BANANA SHIRE COUNCIL
BILOELA STP REVIEW
AND PLANNING REPORT

April 2008
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1.0 INTRODUCTION

1.1 Sewage Treatment in Biloela

Banana Shire Council's is responsible for the collection, treatment and disposal of sewage for the town of Biloela and surrounding areas. The sewage is delivered to the sewage treatment plant located off Quarrie Road, Biloela to the west of the township.

1.2 History of the Treatment Plant

The treatment process used at the existing plant comprises grit and screenings removal, primary sedimentation followed by trickling filters, secondary sedimentation, anaerobic digestion of sludge, sludge drying beds and effluent lagoons. The treatment plant is typical of those built in Queensland in the late 1960's early 70's. The plant has undergone various construction stages in 1960, 1968-71, 1978 and 1983.

Currently the majority of the treated wastewater from the plant is pumped to the adjacent farm dam, and used for irrigating crops. A small amount is pumped to the "Silo" (a primary industry exhibition area), for landscape watering, and some to the Waterloo Woodlands, a 40Ha land used for research work on the effects of irrigation on a variety of native trees.

1.3 Objective of this Report

The objective of this Planning Report for Banana Shire Council is to review the current sewage treatment plant (STP) and treated wastewater recycling scheme, and provide recommendations for upgrading the system to produce effluent quality stipulated in the environmental licence and specific for irrigation/water reuse. The recommended augmentations are required to sustain current and future loadings for the next 10 & 20 years.

This report addresses the following key issues;

- A prediction on the Biloela population growth and future sewage loadings.
- A description and review on the condition of each process unit and of the sewage treatment plant as a whole.
- An assessment on the operational efficiency of the STP and its ability to treat the raw sewage to the required effluent quality for current and future loading.
- An assessment of the sludge treatment, dewatering and disposal strategy employed and a review of possible options for current and future loadings.
- Recommendations on the appropriate sludge treatment, dewatering and disposal options.
- Assessment of current water recycling schemes and other suitable options for Biloela effluent disposal.
- Recommended effluent reuse options treated effluent quality stipulated in the environmental licence, and for the suitable water recycling scheme.
- An estimate on operating and capital cost for the process augmentation recommendations and the water recycling scheme.

2.0 LOADINGS AND EXPECTED POPULATION GROWTH

The *'Sewage Treatment & Effluent Management – Scoping Study'* prepared by Sinclair Knight Mertz, April 2004 provided details of Biloela's equivalent person (EP) population for the period from year 2001 to year 2004. Based on this information and an assumed future population average annual increase of 1.3% the historic and future population of Biloela is given in Table 2.1.

Year	***Equivalent Person Population***
2001	5,360
2002	5,006
2003	5,176
2004	5,565
2006	5,710
2011	6,090
2016	6,500
2021	6,930
2026	7,400

There is limited information on true population for Biloela. The *Sewage Treatment & Effluent Management – Scoping Study* done by SKM, April 2004 provided information on the sewerage volume received by the Biloela STP for various months between May 2001 and March 2004. These flows are shown in figure 2.1.

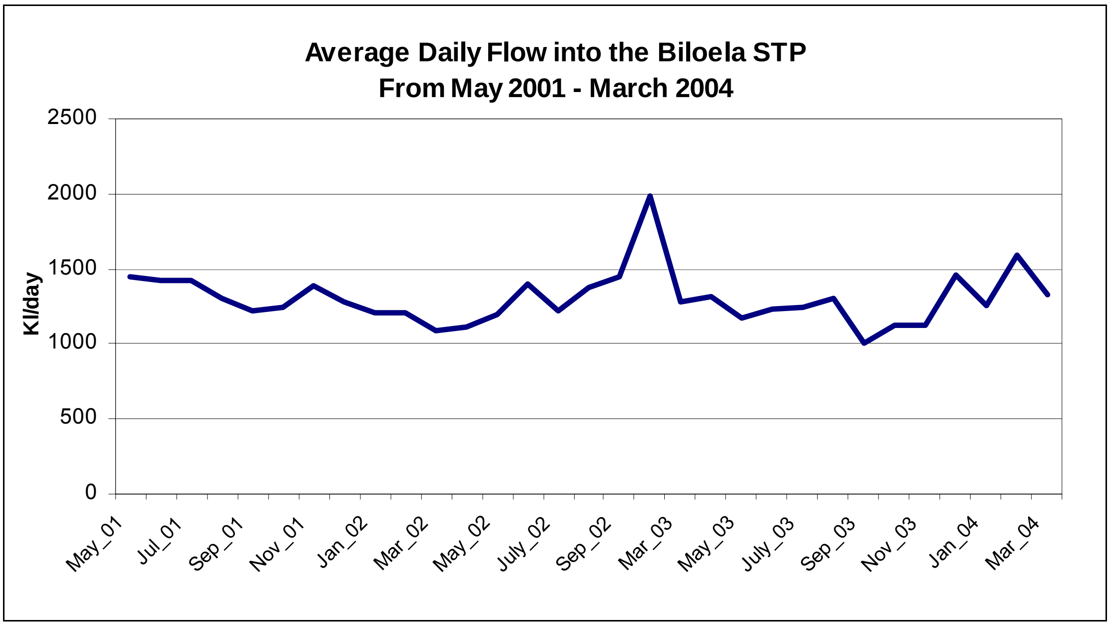

Figure 2.1: Calculated average daily sewage flow into the sewage treatment plant for the months between May 2001 and March 2004.

The majority of the trend line shows no significant increase in sewage flow, (accept for one unusual peak in February 2003) which correlates to the relatively stagnant population growth of Biloela. There is however a slight increase in flow early 2004, but due to the lack of data, it can not be determined if this increasing trend has or will continue.

For a town the size and development potential as Biloela, it is reasonable to assume a growth rate of 1% for the purpose of town and infrastructure planning.

The town of Biloela is an inland, coal mining, agricultural country town. The sewage loading rate commonly applied for such a demographic is 250L/EP.day (Water Resources '*Guidelines for Planning and Design of Sewerage Schemes'*, Vol 1, Sep 1992, pg 5)

The average equivalent person's population for Biloela as well as the expected future population assuming a 1% growth rate are shown in Table 2.1.

Table 2.1: Average equivalent persons population for available data and future expected increases for the town of Biloela.

Year	***Equivalent population***
Real Data *	
2001	5360
2002	5006
2003	5176
2004	5565
Expected Future	
2005	5620
2010	5906
2015	6208
2020	6524
2025	6857

* Data from SKM report the Sewerage treatment and Effluent management – Scoping study, April 2004

3.0 EFFLUENT QUALITY

Banana Shire Council is the holder of Environmental Licence No CG0036 issued by the Environmental Protection Agency (EPA) for operation of the Shire's sewage treatment plants. This Licence does not set specific effluent quality parameters and instead prohibits the direct and indirect release of any contaminants to water and watercourses. The EPA requires that the Biloela sewage treatment plant implement an effluent disposal strategy which includes an effluent irrigation management plan detailing the following;

- Soil capability and assimilative capacity
- Depth of groundwater and effect effluent is having on groundwater
- Nutrient loading and nutrient harvesting
- Sustainability of irrigation practices
- Alternatives to current practices.

The appropriate quality of water used for recycling will depend on the intended end use, site characteristics, and risk factors. The *Queensland Water Recycling Guidelines* detail the quality of recycled water required for various uses.

