Re-use Potential from Septage Receival and Treatment Facilities Armidale

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Paper presented to

The Australian - Indonesian International Conference

"Water Quality and Waste Treatment"

19th - 22nd October, 1998

LOMBOK - INDONESIA

Reference: PATTERSON, R.A., CHAPMAN, T.M. and PORTER, M. (1998) Re-use Potential from Septage Receival and Treatment Facilities The Australian-Indonesian International Conference on Water Quality and Waste Treatment. 19-22 October, 1998. Lombok, Indonesia

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Abstract

Until recently, septage removed from domestic septic tanks was spread on agricultural lands, deposited in trenches at the local sewage treatment works (STW) or placed in the local landfill. Similarly, grease trap wastes, a suspension of solids, greases, oils and fats in water, removed from restaurants, commercial kitchens, fast-food outlets and boarding houses were dumped in landfills.

Changes to environmental and waste legislation in New South Wales prevent the disposal of septage or grease trap waste to land. Alternatives to landfill sites must be found.

Armidale City Council sought to address the problem of grease trap waste disposal as a positive step in increasing compliance of its 1996 Liquid Trade Waste Policy. Regulation of pump-out contractors will ensure compliance with environmental laws and reduce illegal dumping of wastes on unlicensed lands. As Council owns the landfill to which septage is deposited, an economic benefit exists to incorporate septage from its own area (200 homes) with commercial grease trap wastes and open the facilities to neighbouring Councils that have more than 4000 septic tanks.

The facility is an anaerobic/aerobic treatment process. Through special fittings, grease trap waste and septage are dumped by licensed contractors into one anaerobic pond, each pond designed to hold a year's capacity. The two anaerobic ponds permit the operation of one for receivals while the other is de-watered before solids are applied to land. This paper will outline the data collection, system design and the monitoring program for beneficial use of perceived waste products.

The facilities have been built and were commissioned in July 1998. Pump-out contractors will be licensed and trade waste licensees will have a voucher system to monitor pump-out schedules. Fees for receivals, imposed on grease trap waste at 4.5 cents per litre and septage at 2.5 cents per litre, will repay the construction costs and on-going operation and maintenance. It is expected that the facility will generate in excess of $50,000 per annum as well as the agricultural benefits from the effluent and biosolids application to pastures.

Thus, the commitment by the Armidale City Council to build and operate facilities to accept liquid trade waste and septage will encourage compliance with licence agreements and environmental legislation and reduce the incidence of haphazard disposal of these foul products. The beneficial re-use from the facilities will return revenue to the ratepayers as well as protect the environment. The facility is a commendable model of profitable septage and liquid waste management.

Keywords
anaerobic digestion, biosolids, grease trap waste, septage, septic tank, trade waste.

1. Background

Armidale, a city of 23 000 persons, occupies 34 km^2 of the New England Tablelands of north-eastern New South Wales, approximately 1000 m above sea level (ASL). The city is a mainly residential with a small light industrial sector and no major industrial processors. The city services a rural community based upon wool and livestock production and is a centre of education.

In 1996, the Council instigated a liquid trade waste policy [1] based upon the ANZECC [2] guidelines. This policy required Council to identify and license commercial operations discharging trade waste to the sewer. Licensed premises are required to meet guideline limits for oil and grease, suspended solids, biochemical oxygen demand and a range of other organic and inorganic compounds. In most instances, grease traps have to be retro-fitted, often in difficult positions, to provide the level of protection required. From small take-away food businesses to large fast-food outlets, each has to comply with the same guidelines.

Businesses which produce liquid wastes based upon hydrocarbons and petroleum oils are required to install oil separators on the discharge to sewer. The waste products from these operations are recovered by re-processors and are specifically excluded from this project.

Contractors have previously collected the grease trap waste at specified periods and dumped the putrid material at the local landfill. Without adequate protection, there is a significant potential for leakage of contaminated liquids into the groundwater or on nearby lands. The problems with itinerant contractors dumping wastes indiscriminately has been almost impossible to police and highlights a potential source of pollution.

The non-urban population creates a semi-liquid waste. Slowly biodegradable organic matter and non-degradable mineral materials accumulate in domestic septic tanks as a function of wastewater loading rate, residence time and frequency of cleaning. The accumulation of floatable solids as scum, of settleable materials as sludge and the liquid wastewater in the remaining tank volume are collectively called septage. The septage, a suspension of about 20% solids in water, contains high concentrations of faecal coliforms, numerous pathogens and viruses as well as salts and valuable nutrients (nitrogen and phosphorus). Septic tanks require pump-out every 3-5 years to removed accumulated sludge and scum. With each household generating about 80 litres per person per year [3], the local requirement for appropriate treatment of septage is significant

Common practice for septage disposal has been to spread the semi-liquid waste over agricultural lands. While small benefits arise from the localised increase in organic matter in the soil, the hazard of environmental pollution is high. In some areas, septage is dumped into trenches at the local STW and left untreated and uncovered. In other areas, it is common to dump septage at the local landfill and buried with other municipal wastes, as has been the case in Armidale. Each of the above practices is being discouraged by both appropriate legislation and public concern.

