WHAKARONGO SCHOOL and COMMUNITY HALL

SEWAGE SYSTEM EVALUATION & UPGRADE

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Background

Whakarongo School is located mid-way between Palmerston North and the rural township of Ashhurst. It traditionally served the local farm community and had 2 classrooms for most of its early life.

However the development of lifestyle blocks, and the encroachment of Palmerston North residential housing within its traditional collection area, has seen the school roll steadily increase in the past 30 years. This trend has been accelerated in recent years as both these factors have resulted in an influx of young families into the area.

The School roll had risen from 130 pupils to a current roll of around 300 in 6 years and a community trust was building a combined school/community hall on the school grounds with a seating capacity of 375 people. This building work had obtained the necessary building consents as the Council had not required a sewage system review or update.

It would appear to me that the granting of a building consent, without a review of the current sewage system, was an oversight as in my opinion any increase in rural wastewater use, whether from a house, rural factory or school, should require an evaluation of the existing sewage system as a matter of course.

Existing System Evaluation

The original school building was serviced by a single 2700 litre septic tank with the effluent flowing into a shallow soakage trench of unknown length and construction now located under a vigorously growing shelter belt.

In 1995 two additional classrooms with ablution facilities were added. These were serviced by the addition of a separate filtered septic tank, pump chamber and 4 x 25 metre LPED soakage trenches parallel to the existing gravity trench.

In addition the existing septic tank was fitted with an effluent filter and connected to the pump chamber. An overflow pipe connected the new LPED trenches to the original trench(es). Instructions were received by the designer not to interfere with or replace the original trenches as they had 'worked' satisfactorily for years.

While the new LPED addition was an improvement on the original gravity disposal method, the result was still a theoretical DLR in excess of 20 litres of (primary treated effluent) per square metre per day in category 5 soil. The fact that no effluent break out or sewage back up had been experienced indicated that the effluent was not being contained within the LAA and probably flowed into a farm drain or elsewhere outside the school boundary.

The Existing System 'Works'

The current thinking at the school was that the existing septic tank and gravity disposal system worked (ie it didn't present a problem) and the school committee and now Board of Trustees didn't feel the need to 'waste' education money on something that didn't need fixing.

There was a good reason why the effluent disposal didn't present a problem and that is common to a number of rural schools where the sewage system has been in place for 10-15 years or more, and especially where the septic tank and effluent field has been organised or installed by parents (mostly farmers) of the school pupils. That reason is that in nearly the majority of cases that I have investigated for the Ministry of Education and Boards of Trustees is that the effluent from school septic tanks has often been discharged into either land drainage, a gulley or into a stream.

This situation has largely arisen as a result of the enthusiastic efforts of school committees and Boards of Trustees to minimise 'out of classroom' costs and, as rural schools are principally for rural children, the traditional farmers' attitude of 'over the bank' has tended to play a significant part in determining where school septic tank effluent was discharged.

In this case, when the new sewage system was installed, the excavations uncovered a 150Ø field tile drain running along the boundary next to the effluent drain and this carried the effluent away from the school into a roadside drain.

System Design Parameters

The design wastewater usage for the 300 pupils and staff, at 20 litres per person per day (1), is 6000 litres per day. The additional wastewater from the community hall, which can seat 375 people, was assessed at 15 litres per person per function with a maximum of 5625 litres per function.

The school land area is approximately 20,000m2 with the school building and hardstand areas comprising 50%. The grassed play field area was approximately 9,000m2 including a small shelter belt strip along 2 boundaries of 1000m2.

To further restrict the area of land available for effluent disposal a 1000m^2 area along the longer road frontage, although used by the school as a play area, was actually a designated road reserve and could not automatically be considered for effluent disposal.

Sewage System Options

In theory the usual options of primary or secondary treatment systems were considered although the first two were not viable and were listed primarily for the benefit of those at the school who thought the existing sewage system was working satisfactorily.

Primary (septic tank) with gravity disposal. This option would have involved the installation of additional septic tanks and extended soakage trenches. This option was rejected as traditional gravity septic tank systems in this soil have a history of poor performance largely due to the effluent trenches being constructed below the water table or in the clay layer where the soakage is minimal.

This, together with the known faults of traditional septic tank systems, namely, septic tank sludge sealing the natural pores in the ground and gravity fed effluent overloading the soil around the point of entry, have resulted in many septic tank trench systems failing as progressive creeping failure clogs up the trenches.

In effect the length of the trenches, coupled with the rate of creeping failure, merely gives the time period it takes for the complete trench system to become clogged and require replacing.