The effluent re-use scheme for Biloela currently comprises of three different end uses, these are:

- Supplying effluent to a privately owned dam which is used to supply water to irrigate pastures and fodder, as well as non-food crops such as cotton, sorghum and lucerne.
- Supplying effluent to the "Silo" which is used to water landscape gardens; and
- Supplying effluent to irrigate a section of forest that is not open to the general public for recreational purposes, rather used as a research project to study Australian native trees.

All three end uses have different degrees of potential human contact and risk of indigestion. Therefore the class of water that is required for each application varies.

The *Guidelines* consider that the above applications of effluent would have a medium level of human contact, with minimal risk of ingestion, therefore a Class B water quality or better is appropriate. The "Silo" applies effluent to landscape gardens which has an increased risk if human contact, however if the effluent is applied using subsurface irrigation the class required is no greater than Class C. The classification of the recycled water for use in Queensland is summarised in table 3.1.

Table 3.1: Classification of Recycled water for use in Queensland

Class of Water	Thermotolerant coliforms (median)	Turbidity (NTU)	SS (mg/L)	Chlorine residual (mg/L)	pH	Other criteria
A+	<1 cfu/100mL*	<2	-	>1	6-8.5	6 log removal of viruses 5 log removal of bacteria & protozoa
A	<10 cfu/100mL	<2	-	>1	6-8.5	-
B	<100 cfu/100mL	-	<30	-	6-8.5	-
C	<1000 cfu/100mL	-	<30	-	6-8.5	-
D	<10,000 cfu/100mL	-	-	-	6-8.5	-

*Note: * !0 cfu/mL 95%tile*
For more detail on the criteria of each class of water and recommended end uses, please refer to the EPA's 'Queensland Water Recycling Guidelines'

The *Guidelines* explain the effect and relevance of various contaminants to various environmental applications; however it is the responsibility of Council, as owner and operator of the sewage treatment plant, and users of irrigation water to confirm the environmental sustainability of the intended application.

Currently the EPA's accepted method to justify the irrigation application rate, and sustainability of recycled water applications is by using an effluent irrigation modelling program developed by the Department of Natural Resources (DNR) called MEDLI (Model for Effluent Disposal Using Land Irrigation). Details of this program is provided in Section 10

4.0 LOADINGS

4.1 General Consideration

Flow entering the sewage treatment plant varies throughout a day, month, or year. The instantaneous flow rate, total volume and concentration of contaminants to the plant are dependent on community activity, as well as climatic conditions.

A treatment process that relies on biological activity to treat the sewage is susceptible to underperforming due to sudden fluctuations in incoming flow and/or concentrations of contaminants.

4.2 Fluctuating Average Daily Volumes to the STP

Sewage received by the Biloela STP was recorded monthly between May 2001 and March 2004. Figure 4.1 graphically displays the calculated average daily flows for each recorded month, as well as the calculated maximum and minimum daily flows.

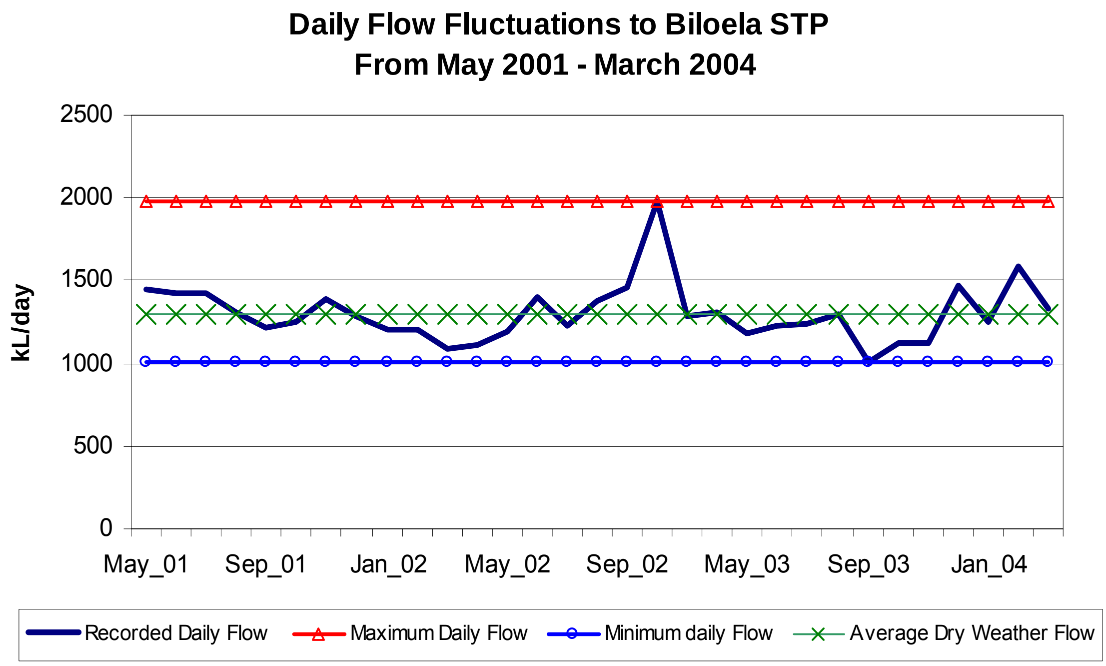

Figure 4.1: Calculated average daily flow to the Biloela sewage treatment plant.

Figure 4.1 graphically compares the maximum, minimum and average daily flow to the recorded daily flow received by the Biloela STP. For the recorded period, the maximum daily flow is 52% greater than the average, and the minimum is 23% lower. When taking out the highest and lowest recorded values, the average daily flow does not significantly change, however the standard deviation (measurement of how dispersed the values are in the data set) is reduced by 32%.

Stormwater that infiltrates to the sewerage system will increase the hydraulic load to the plant, however not necessarily the organic load. In some cases it is considered reasonable to eliminate exceptionally high daily flows recorded due to stormwater infiltration. Figure 4.2 shows the recorded rain fall data for the same period as shown in Figure 4.1.

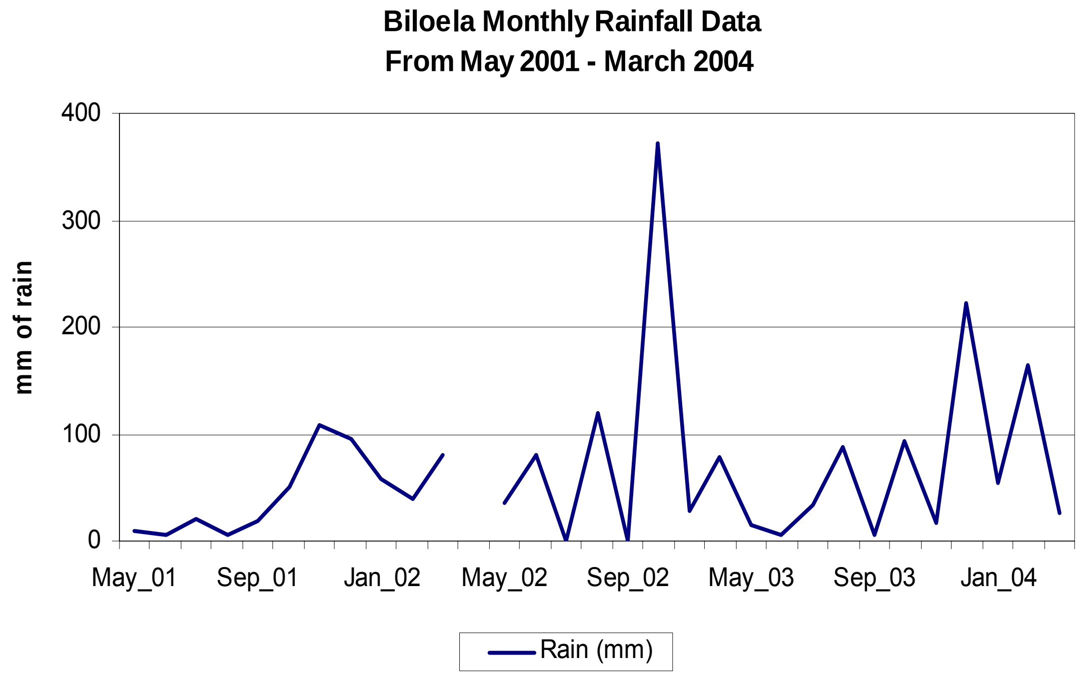

Figure 4.2: Rainfall Data for the Township of Biloela.