Armidale City Council addressed the problem of liquid waste disposal, in a positive manner, to both satisfy the increased collection of grease trap wastes and the provision of alternative septage disposal facilities. The concept of a dedicated treatment facility arose from the need to consider the secure storage of liquid wastes and the final use of the decomposed waste products.

This paper outlines the process and the outcomes of Council's commitment to a holistic approach to liquid waste management.

2. Aim and Objectives

Council was committed to increasing liquid trade waste compliance by commercial operations to protect the sewers, the treatment facilities and the environment. The aim of this project was to provide environmentally sound receival facilities for those wastes. As Council operates the local landfill, a further consideration was to provide facilities to accept septage as an alternative to landfill dumping. Consistent with the Council's policy on sewage treatment, such a system had to be biologically based, avoiding the use of chemicals.

The holistic approach was to consider the end use of the liquid and solid components of the waste after treatment. The potential generation of liquid organic wastes was unknown. This project will provide valuable data in that area.

3. Data Collection

By 1996, grease traps (grease arresters) were installed in large commercial cooking establishments such as the University of New England's residential colleges, the boarding schools, the large service clubs, hotel, motels, restaurants and the fast food outlets. Various categories apply to the type and volume of dischargers as shown in Table 1. Numerous small operations will be retrofitted with grease traps and these installations will be on-going over several years.

TABLE 1. Categories of Waste Dischargers And Limits to Wastewater Quality

Category	Type	Daily volume kL/day	Total Oil and grease mg L^{-1}	Suspended solids mg L^{-1}	Council Charges (above general sewerage rate)
1A	kitchen, laundry	< 5	< 100	< 300	Maintenance fee only
1B	workshops, laboratories	< 5	< 100	< 300	Maintenance fee only
2	kitchen , laundry	5 - 20	< 100	< 300	Maintenance fee + operating charges
3	industrial	above guidelines, plus mass loading of heavy metals that do not cause problems to effluent or biosolids			Maintenance fee + operating charges

(after ACC, 1996)

Category 1B and those operations in Category 3 which produce wastes contaminated by products harmful to the decomposition of sewage, need to be excluded from the grease trap and septage treatment facilities. These include service stations, mechanical workshops, film laboratories and some light industries.

Gramarc Pty Ltd, one of two local pump-out contractors, provided data on their clientele giving a break-up of volume of liquid waste and frequency of removal. To that date, all wastes were disposed of at the Armidale landfill at a cost of $0.045 per litre above the cost of collection and transport. No data were available on the consistency of the liquid waste or the proportion of greases to other organic solids. Further, it could not be determined whether the frequency of pumping was sufficient to meet the guideline for total oil and grease (< 100 mg L^{-1}).
No chemical analysis of the grease trap waste is performed. Evidence suggests that the waste matter is

mainly congealed greases and trapped oils, particulate matter from food processing operations and cleaning chemicals. Monitoring the performance of oil separators for removing petroleum products is mandatory, initially upon installation and then on an annual basis. At the least, this establishes that the requisite design specifications are appropriate.

The data in Table 2 are estimates from contractor's records. Business operations have been grouped together on the basis of the type of potential grease generation. Until the introduction of the licensing agreement, there was no requirement for pump-out contractors to keep accurate records or for business operators to record pump-out events. At the stage of writing, many businesses were still to install grease traps and determine the pump-out frequency required to meet the liquid trade waste guidelines. Systems vary in size from 200 to 1500 litres.

TABLE 2. Grease Trap Waste Collection from Armidale Businesses

Type of operation	Volume of liquid wastes removed at various frequencies		
	weekly (L)	fortnightly (L)	monthly (L)
food preparation		4500	1000
hospital			1500
major fast food outlets	1500		3000
commercial kitchens		7200	4200
motels		3200	1900
restaurants		22100	22100
residential colleges	10500		3500
take-aways (small)			1500
Column totals	12000	37000	38700
Total for 12 months			2.0 ML

(Source raw data: Gramarc Pty Ltd, April 1997)

The values shown in Table 2 indicate that approximately 2.0 ML of grease trap waste are currently available each year. It is expected that an additional 50% should account for new connections and more frequent pump-outs based upon vigilant monitoring. The annual production of grease trap waste from all current sources is estimated at 3.0 ML. It is considered that contamination of the grease trap waste with detergents and food residues significantly reduces it commercial value for recycling or recovery. Cooking oils and greases recovered at source have an economic value and a ready market as heating oil.

