***

Cost Item	NPV
EA Stage 1 STP	$10,000,000
Operating costs	$2,623,988
Total (A)	$12,623,988
Virotec total costs	$4,133,222
Inlet works, clarifiers	$800,000
Tank Farm	$150,000
Total (B)	$5,080,222
Project Costs Savings (A-B)	$7,543,765

Note: The difference in capital expenditure between the two systems equals $7,970,046.

The significant capital costs of building a new STP and the lower costs for a biological-chemical upgraded treatment system demonstrates that the Virotec approach results in a NPV savings of $7,543,765. Even though the operating costs of the Virotec technologies are about 14% higher, the capital expenditure differential is significantly compelling.

Furthermore, if the savings in capital expenditure in Year 1, which amounts to $7,970,046, are invested at 5% interest, the compounded interest earned over the 20 year time frame, less the operating costs differential, will generate total earnings of $14,176,485 on a NPV basis. In other words, Council will be much better off with the biological – chemical treatment system as recommended by Virotec.

7.0 CONCLUSION

The Case Study demonstrates that a simple, low cost methodology exists for treating sewage to EPA licence limits, improving treated effluent quality, removing nutrients, eliminating odours and handling increased hydraulic capacity of the treatment plant. ViroSewage™ Technology is proving to be a viable answer to manage these issues.