Figure 4.1 and 4.2 show a strong correlation between the high recorded flow into the sewage treatment plant and the periods of high rainfall. This suggests that there is a medium to high degree of stormwater infiltration to the sewer system.

This suggests that during high rain fall, the plant will have an increased hydraulic loading and a reduced organic loading.

4.3 Instantaneous Flow Rate Fluctuations

Instantaneous flow rate varies significantly throughout a day. The flow rate is dependent on community activities. Commonly the peak periods for municipal sewage treatment plants are between 8-10am and 6-8pm. During these times people are taking showers, using bathrooms, and cooking. Flow rates can range between 2-5 times average dry weather flow (ADWF) whilst during late evening and early mornings flow can drop below zero flow to the plant.

4.4 Load Fluctuations and Raw Sewage Quality

To asses the true fluctuations in concentrations, it is necessary to perform periodic sampling during a minimum of 24 hours. For optimal results, the sampling should be done over one week.

No current data is presently available that shows the variation of concentrations of the raw sewage throughout the day. Analytical results for raw sewage quality are available for different days of the week over several years. The geometrical mean of this weekly data has been used to generate a typical raw sewage quality for use in the assessment of the treatment plant performance. This is considered a reasonable assumption, as under normal operation (that is low rainfall) extreme fluctuations in contaminant concentrations are not likely.

There have been two recorded raw sewage analysis obtained by Cardno, and these two results vary significantly in concentrations of contaminants. Table 4.1 below gives a summary of the raw sewage concentrations received at the Biloela STP. These figures are generated from actual data, and are atypical for medium strength sewage from a predominantly domestic source.

Table 4.1: Biloela Raw Sewage Quality (Geometrical Mean)

Parameter	Units	Value 8/03/05	Value 19/04/05	Value 04/05/05	Typical Value
Suspended Solids	mg/L	640	250	120	220-350
BOD	mg/L	288	159	119	200-450
COD	mg/L	810	420	330	-
Total Phosphorous	mg/L	17	8.8	8.6	7-15
Nitrate as N	mg/L	-	<0.5	05	0
Ammonia as N	mg/L	-	40	33	25-40
Total Nitrogen	mg/L	64	56	49	-
pH	-	6.8	7.5	7.5	6.5-8
Conductivity	uS/cm	1200	1300	1100	700-900
Total Dissolved Solids	mg/L	720	580	740	500-650

The sample taken on the 8th March 2005, has a significantly stronger concentration of solids, BOD, and nutrients. It was also slightly more acidic than the other samples taken. The time a sample is taken can strongly affect the quality of the sewage, and it is known what time this sample was taken. Samples taken early in the morning can have elevated concentrations due to the settlement, and septicity of the raw sewage that was stagnant in pump wells or pipe lines over night. This would explain the elevated concentrations, and increased acidity. Sample technique is also a factor that strongly affects the results. If the location of the sample was not thoroughly mixed, than sample is not considered representative of the average concentration of the raw sewage.

The samples taken in April and May are considered to have a weak concentration of suspended solids and BOD, but significant levels of nutrients. This is also likely to be due to the time of the sampling, or the sampling technique.

Due to the inconsistency of the raw sample results, for design and operational assessment purposes, it is assumed reasonable to use values within the typical range for average strength municipal sewage, with elevated concentrations for nutrients as this remained relatively consistent throughout all samples. The values used are shown in table 4.2

Table 4.2: Raw Sewage quality used for design and process assessment

Parameter	Units	Design Value
Suspended Solids	mg/L	270
BOD	mg/L	270
COD	mg/L	600
Total Phosphorous	mg/L	10
Nitrate as N	mg/L	0
Ammonia as N	mg/L	40
Total Nitrogen	mg/L	-
pH	-	7.3
Conductivity	uS/cm	1200
Total Dissolved Solids	mg/L	720

5.0 EXISTING SEWAGE TREATMENT PLANT

5.1 Description of the Treatment Plant

The sewage treatment plant (STP) at Biloela is typical of plants built in the late 60's early 70's, based on primary sedimentation, and trickling filters. This type of system is designed typically to produce a secondary treated effluent quality of 20mg/L Biochemical oxygen demand (BOD) / 30mg/L Suspended Solids, with little or no nutrient removal, although some nitrification may occur in the trickling filter under low-load conditions

The process system currently consists of the following units:

- Inlet works with screening and grit removal;
- Primary sedimentation tank (2 units);
- Trickling filter (3 units);
- Humus tank/Secondary sedimentation Tank (2 units);
- Disinfection of the treated effluent using chlorination;
- Final Ponds

The Upflow Slow Rate Sand Filters located upstream of the Chlorination Tank are inoperable and do not provide the Tertiary Filtration step originally included in the system.

There were two site visits conducted by Cardno. At the time of the first visit one of the primary sedimentation tanks was off line due to repairs, and one of the trickling filters was also not operational. Upon the second visit, the primary sedimentation tank was back on line, however the trickling filter remained off line, and one of the secondary sedimentation tanks was off line.

The following section discusses the process description of each unit, and design considerations. It will include an assessment of the operational performance of the current works, and the effect on the operational efficiency when units are not on line.

5.2 Inlet Works

5.2.1 General Consideration

The Inlet Works is the first treatment unit of the Biloela sewage treatment plant and comprises screening and grit removal. Grit and screening removal is practiced to remove gross inorganic solids (screenings) and grit from the sewage to protect downstream plant and equipment.

The screens are designed to capture gross inorganic or non-biodegradable solids, such as toilet paper and rags and remove them from the flow, to prevent blocking downstream pipes and pumps. It is considered preferable to minimise the capture of faecal matter due to the potential to cause odours and attract flies, insects and other pests.

The inlet works at the Biloela STP consist of bar screens and grit removal channels. The first set of screens is stainless steel 15mm aperture bar screens which have automatic scraping and collection of screenings, as shown in Figure 5.1.

Figure 5.1: Automatic rake collecting screenings from bar screen

The screenings are collected on a steel plate, which is then required to be manually gathered and taken to land fill. A typical collection of screenings is shown in Figure 5.2.

Figure 5.2: Collected screenings on first set of plates.

The collected screening contain a significant proportion of faecal material which is undesirable, this tends to suggest that either the screen apertures are too small or the flow velocity is too low.

After the automatic screens the sewage then flows through two more sets of bar screens with approximately 25mm apertures. These collect minimal quantities of material and are manually cleaned by the operator as required.