1. **Primary (septic tank) with Low Pressure Effluent Dosing (LPED) disposal.** The additional tankage would be the same as for item 1 with the filtered effluent being evenly pressure dosed (usually by a pump) into a series of shallow soakage trenches at a rate the ground could absorb and treat.

2. As the soil type is category 5, and the LAA is effectively acting as a secondary treatment area, the disposal area would need to be designated for effluent disposal, fenced off and not used for any other purpose. In this case the LAA would be around 2500m^2 which would take up most of the rugby field being the only suitable area of land available.

3. **Secondary Sewage Treatment.** Secondary treatment is provided within the treatment plant by an additional treatment process (after the primary tank) where aerobic organisms are concentrated in the secondary treatment chamber.

   To be successful the secondary treatment process must achieve a balance where the primary (anaerobic) effluent is bought into contact (over the required time period) with sufficient aerobic organisms to consume the harmful bacteria and produce effluent which complies with BOD:TSS 20:30mg/litre as stated in AS/NZS 1547:2000.

   Secondary treated effluent can be pumped directly into the soil through trickle irrigation tubing which does not need to follow the contour precisely (as required with primary LPED disposal trenches) and this enables the existing school shelter belt and pine plantation areas to be utilized as a Land Application Area provided the effluent is consistently treated to secondary treated quality.

Test Data Reveals Variation in Performance of Some Secondary Treatment Processes

In advising the Board of Trustees of the most appropriate cost effective treatment process with minimum maintenance and operating costs, consideration was given the suitability of sewage treatment processes for use in a school environment. This included consideration of the results of the Hawkes Bay Regional Council compliance monitoring program of domestic secondary sewage treatment systems and the respective treatment processes used.

Set up in 2001 (2) a monitoring programme required consent holders to carry out at least one grab sample per year and forward the results to the Hawkes Bay Regional Council. Council noted that manufacturers had made claims regarding effluent quality performance and the results obtained from Council monitoring showed that many systems were not meeting their own performance requirements.

A further report published in On-Site NewZ in 2004 (2) noted that there had been a considerable reduction in compliance that year. The report went on to state, *"The majority of systems sampled are aerated wastewater treatment units servicing a mixture of permanent dwellings and holiday homes. All systems had been serviced six monthly. Overloading of the system may be a reason for non-compliance for some holiday homes…, or it may simply be the shock loading from intermittent use."*

This report (3) stated that the HBRC had been working with the local on-site industry since 2001, via the Sewage On Site (SOS) group and this group was of the opinion that this information on system performance needs to be provided to the public so they can make an informed decision.

A letter from HBRC to members of the SOS group (4) stated the results of the tests were being made available to the consent holder and the system manufacturer and further went on to state," *Only four types of systems* (5) *had a sufficient number of systems in place to provide reliable data for the statistical analysis*"

Test result data distributed at the SOS meeting in January 2004 (6) revealed that only 17% of the 58 systems tested actually produced secondary treated effluent with respect to BOD5.

Of the systems failing to meet the Standard effluent BOD5 quality (83% of those tested), the average BOD5 test result was 111g/m^3. (7). For comparison purposes promotional material from a New Zealand septic tank effluent filter manufacturer (8) claims their effluent filter will produce an effluent quality of BOD5 90g/m^3.from a septic tank or primary chamber of their sewage treatment system.

Further information released in April (9) showed that the rate of failure to produce secondary treated effluent with respect to BOD5 had increased from 44% of systems in 2001 to 50% of systems in 2003 to 85% of systems in 2004.

It would appear to me from analysing results from the 4 systems identified by HBRC (10) that the average BOD5 produced by system A is in excess of 100g/m^3 (81 tests), the average BOD produced by system B is in excess of 70g/m^3 (22 tests), the average BOD produced by system C is in excess of 45g/m^3 (5 tests) and the average BOD produced by system D is in excess of 30g/m^3 (21 tests).

It would also appear to me that system A exceeded the AS/NZS 1547:2000 standard (BOD5) level in 80% of tests, system B exceeded the standard (BOD5) level in 55% of tests, system C exceeded the standard (BOD5) level in 75% of tests and system D exceeded the standard (BOD5) level in 66% of tests.

While aerated systems have been identified as the treatment process in a majority of systems it appears to me that manufacturers of plastic, zeolite and foam treatment media systems have also been sampled in the Hawkes Bay Regional Council monitoring programme, and these test results have been sent to the manufacturers involved.

The pattern of school wastewater usage places particular demands on the sewage treatment process. The pupils produce wastewater in peak loads during the day and there is little or no flow over weekends and holidays. System processes which do not handle peak or shock loads or which require a long start up time, are generally not suitable for use in a school environment.