Septic tank pump-outs occur at irregular intervals, usually based upon poorly conceived ideas of septic tank operation or poor management strategies. Recent changes to local government regulations will impose more vigilant management of on-site systems and pump-outs will occur at more regular intervals. An estimate of the number of septic tanks within economic transport distance of Armidale was made from previous records [4] is given in Table 3. The average size of a domestic septic tank is 2050 L, of which the majority is removed during pump-outs. The septage consists of the hardened surface scum, the sludge in the bottom of the tank and the liquid volume between. Contractors need to break up the scum and mix with the liquid to permit vacuum extraction. By the time the septage arrives at the treatment facility, most of the dried scum has been resuspended in the liquid.

TABLE 3. Estimated Number of Septic Tanks in the Rural Areas around Armidale

Local Government Area	**Shire population***	**Location relative to Armidale**	**Estimated number of septic tanks**	**Estimated annual volume septage** (kL)**
Armidale	21400#		200	100
Dumaresq Shire	3800	surrounding Armidale	1000	500
Uralla Shire	5950 ^	Uralla, 25 km south	550	275
Guyra Shire	4360 ^	Guyra, 30 km north	600	300
Totals	35510		2350	1175

* Department of Local Government 1998 ^ village sewered
\# Armidale is well serviced by sewerage scheme ** Estimated at 4 y frequency

The above estimate accounts for an annual collection of 1.2 ML of septage. Together with the grease trap waste, approximately 4.2 ML of liquid waste are generated by the surrounding communities each year.

The expected composition the 4.2 ML is given in Table 4. The values are estimates based upon overseas data for septage[5] and provide for planning of the end use of the effluent and solids. The total solids and the grease will further degrade under the anaerobic conditions, releasing additional nitrogen, phosphorus and salts.

TABLE 4 Likely Composition of the Annual Load of Septage and Grease Trap Waste

Constituent	**Estimated dry weight (tonnes)**	**Equivalent units**
BOD_5	18	49 kg per day
Suspended solids	45 tonnes	
Total nitrogen (TN)	3.3 tonnes	7.2 tonnes Urea
Total phosphorus (TP)	0.75 tonnes	6.8 tonnes single ‘Super’
Grease	24 tonnes	

4. System Selection

Three considerations were important in the selection of treatment facilities. Firstly, Council has a policy of biological treatment, that is, no added chemicals are used in sewage treatment. Secondly, the system had to encourage greater participation in the liquid trade waste policy at a reasonable fee for service. Finally, the facility had to be economically viable. Four methods of disposal, consistent with these principles, were investigated.

Land application of the wastes onto adequately protected lands under licensed conditions was inappropriate for Armidale’s climatic conditions, where cold winters and wet summers are the norm. Direct injection or immediate discing of wastes into the soil after land spreading was considered unviable for the low volumes available, less than 5000 litres per tanker load. Septic tanks contain partly decomposed organic and inorganic (plastic) products, leading to potential blockages of soil injection equipment. During wet weather, storage of septage and grease trap wastes would present significant health and environmental risks. Management of the soil resource would require nutrient and pH adjustments for these highly variable wastes, a task beyond the contractors' or Council resources.

Co-treatment with wastewater by injection of the wastes at head of works was inappropriate. Such a facility simply adds back to the system, as a mass loading, that which was removed and concentrated at source. There would be significant operational costs in implementing this option.

Co-disposal with solid wastes by composting with green wastes would require special mixing equipment and a supply of green waste in the same location. The variability and the nature of the wastes (both putrescible and green) would require significant vigilance to develop a recoverable compost and prevent health and environmental impacts. Worm farming does offer some attractive benefits, but operational costs are high.

The most favoured choice was for biological treatment of the liquid wastes in an independent operation, a system of anaerobic/aerobic ponds. Such a system would accept wastes without screening or dewatering, offer security of the wastes irrespective of climatic conditions, provide biological degradation of the organics and produce end products suitable for land application or liquids acceptable into the sewage treatment system.

Chemical treatment by lime stabilisation was contrary to Council policy and not investigated.

5. System Requirements

The independent facilities were to be constructed on Council owned land adjacent and upslope of the STW. This area provided significant environmental protection and potential final treatment of aerated liquid discharges. Dedicated irrigation areas are nearby and suitable irrigation equipment is already installed, utilising effluent from the stabilisation ponds.