Following the screens the water flows through the grit channels, where heavier solid particles, such as grit, sand and other heavy solids settle to the bottom. The Biloela grit channel is shown in Figure 5.3. The grit is manually swept, collected and disposed of to land fill by the operator once every month.

Figure 5.3: Grit channels for the Biloela STP

Both the screening and grit removed from the sewage will be contaminated with some organic matter and have the potential to cause odour problems if not properly washed and dewatered.

5.2.2 Assessment of Inlet Works

The existing screens will remove the larger gross solids such as toilet paper, rags and some faecal matter from the flow. The build up of these solids on the bar screens, along with any septicity in the incoming raw sewage, has the potential to cause odour problems. The existing screens have a low efficiency in terms of solids removal allowing a considerable volume of solids below 15 mm to pass through to the primary sedimentation tank, while capturing the undesirable faecal material.

The design of the grit channels relies on reducing the velocity of the sewage to a point where the heavier particles settle out and collect on the floor of the channel. The maximum design velocity for grit channels is 0.3 m/s. The design of the grit channel at Biloela is such that the flow velocity in the grit channel can only be determined if the flow rate and the level are known. The operator suggests that grit is only required to be removed once every month. The design of the grit channel is such that raw sewage flow fluctuations can reduce the effectiveness of the grit channels and sudden surges in the flow can cause turbulence and allow the grit to be carried to downstream units, in particular the primary sedimentation tank. The grit also accumulates in the flow venturi and interferes with the influent flow measurement.

A visual assessment of grit accumulation in downstream units is not possible, as the likely accumulation of grit is at the bottom of the primary sedimentation tanks, and anaerobic sludge digester.

Although the screenings are automatically removed from the screens they are still required to be collected and stored before taking to land fill by the operator. The grit channels also require regular manual cleaning by the operator. This process is labour intensive and unpleasant for the operator. The grit and screenings removed from the inlet works are contaminated with organic matter that can cause displeasing odours unless they are placed into a sealed container immediately. The provision of high pressure sprays to break up the faecal material on the screens to allow this organic material to fall back into the sewage flow would be advantageous.

Modern screens have bar spacings as small as 6 mm that remove significantly more of the gross solids from the flow. Similarly modern grit removal equipment based on constant speed centrifugal flow is more efficient than grit channels. The modern units are compact and are provided with grit and screenings washers to remove excess organic matter and can be easily sealed to minimise the escape of odour.

One issue noted during the visits was that the Humus return pipeline from the Secondary Sedimentation Tanks and the Filtrate pipeline from the Sludge Drying Beds both discharge upstream of the screens and therefore upstream of the flow measurement venturi, this will result, unless taken into consideration, in errors in the assessment of influent flows.

Another issue with potentially more impact is the high level plant by-pass pipeline which, in the time of high flows will divert unscreened and undisinfected raw sewage into one of the effluent lagoons. This sewage while, presumably, diluted by stormwater will result in pollution of the treated effluent storage and deterioration of the effluent available for reuse. This pipeline should be decommissioned as a matter of urgency.

5.3 Primary Sedimentation Tank

At the time of the first site visit one primary sedimentation tank was off line due to repairs of the mechanical scraper. This unit is normally on line, therefore the review and assessment for this process is conducted on both units being on line.

5.3.1 General Consideration

The purpose of the primary sedimentation tank is to remove settleable solids from the sewage and in doing so reduce the suspended solids load and BOD load to downstream processes, in particular the trickling filter. The settleable solids fall to the floor of the tank as sludge. A slowly rotating floor scraper collects the sludge and sweeps it into a central collection hopper from where it is withdrawn at regular intervals and transferred to the anaerobic digester.

The design of a primary sedimentation tank is based on the hydraulic flow rate and surface area of the tank in terms of cubic metres of flow per square meter of surface area per unit of time and is usually expressed as $m^3/m^2.d$.

Other important design features include:

- Tank volume
- Retention time;
- Weir overflow rate; and
- Mixing or hydraulic short circuiting

Typical design parameters for a primary sedimentation tank are shown in Table 5.1 below

Table 5.1: Primary Sedimentation Tank Design Values

Item	Units	Range	Typical Value
Hydraulic loading rate at ADWF	$m^3/m^2.d$	24 – 50	30
Hydraulic loading rate at Peak Hourly flow	$m^3/m^2.d$	50 – 75	60
Retention time at ADWF	Hrs	1.5 – 2.5	2.0
Weir overflow rate	$m^3/m.d$	125 – 500	250
Suspended solids removal rate	% at 200C	40 – 70	50
BOD removal	% at 200C	20 – 50	40

The surface loading rate for optimal operation is given in literature as $30m^3/m^2$/day (Water Resources Commissions Department of Primary Industries, *QLD Guidelines for planning & Design of Sewerage Schemes, September 1992).* This rate is designed to achieve a removal efficiency of 35% for BOD and 65% for suspended solids. A loading rate ranging from 30-50 m^3/m^2/day is also considered acceptable according to other sources (Metcalf & Eddy, *Wastewater Engineering*, 4th edition, 2003)

If the retention time is too long the content of the tank, especially the settled sludge, can become anaerobic and generate unpleasant odours from rising methane gas bubbles bringing up sludge. If nitrates are introduced to the tank denitrification can also generate rising nitrogen gas bubbles bringing up sludge. This rising sludge can reduce the settle ability of the solids and reduce solid removal efficiency. If the retention time is too short the tank will be inefficient and the suspended solids and BOD removal efficiency will be reduced.

The clarified wastewater overflows from the primary sedimentation tank carries through to the distribution chamber, which then feeds the clarified water onto the trickling filter.

5.3.2 Assessment of Primary Sedimentation Tank

Biloela has two primary sedimentation tanks. The screened flow is split after the grit channel and evenly distributed to each primary sedimentation tank. During the time of the site visit, one primary sedimentation tank was off line as the bottom sludge scraper was being repaired. The unit was back on line at the time samples were taken on 19th May 2005.

During the time of the site visit the primary sedimentation tank that was on line would have had double the loading than usual, and had half the retention time. Figure 5.4 is a photograph of the primary sedimentation tank that was on line. The effluent appeared to be murky with no significant scum layer on the surface of the tank. From a visual perspective, the primary sedimentation tank appeared to be operating effectively, with no obvious flow short circuiting or significant mixing observed.

The tank construction appeared to have a strong stable foundation.

Figure 5.4: On line Primary Sedimentation Tank

Due to fluctuations in raw sewage flow, the surface loading rate for the primary sedimentation tanks varies throughout the day.

These flow fluctuations have the potential to significantly reduce the efficiency of the primary sedimentation process.

In addition to the raw sewage the primary sedimentation tank also receives recycled flows from the treatment plant including:

- Humus tank settled sludge return
- Supernatant from the anaerobic sludge digester;
- Drying bed underflow; and

The flow rate of the humus sludge return rate is not known. However there is a flow meter at the inlet works which show sudden surges of flow during particular times of the day, indicating the return flow. As the return is only done once a day, and does not flow for a prolonged period of time, this volume is not considered to significantly impact the performance of the plant.

Our assessment of the primary sedimentation tanks if both units were on line are detailed in Table 5.2 and 5.3.