In addition, Whakarongo School is in an area where new rural subdivisions are being established on a regular basis and the school roll is expected to increase. The treatment process would either need to be able to handle the increased loading or be able to be extended if necessary to meet this demand.

Given the above information, and my own observations of sewage system processes in the medium and long term, I advised the Board of Trustees that a recirculating textile Packed Bed Reactor (rtPBR), known as an Advantex sewage treatment system, as designed by Orenco Systems Incorporated (OSI) in the United States, would provide secondary quality effluent for current and anticipated loadings produced by the school and community hall.

Sewage System Design

The sewage from the school/community hall is collected in 2 x 11,000 litre septic tanks, the second of which is fitted with a screened (filtered) pump vault and timer-dosed to the recirculation tank at the treatment plant. As the school buildings were only 4 metres from the fence two septic tanks were used in place of one large tank as the area available was restricted.

All the school sewage is collected in a 25,000 litre septic tank fitted with an effluent filter and gravity feeds into a 13,000 litre recirculation tank. The recirculation tank also receives the timed doses from the hall as the effluent has already been filtered by the pump vault and is of a similar quality to that from the school septic tank.

The filtered effluent is timer-dosed and recirculated over the textile Packed Bed Reactor, which consists of an Orenco AX-100 treatment pod. The AX-100 can treat 10,000 litres per day and had been selected to cater for the anticipated increased volumes as the school roll and hall usage increases.

It appears to me the PBR process represents a stable treatment process in that the effluent is dosed over textile media at a rate, and droplet size, that results in the effluent adhering to the textile media in a thin film where it undergoes enzymatic attack from organisms which consume the effluent and produce secondary treated effluent.

The progress of effluent through the treatment media is by displacement. A timer-controlled dose displaces the previous dose which effectively moves down a layer where it adheres to the next level of textile and undergoes further enzymatic attack and breakdown. The layer of effluent at the bottom of the textile is displaced into the recirculation tank where it is either recirculated over the treatment media or diverted through the UV unit into the treated effluent tank.

After passing through a UV sterilization unit the treated effluent is stored in a 27,000 litre treated effluent tank where it is timer dosed into the Land Application Area (LAA) over 7 days. Due to the restricted area for land application the treated effluent produced over 5 school days is stored and timer-dosed to the LAA over 7 days to reduce the land area required. The operation of the Advantex sewage treatment systems is remotely monitored by Vericom telemetry which can significantly reduce service visits and maintenance costs.

As there is no reserve area of land available, apart possibly from a portion of road reserve land currently inside the fenced school play area, the DLR can be further reduced (in lieu of a reserve area) by recycling the treated and disinfected effluent to flush the school toilets. This can reduce the volume discharged to the LAA by around 15%.

REFERENCES

1. Wastewater usage figure from TP 58, third edition ARC publication 2004, page 53.

2. On Site NewZ – January 2002. Contribution by Ian Gunn.

3. On-Site NewZ – January 2004 contribution by Helen Codlin, Hawkes Bay Regional Council.

4. Compliance Monitoring Report Analysis, dated 8 April 2004, from Helen Codlin, Manager Environmental Regulation, Hawkes Bay Regional Council to members of the Sewage On Site group.

5. Compliance Monitoring Report Analysis, dated 8 April 2004, from Helen Codlin, Manager Environmental Regulation, Hawkes Bay Regional Council to members of the Sewage On Site Group. The system manufacturers were listed but have been omitted from this paper. However the Council information is public information and can be obtained from the Hawkes Bay Regional Council, Private Bag 6006, Napier.

6. Packaged Treatment Plants, 2003/2004 Sample Analysis Results. Hawkes Bay Regional Council circular presented at the January 2004 meeting of the Sewage On Site group. Copies available from HBRC.

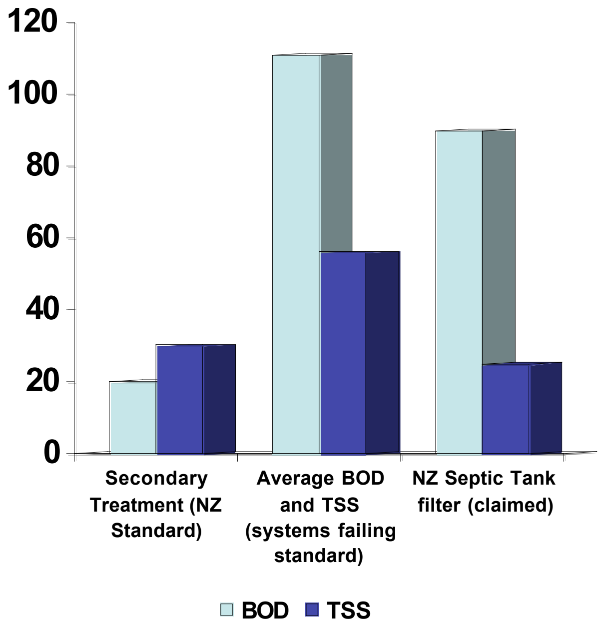
7. Packaged Treatment Plants, 2003/2004 Sample Analysis Results. Hawkes Bay Regional Council circular presented at the January 2004 meeting of the Sewage On Site group. Copies available from HBRC.