The estimated annual volume for septage was calculated at 1.2 ML and grease trap wastes at 3.0 ML. An anaerobic pond with a volume of 4.0 ML would provide storage and treatment of a full year's supply. Removal of the liquid component allows for significant increase in solids storage without physical or biological detriment to the system. Degradation of the wastes would generate soluble organic products as well as ammonia, orthophosphate, salts and soluble inorganics. A surface scum and sludge would form as part of the anaerobic process, made up of raw wastes, partly decomposed matter and insoluble products.

A second anaerobic pond would provide continuing acceptance of wastes while the first pond was being dewatered and emptied. Solids will be disposed of onto agricultural lands and incorporated with the surface soil. Sludge will be handled in a similar manner to the biosolids from the STW. Other opportunities for the commercial use of these end products will be investigated.

Liquid will gravity feed from the anaerobic pond to the aerobic pond. From this shallow pond, effluent will be drawn off for either injection into head of STW or to land application as part of the overall irrigation strategy.

6. System Design

Local engineering firm, Bricon Pty Ltd was contracted by Armidale City Council to prepare detailed design plans for the facility [6]. The ponds were to be located on elevated lands above the STW stabilisation ponds to allow for gravity flow of effluent from the anaerobic to aerobic pond into the head of STW. The facility is totally within Council owned land.

The dimension for the ponds are given in Table 3. The anaerobic ponds are designed for one year's storage in deep ponds, where oxygen is excluded by both depth and the formation of a surface crust. The aerobic pond is shallow with a large surface area relative to volume.

TABLE 3 Dimension of Ponds for Liquid Waste Treatment Facility

Pond/purpose	**Surface area (m^2)**	**Depth (m)**	**Estimated volume (m^3)**	**Ratio surface area to volume (m^2 / m^3)**
Anaerobic 1	1140	5	4000	0.29
Anaerobic 2	1140	5	4000	0.29
Aerobic 1	970	1	1000	0.97

(after Boeren, 1997)

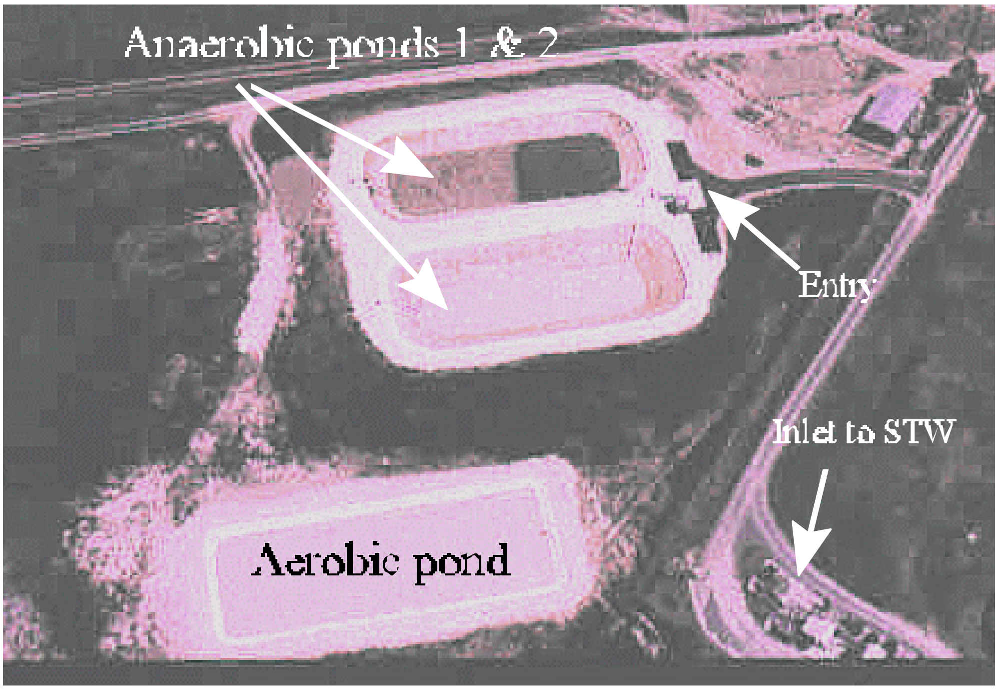

Figure 1 Aerial view of septage receival and treatment facilities

7. Additional facilities

Figure 1 shows an aerial view of the three ponds and the access road. The STW are located to the lower right (north west) of the head of works shown as the buildings in that location. The building in the top right hand provides storage facilities for a contractor's truck and workshop facilities.