Table 5.2 – Biloela STP Primary Sedimentation Tanks (Current)

Item	Units	Value
Flow (2004)	kL/d	1303
Number of tanks	units	2
Diameter No 1	m	10.67
Diameter No 2	m	13
Surface Area (Total)	m^2	222
Side wall depth No 1	m	2.1
Side wall depth No 2	m	2.25
Estimated volume including cone section (Total)	m^3	486

Table 5.3 – Biloela Primary sedimentation Tank Operation parameters

Item	Units	Value ADWF	Value 3 X ADWF	Value 5 X ADWF
Hydraulic loading rate	$m^3/m^2.d$	5.87	17.6	29.33
Retention time	Hrs	9.1	3	1.8
Weir overflow rate	$m^3/m.d$	17.52	52.6	87.6
Suspended solids removal rate	%	67.5	60.7	55
BOD removal	%	45.5	38.6	33.5

The data shown in Table 5.2 and 5.3 shows that the existing primary sedimentation tank is underloaded, and has the potential to cause operational problems.

The primary concern is the long retention time. Underloading the primary sedimentation tank can cause the settled solids to anaerobically digest. Anaerobic digestion occurs when oxygen is depleted completely from of the sludge and produces methane gas, as well as volatile fatty acids. The consequences of this are;

- The gas floats to the surface and carries with it solid particles, and reduces the settling efficiency of the unit, as well as producing mal odour.
- Volatile fatty acids contribute to increasing the organic loading to downstream process units.

This is avoided by wasting primary raw sludge everyday to the digesters, not allowing the sludge to sit in the hopper bottoms for extended period of time.

A simple mass balance can be undertaken to determine the volume of sludge that is required to be sent to the digester every day, or the operator can simply waste until the sludge into the sludge pump station turns clear.

If using the data given from analytical results (sample taken May 2005) the mass of accumulated solids generated in the primary sedimentation tank is approximately 307.5kg. At an estimated 2% solids dry weight (ranging from 1 – 3% for primary raw sludge) the volume that is required to be wasted on a daily basis is approximately 15.3m^3.

Table 5.4 details the expected performance of the primary sedimentation tanks for the expected future loadings of the year 2025**.**

Table 5.4– Biloela STP Primary Sedimentation Tank (Year 2025)

Item	Units	Value ADWF	Value 3 X ADWF	Value 5 X ADWF
Hydraulic loading rate	$m^3/m^2.d$	7.23	21.69	36.5
Retention time	Hrs	7.4	2.5	1.5
Weir overflow rate	$m^3/m.d$	21.6	64.79	107.99
Suspended solids removal rate	%	66.6	58.7	52.7
BOD removal	%	44.6	36.6	31.1
Raw sewage BOD	mg/L			
Clarified sewage BOD (theoretical)	mg/L	138.6	158.5	172.3

* It should be noted that even when only one Primary Sedimentation Tank was on line, the loadings were below optimal design limits.

On the data shown in Table 5.4 the primary sedimentation tank will serve the treatment plant well beyond the Year 2025 on the basis that the concrete structure and mechanical scraper system remain in good order, and desludging is continued at a rate which ensures anaerobic digestion will be minimised.

The hydraulic loading rates are within the accepted design range. The side wall depth is low, but the hopper bottom cone has an adequate angle to promote sludge collection. The design does not appear to be affecting the process performance of the tank.

5.4 Trickling Filter

5.4.1 General Consideration

The trickling filter at Biloela STP is the most critical treatment unit in the purification process. The trickling filter treats the soluble organic matter in the clarified wastewater from the primary sedimentation tank. The clarified wastewater is distributed evenly over the filter surface through the rotating distributor arms and flows down through the rock media of the filter. A biological slime containing bacteria and protozoa grows on the media and as the wastewater passes over the slime the bacteria purifies the wastewater by converting the organic material into harmless compounds – mainly carbon dioxide and water.

The trickling filter in the application at Biloela STP is not primarily designed to nitrify – that is convert ammonia in the sewage to nitrate, however some nitrification may occur if the filter has a light organic loading with the subsequent reduction in ammonia concentration in the wastewater.

All tricking filters produce a fine sludge that is washed from the filter in the effluent. The sludge is formed from the bodies of the dead insects and grazing animals that inhabit the filter as part of the overall eco-system within the filter and is termed humus sludge. Effluent from the base of the filter is collected and directed to the secondary sedimentation tank (sometimes referred to as a humus tank or secondary clarifier) where the humus solids are separated from the treated effluent. The treated effluent from the humus tank passes to the disinfection process while the humus sludge is returned to the inlet of the works and settled in the primary sedimentation tank.

5.4.2 Assessment of the Trickling Filter

The trickling filters at Biloela STP were observed to be in good condition; however one of the three filters was not on line at the time of the site visits.

On visual inspection the trickling filters on line appeared to be in a satisfactory condition, however required some service and maintenance work. The flow from each arm was not evenly distributed. The concrete structure and foundation of the filter had few cracks and is considered to be in satisfactory condition.

Figure 5.5: Trickling filter at Biloela that was on line at the time of the site visit.

The trickling filter that was not online was receiving some flow, however due to the lack of hydraulic pressure and poor flexibility of the distribution arms (due to rust and weight) the arms were not rotating. The clarified effluent was flowing straight through the filter bed at one location. This practice meant that little to no treatment was occurring.

The flow into the trickling filters is comprised of two streams:

- The clarified effluent from the primary sedimentation tanks, and;
- The return recycled flow from the secondary sedimentation tanks.

The humus return flow from the secondary sedimentation tanks is not recorded however it will increase the hydraulic load to the trickling filters.

The optimal design parameters for a trickling filter are summarised in Table 5.5 below. The loading rates given in Table 5.5 are designed to achieve a treated effluent quality of 20 mg/L BOD and 30 mg/L suspended solids for a sewage temperature of 20^0C.

Table 5.5: Optimal Design Parameters for a Low Rate Trickling Filter

Parameter	Unit	Value
Hydraulic Loading Rate	m^3/m^3 media .day	0.3 – 0.8
Organic Loading Rate	kg BOD/m^3.day	0.07-0.22

The hydraulic loading rate is the rate at which the effluent passes through the media. This should not exceed 0.8 m^3/m^3 media per day. Above this rate the effluent will not have adequate contact time with the biological slime on the media to ensure full treatment. Conversely, the filter media must remain moist at all times. If the media is allowed to dry out for a prolonged period, the bacteria starts to die and the treatment efficiency is reduced. To prevent the media drying out during periods of low flow rates it is normal practice to recirculate treated effluent to the filter.

The results of our assessment of the trickling filter if all three filters were on line are shown in Table 5.6 below.

Table 5.6 – Biloela STP Trickling Filter (24 hour values)

Item	Units	ADWF	3 X ADWF	5 X ADWF
Flow (2004)	kL/d	1302.5	3908	6213
No of filters	units	3		
Diameter No 1	m	18.29		
Diameter No 2	m	24.8		
Diameter No 3	m	24.8		
Depth of Media No 1	m	1.69		
Depth of Media No 2	m	1.75		
Depth of Media No 3	m	1.75		
Volume of media (Total)	m^3	2134		
Hydraulic loading rate at ADWF with no humus return	m^3/m^3.d	0.61	1.83	3.05
Hydraulic load with recirculating return at ADWF return rate	m^3/m^3.d	1.22	2.44	3.66
Organic load **Daily load is same as ADWF load**	kg BOD/d	200		
Organic loading rate	kg/m^3.d	0.09		
BOD removal	%	91	85	80
BOD - trickling filter discharge	mg/L	13.4	29.6	41.3

* It should be noted that the hydraulic loading rate was on the upper limit of the optimal design range when only two filters are on line and the flow rate is ADWF. At high flow such as peak flow times, the hydraulic loading exceeds optimal design capacity. The organic loading remained adequate for BOD and some nitrification.