8. GT 150 effluent filter manufactured by Gould GT Systems. Performance as stated in company promotional brochure of BOD:TSS 90:25g/m^3

9. On-Site Wastewater Discharges – Analysis BOD Monitoring Data, by Barry Zong Bo Hu, Environmental Regulation Section, Hawkes Bay Regional Council, dated March 2004. Copies available from HBRC.

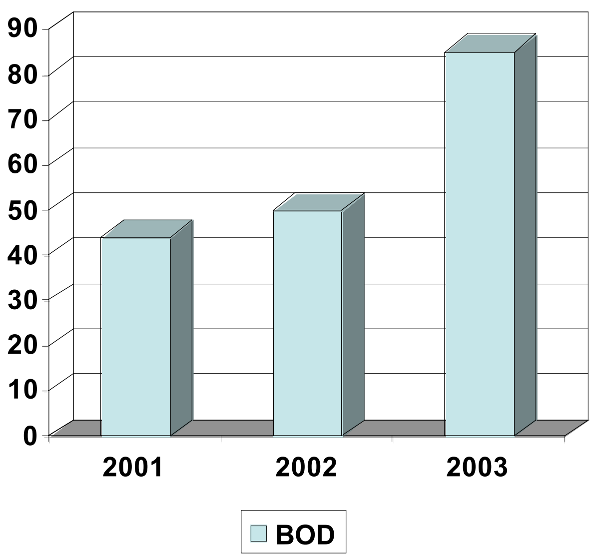
10. Collation of data together with system manufacturers, from items (4), (5) & (6) above, supplied to author by HBRC upon request.

Council Tests of Secondary Treatment Systems in Hawke's Bay



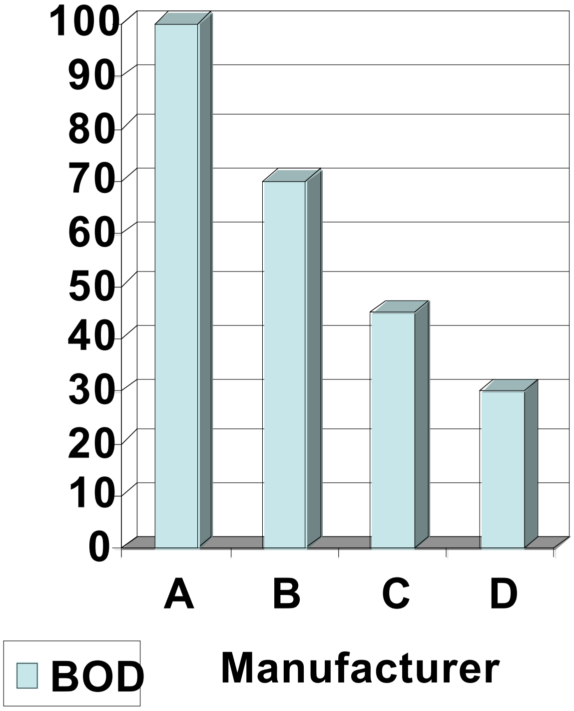
- Only 17% produce secondary treated effluent
- Average of the 83% failed systems was worse than a filtered septic tank
- Not suitable for dripline

Increasing Rate of Failure in HB Council Monitoring Programme



- Rate of failure increased from
- 44% in 2001
- 50% in 2002
- 85% in 2003
- Fragile systems only get worse.
- Cheaper systems producing worst results.

Systemic Failure of Systems Revealed in HB Monitoring



- A: avg BOD 100+ (81 tests)
  - Exceed std in 80% tests
- B: avg BOD 70+ (22 tests)
  - Exceed std in 55% tests
- C: avg BOD 45+ (5 tests)
  - Exceed std in 75% tests
- D: avg BOD 30+ (21 tests)
  - Exceed std in 66% tests

Treatment Processes Tested

- Aerated treatment process - majority
- Plastic treatment media
- Zeolite treatment media
- Foam treatment media
- Results sent to owners & manufacturers
- Some manufacturers, despite knowing their system results, are continuing to promote their systems as secondary sewage treatment systems