The process of operation is that the contractor's vehicle enters by the bitumen (black) road on the right. Waste is dumped into a sump at the "inlet". The contractor initiates a recording device and the waste is metered to the anaerobic pond (Figure 2).

The Council and the contractor will have records of volumes of waste deposited to the system, from which accounts can be raised. Cross reference of this metering system with the licensing approvals will allow Council to ensure compliance with specified pump-out frequencies and volumetric extractions.

8. The Results

Three months after commissioning in July 1998, 300 kL of waste has been accepted and directed to the uppermost pond (anaerobic pond 1). A scum of grease and algae has formed over 50% of the surface of the pond. The scum is thin and easily moved in response to wind as can be observed in Figure 1. The change in colour denotes the scum from the clear (darker) surface.

Until a scum is formed on Pond 1, biological degradation will proceed by facultative processes. It is expected that the scum will form completely before the pond reaches top water level. Until such time as

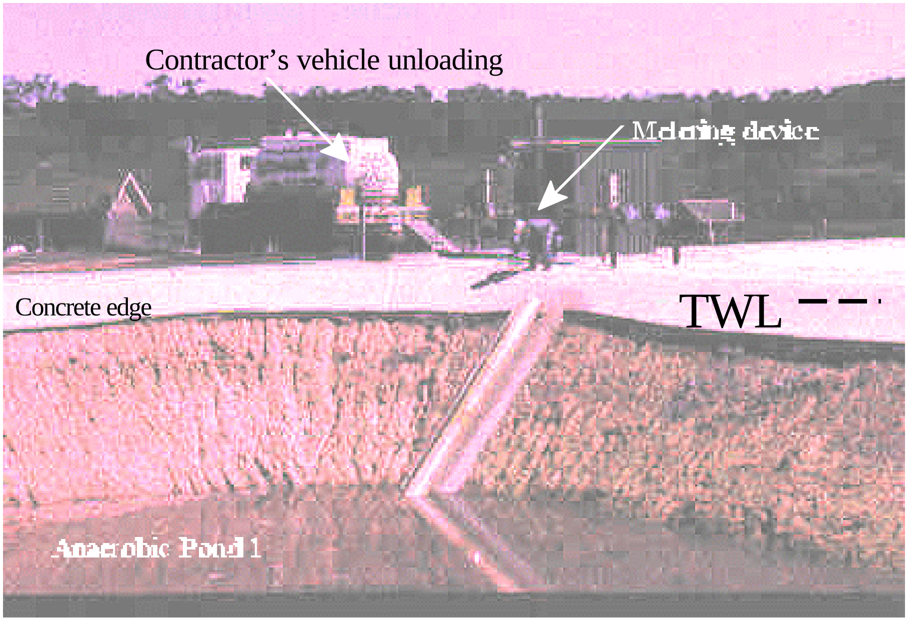

Figure 2 Contractor unloading waste through metering device

there is overflow from the anaerobic pond to the aerobic pond, monitoring of the system will not provide reliable data upon which breakdown rates and predicted levels of soluble nutrients can be assessed. Monitoring of the crust formation and the liquid overflow will provide valuable data for improving system design.

Fees for receivals are imposed at the rate of $0.045 per litre for grease trap waste and $0.025 for septage. About 1500 litres are removed from a septic tank, equating to $37.50 per pump-out. Council expects to recover the cost and operation of the facility in three years and generate in excess of $50 000 per annum. A significant benefit, difficult to measure, will be the increased performance of the STW arising from the removal of a significant proportion of grease and oil from the wastewater stream.

Additional benefits will accrue to the Council when the effluent and digested solids are applied on adjoining agricultural lands. In this way, the holistic approach to sewage management will be realised. The beneficiaries of the facilities will be the local community, through reduced loadings on the landfill site, and neighbouring Council have been offered the use of the facilities and relieve the load on their landfill and STW operations. As the cost of dumping in the facility is borne by the business or household, each Council will reduce expenditure on providing for this service.

9. Conclusions

With the construction of the septage receival and treatment facilities, Armidale City Council made a commitment to the holistic management of sewage and wastewater products. Increased compliance with the liquid trade waste policy will provide positive benefits to the sewerage system and encourage environmental protection by all waste contractors. A facility to accept septage will benefit the Council and adjoining shires and reduce indiscriminate dumping of septage on unprotected lands. All weather access is available and the ponds are independent of unfavourable weather conditions, unlike other options for treatment.

The prospects of beneficial re-use of the liquids and solids will provide an additional source of nutrients for the adjoining agricultural lands. Other opportunities may arise for use of the solids from the anaerobic ponds.

10. References

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