Our preliminary assessment of the trickling filter at Biloela STP, on a 24 hour basis, indicates that during average flow conditions, with no recirculating flow the filters do not suffer a hydraulic overload. However there are likely to be times during peak flow, that the filters will be hydraulically overloaded. If high flows are persistent the treatment efficiency of the filters will be reduced.

From Table 5.6, the average hydraulic loading to the filter, without recirculating return, is 0.61 m^3/m^3media.d which is within the optimal range of operation, 0.3 - 0.8 m^3/m^3.media.d. In simplistic terms the water is passing through the filters at an acceptable rate during average dry weather flow.

For the sample taken in May 2005 the BOD leaving the primary sedimentation tank was measured at 130mg/L, and the humus tank effluent was measured at 20mg/L. This generates an organic loading of 0.067 kg BOD/m^3.media per day which is within the design parameters given in Table 5.4, (the value given in Table 5.5 reflects theoretical values that should be generated with the input data obtained, these correlate very well to actual data).

Although the organic loading will vary throughout the day due to flow and loading fluctuations, the overall daily organic loading for the system is acceptable, however with elevated hydraulic loading; the treatment efficiency can be greatly reduced.

To put it simply with increased hydraulic loading, but adequate organic loading, the micro-bacteria that are responsible for treating the sewage are receiving enough food; however the rate at which the food passes is too high for the bacteria to use. Therefore treatment efficiency is greatly reduced.

As there are peak and off peak flow periods during a 24 hour cycle, it is common that during off peak flow the media on the trickling filters can dry out. Therefore when flow increases the micro-bacterial population has died and treatment efficiency is reduced. To increase treatment efficiency the media on the trickling filter should under go minimal shocks, and changes to their environment. This is often achieved by introducing a return flow from the humus tank during times of low flow.

The recirculating return flow from the humus tank to the trickling filter at Biloela is continual, and adds to the hydraulic loading to the filter, which ultimately overloads the filters during peak flow periods.

For optimal treatment efficiency of the recirculating return flow from the humus tank to the trickling filter should be activated when there is low flow, and minimised or stopped during high flow periods.

Figure 5.6: Inlet distribution well for the trickling filters showing the recirculation flow entry point.

Figure 5.6 shows the recirculation return flowing into the dosing chamber for the trickling filters. The flow comes out in such force that the water causes high turbulence in the chamber. This turbulence reduces the volume that trickling filter (1) one should receive.

This is shown more clearly in figure 5.7

Figure 5.7: Uneven flow into the inlet feeding chamber for trickling filter one (current off line filter)

The flow to the filters should be proportional to the volume of media in each filter. The volume of media per trickling filter is:

- Trickling filter one has 444m^3 of media
- Trickling filter two has 845 m^3 of media
- Trickling filter three has 845 m^3 of media

It is evident by the width of the outlet channels to each filter that the flow is intended to be split proportional to the media volume. (The width of the inlet channel for filter one is approximately 1/5 of the total width to all filters, as shown in figure 5.6). However the turbulence in the chamber is inhibiting this even distribution.

For optimal treatment efficiency for the trickling filters it is necessary to ensure even distribution of flow over the entire media volume of all filters. This can be achieved by installing baffles in the dosing chamber to inhibit hydraulic force.

5.5 Humus Tank/Secondary Sedimentation Tank/ Secondary Clarifier

5.5.1 General

The purpose of the humus tank is to separate the humus solids from the trickling filter effluent. The clarified effluent flows over the weir and into the tertiary sand filters while the solid particles of humus sludge settle to the tank floor and are returned upstream.

5.5.2 Assessment of the Humus Tank/Secondary Clarifier

At the time of the second site visit one of the secondary sedimentation tanks (humus tanks) was off line. The assessment of the tanks was based on both tanks being on line.

The design of humus tanks in this application is similar to the design of primary sedimentation tanks. The accepted design parameters for a humus tank are shown in Table 5.7 below.

Table 5.7 – Humus Tank Design Values

Item	Units	Range	Typical Value
Hydraulic Loading Rate	m^3/m^2.hr	1-1.5	1.25
Hydraulic loading rate at Peak flow	m^3/m^2.hr	1.8 - 3	2.4
Retention time at ADWF	hrs	1.5 – 2.5	2.0
Weir overflow rate	m^3/m.d	125 – 500	250

The design parameters and performance for the Biloela STP humus tank is shown in Table 5.8 below.

Table 5.8 – Biloela STP Humus Tank

Item	Units	Value ADWF	Value 3 X ADWF	Value 5 X ADWF
Flow (ADWF) plus plant recycle	kL/d	1302		
Number of tanks		2		
Diameter	m	10.8		
Surface Area	m^2	183.12		
Side wall depth	m	2.2		
Estimated volume (including cone section)	m^3	402.9		
Hydraulic loading rate	$m^3/m^2.hr$	0.3	0.89	1.48
Retention time	hrs	7.42	2.47	1.48
Weir overflow rate	$m^3/m.d$	38.41	115.22	192.04
Suspended solids removal rate (from analysis)	%	56		
BOD treated effluent (from analysis)	mg/L	20 - 25		

Calculations indicate the humus tank is underloaded. The hydraulic loading rate, retention time, and weir overflow rate are all below optimal operating value.

The humus tank is required to settle the solids, and allow clarified effluent to pass through to the sand filters. Longer retention time will allow for greater solid settlement; however this can cause a depletion of dissolved oxygen creating anoxic conditions, thus denitrifying the nitrate that has formed from the trickling filters. The produced nitrogen gas can reduce settling efficiency as the bubbles can rise and bring sludge with it.

Analysis shows that there is a reduction in the total amount of nitrogen from the raw to the humus effluent, overall at 24% loss of nitrogen from the system. This cannot all be contributed to wasted particulate nitrogen sources, therefore a reasonable conclusion is that some denitrification has occurred.

Figure 5.8: Secondary Clarifier at Biloela STP, some bubbles on surface, indicating some denitrification.

One method used to reduce the chance of denitrification in the secondary sedimentation tanks is to increase the rate or frequency of the return humus sludge recycles to the inlet works. This can reduce the population of nitrifying bacteria population, and reduce the likeliness of dissolved oxygen depletion.

5.6 Tertiary Filtration – Sand Filters

5.6.1 General Consideration

The purpose of the sand filters is to remove the fine suspended solids from the clarified effluent that did not settle out in the secondary sedimentation tanks. The clarified effluent from the humus tank is evenly distributed over the sand media in the filter. Fine particulate matter is trapped in the void spaces between sand granules, and the filtered effluent passes through the bottom drainage system, and into the final disinfection chamber.

5.6.2 Assessment of the Sand Filters

The two sand filters are not operating as filters, the media has been removed and current operation consists of a bottom inlet, the effluent flowing upward through the empty volume left by the media and out into the discharge/backwash troughs as shown in figure 5.9.

Figure 5.9: Sand filters in operation opposite to operational specifications.

It is more usual for gravity sand filters to flow from top to bottom, and receive regular backwashing to clean the sand media and allow for adequate solid removal performance. Upflow filters are not successful unless close monitoring of backwash operations is carried out to ensure the backwash process does not entrain solids within the media rather than flushing solids out.

It is our recommendation that the need to include filtration in the process train is re-assessed and if necessary the sand filter be re-instated and modified with efficient backwashing system installed.

The accepted design parameters for a gravity sand filter are shown in Table 5.9, and 5.10 details the operating conditions for the sand filters if operating according to normal flow directions.

Table 5.9: Design Parameters for a Slow Rate Gravity Sand filter

Item	Units	Range	Typical Value
Filtration Rate	m/hr (m^3/m^2.hr)	8-12	10
Media type Sand	mm	0.45-0.65	0.45-0.65
Media Depth	mm	50 0-1500	1000
Backwash Rate	m/hr	42-50	45
Backwash Time	Min	5-10	7

Table 5.10 Operating Parameters for Gravity Sand Filters

Item	Units	Value ADWF
Length Filter	m	7.2
Width of Filter	m	2
No Filters	units	2
Surface Area per filter	m^2	14.4
Type of Media	Sand	
Media Size	mm	0.45 – 0.65
Filtration Rate per filter at ADWF	m/hr (m^3/m^2.hr)	3.8
Filtration Rate at 3 X ADWF	m/hr (m^3/m^2.hr)	11.4
Backwash Rate	m/hr	Not in operation
Backwash Time	minutes	Not in operation (7 min is standard)
Backwash volume per backwash	m^3	82
Backwash Tank Volume	m^3	96

Table 5.10 indicates that the gravity sand filters are, if commissioned, oversized for the current ADWF, and only reach optimal design rate at 3 X ADWF flow rate.

By Year 2025 the ADWF is predicted to be 19L/s, which will generate a filtration rate of 4.6 m/hr per filter. This filtration rate is low, and not within optimal range, however will suffice for solid removal.

The backwash tank is adequately sized for standard backwashing requirements. The volume of the tank is approximately 93m^3. For a 7 minute backwash at the design rate (48m/hr), the volume of backwash water required is 82m^3. If extra backwash water is required (that is an extended backwash is deemed necessary), a suitable option to provide more water would be to ensure filtered, disinfected effluent be used to re-fill the backwash tank.

5.7 Final Disinfection Contact Tank

5.7.1 General

The final contact tank is used to ensure that the chlorine solution has adequate retention time to achieve the maximum bacteriological kill rate. A 30 minute retention time is generally considered adequate.

5.7.2 Assessment of Final Disinfection Contact Chamber

The current volume of the contact tank is approximately 77.3m^3. At the average dry weather flow the retention time in the contact tank is 90 minutes, however if the flow rate exceeds 5 x ADWF for a prolonged period of time, then the detention time falls below the half hour requirement. This elevated flow rate for extended periods of time is not likely, therefore the current chlorine contact tank is considered adequate.

The predicted ADWF for the year 2025 is 1.6ML/d or 18.6 L/s. This gives a retention time in the contact tank of 71 minutes and for peak flows, such as 3 x ADWF the contact time is approximately 35 minutes, therefore expected to adequately disinfect the effluent before release into the ponds or irrigation use.

5.8 Final Ponds

5.8.1 General

The purpose of the final ponds is to further treat the treated effluent. The high retention time is useful to further settle solid matter, the sun's UV light is a natural method used to kill micro bacterial activity, while the aerobic conditions in the Ponds allow for ammonia reduction and some nutrient uptake by plants.

Final polishing ponds used for the polishing of effluents from conventional secondary treatment processes have a retention time ranging from 5 – 20 days. They are shallow, ranging from 0.5-1.5 m in depth, and remain aerobic throughout the entire body of water.

5.8.2 Assessment of Final Polishing ponds for Biloela

There are three final ponds at Biloela STP, each varying in size. Pond 1, 2 and 3 have retention times of 5.8, 5.1 and 1.6 days, respectively. The total pond retention time is approximately 12.5 days, and the design depth is 0.9m, ensuring aerobic conditions.

Treated effluent enters pond (1) one, the largest of all three, which serves the purpose of collecting the bulk of the solids, this is useful when ponds are required to be cleaned out (remove sludge, dry and dispose sludge).

There was no analysis taken from the filters filtrate, therefore the solids loading into the ponds is not known. Due to this lack of data, the sludge content of the ponds can not be determined.

BOD loading to the ponds is elevated ranging from 20 to 25 mg/L. According the theoretical removal rate, the retention time in the ponds should be adequate to achieve a final effluent quality of approximately 5-6 mg/L. Recorded final BOD quality at the end of the ponds has a high degree of variation. This is most likely caused by the re-contamination in the ponds, and reduced retention time due to solid build up.

Upon the site visit it was evident that a large variety of wild life inhabits the ponds, including birds, amphibians and turtles. These animals contribute to microbial, BOD, solid and nutrient re-contamination. For this reason it is not uncommon to find that ponds can produce effluent that is of poorer quality than the influent.

There was however a noticeable reduction in nutrient concentration from the influent to effluent. For the sample taken in April 2005 there is a 75% reduction in ammonia and a 78% reduction in phosphorous from the secondary sedimentation tank effluent to the final pond's effluent. This is most likely due to plant uptake.

Recordings of elevated pH, and suspended solids in the ponds is indicative of algae blooms. Although algal growth is a natural and wanted characteristic of ponds due to the photosynthesis (conversion of carbon dioxide to oxygen) elevated concentrations of algae can cause problems. Algae can potentially produce toxins, reduce UV penetration increase solid loading which reduces the overall effectiveness of the ponds.

Figure 5.10: Final Effluents, Pond number one entry point left of picture

Figure 5.10 is a photo of the ponds at the entry point. It was evident at the time of the site visit that pond one (1) had excessive organic loading, this is evident by the smooth, glassy surface area on the pond when other places downstream had visible ripples due to the lower surface tension (i.e. lower organic loading).

The current plant bypass system will under high flow conditions discharge raw sewage prior to screening and grit removal to the ponds, this is an unacceptable arrangement and should be discontinued to prevent pollution of these ponds which are part of the effluent irrigation scheme.

6.0 EFFLUENT REUSE OPTIONS

6.1 Current Effluent Reuse Scheme

Effluent reuse schemes and sewage treatment plant operations are closely interrelated components of the treatment process with each component having a direct impact on the successful management of pollutants as they are likely to adversely impact on the environment. The reuse scheme that Biolela has implemented in the past comprises of;

- The majority of the effluent being sent to the Farm Dam belonging to Mr Manwaring, who uses the effluent to irrigate crops of sorghum and cotton, the property area is approximately 57Ha.

- A portion is delegated to the “Silo”, where the effluent is used for landscape irrigation, comprising of grass land, and garden area. The agreement between the Council and “Silo” was for 80ML/annum, however the monitoring of the volume is not recorded, therefore actual distribution is not known.

- The Waterloo Woodlands is situated on a 40ha lot council owned property. This forestry is a joint project with the DPI Forestry Research with some Natural heritage Trust funding, an comprises of various native Australian fauna and flora. An agreement on environmental monitoring, reporting and effluent irrigation was provided by Council, however this regime has not been strongly implemented and enforced.

In many cases, beneficial reuse of effluent can be cost effective as it reduces the demand for other water resources, increases the productivity of agriculture, limits possible adverse impacts on the natural environment and reduces or negates the requirement to subsidies land with other forms of nutrient dosing.

It is now possible to simulate the effects of effluent loading to a land application by modeling the effects to the surrounding environment. The accepted computerized hydraulic model accepted to evaluate the sustainability of effluent re-use is MEDLI (Modeling Effluent Disposal to Land Irrigation). The following factors are considered in the hydraulic modeling program;

- Soil capability and assimilative capacity
- Depth of groundwater and effect effluent is having on groundwater
- Nutrient loading and nutrient harvesting
- Sustainability of irrigation practices
- Wet weather storage capacity required to ensure minimal site run off.

Details of the MEDLI program and it results are provided in section 6.3

6.2 Quality of Effluent

The effluent produced at the Bilolea STP is considered to be of secondary quality, achieving minimal nutrient removal. Table 6.1 shows the average concentrations of contaminants for samples taken in May and April 2005.

Table 6.1: Average concentrations of effluent from the Humus Tank effluent and Final ponds exit stream.

Contaminants	Units	Humus Tank Effluent	Final Ponds
Biochemical Oxygen Demand (BOD)	mg/L	22.5	12.5
Chemical Oxygen Demand (COD)	mg/L	85.5	99
Suspended Solids	mg/L	35	39
Ammonia as N	mg/L	14	2.7
Nitrate	mg/L	7.1*	5.9
Total Nitrogen	mg/L	34	9.4
Total phosphorous	mg/L	9.3	1.4
Conductivity	Us/cm	1040	800
pH	-	7.6	8.6

* Results for one sample represented due to significant error in the results for sample taken in April.

The results show that there are significantly elevated concentrations of nutrients exiting the humus tank, and these are reduced by the ponds. As the effluent that is being used for current land applications is directly pumped from the final ponds to the dam, the nutrient loading to the land and crops would be low.

Although there is no analytical results for the bacteriological quality of the water it is likely that, due to the wildlife on and in the ponds there will be elevated concentrations of thermotolerant coliforms. The concentration of suspended solids and pH values exiting the final ponds is above the limits expected for Class B water, and similarly the concentration of thermotolerant coliforms is also likely to be above the limit recommended for the land applications discussed in Section 3.

6.3 MEDLI Model

A computer based hydraulic modeling program has been jointly developed by the CRC for Waste Management and Pollution Control, the Queensland Department of Primary Industries and Natural Resources and Mines (NRM) for the purpose of designing and analysing effluent disposal systems for rural industries and waste water treatment plants using land irrigation. The program is called MEDLI (Model for Effluent Disposal using Land Irrigation). Using actual historical climatic data (rainfall, temperature, evaporation and solar radiation), soil profiles, irrigation area characteristics, and effluent flows and quality, MEDLI provides:

- Design wet weather storage capacity required for a predicted 95% effluent usage (5% loss due to overflowing during periods of excessive wet weather).
- Nutrient balance over the soil, plants and water tables to ensure long term sustainability
- Irrigation application rate for specified irrigation area.

A MEDLI model was run for the Biloela effluent irrigation scheme. The model is based on the assumption that rainfall and climatic patterns evolve over time, and using historical data, a reasonable prediction of future rainfall can be formed. Climatic data for the area of Biloela was obtained from the Department of Natural Resources and Mines for the period between the Years 1957 to 2004. Using the predicted effluent quality and flow, the following conclusions were formed:

> In order to ensure a 95% long term sustainability in effluent usage, a wet weather storage capacity of 6.5 ML is required. Irrigation is based on the soil profile (typical black earth was used), an application at a rate of a maximum of 10mm/day, and triggered at 1mm soil water deficit.
>
> According to the current nutrient quality of the final effluent, the nutrient and salt balances were examined and it was determined that at the application rate of 10 mm/day, the irrigation scheme is environmentally sustainable in the long term, provided the rotation of crops and pastures is continued ensuring plants are taking up the nutrients, and there is no build up of nutrients on land that is not periodically harvested.

6.3.1 MEDLI Model Outputs

Outputs of the MEDLI model investigation are summarised in Table 6.2.

Table 6.2 - Results of MEDLI model analysis for 2025

Parameter	Unit	
Total reclaimed water flow rate	ML/year	1601
Irrigation maximum application rate	mm/day	10
Average irrigation Application rate	mm/day	2.8
Storage Balance		
Storage volume pond required	ML	14
Evaporation loss from pond	ML/year	0
Volume of overflow	ML/year	28.8
Number of overflow event	Days per 10yrs.	185
Percentage reuse	%	95.4
Irrigation Balance		
Land area available	ha	57
Number of days rain prevents irrigation	pa.	67
Sustainable irrigation rate	mm/year	1044
Rainfall	mm/year	637.4
Soil evaporation	mm/year	580.4
Transpiration	mm/year	915.3
Runoff	mm/year	39
Drainage	mm/year	148
Change in soil moisture	mm/year	-1.7

6.3.2 Required Buffer Zones

For the irrigation of Class B reclaimed water, adequate buffer zones need to be reserved around irrigation areas to prevent airborne spray drift into residential areas and areas with public access. The standard buffer zone for spray irrigation with Class B reclaimed water is 30 metres. The SARWG guidelines specify that required buffer zones could be reduced by:

- Low rise (7-10^0) sprinklers
- Small throw or micro-sprinklers
- Part circle sprinklers
- Tree/shrub screens
- Anemometer switching systems
- Night time watering

For planning purposes, Council has identified 170 hectares of land that would be suitable. A further site, equalling to approximately 10 hectares would be required in the year 2023. For both planning horizons, additional land would be required to serve as buffer zones if irrigation with Class B reclaimed water is intended. No specific restrictions apply to the irrigation of Class A reclaimed water, however the usage of effluent for truck and vehicle washing as proposed will require Class A+.

7.0 OPTIONS FOR SEWAGE TREATMENT PLANT OPTIMISATION

Currently the sewage treatment plant at Biloela is producing poor quality final effluent, exceeding generally acceptable levels of BOD, and SS. In order to consistently produce Class B final effluent quality as required for irrigation purposes, there are three areas in the Biloela STP that require augmentation, these are;

1. The inlet works, specifically screening and grit removal;
2. The secondary (biological) process; and
3. The tertiary treatment process, including the filtration, disinfection and final ponds.

The criteria adopted for selecting the optimum upgrade option for Biloela includes:

- Future effluent quality requirements are met;
- Reliability of the technology;
- Robustness of the technology, and
- Capital and Operating costs.

7.1 Inlet Works

While the existing inlet works is causing no major process problems significant quantities of faecal material is being captured on the screens indicating low flow velocities through the screen channels, this is reinforced by the quantities of grit being deposited through the flow venturi flumes. Operation of the inlet is labour intensive, unpleasant to the point of being a possible health hazard to the operators and a potential source of odour. Upgrading of the screens and grit removal systems is considered essential.

7.1.1 Suggested Augmentation

Modern screen assemblies are compact, contain screenings washers to remove organic matter and can, if necessary, be easily sealed to minimise the escape of odour

Installation of a new mechanical screen is recommended. Associated with the new equipment will be screenings washing/dewatering, compaction and conveying to a storage bin.

For Biloela, it is recommended that the Screw Screen with 3-6 mm mesh from Moura STP that will be redundant upon completion of the current augmentation works be relocated to Biloela.

This will replace the existing screens that can then be removed. The second parallel screen channel can then be fitted with a manual bypass screen for use in high flow situations. The new unit would be complete with washing and dewatering and deliver dewatered grit and screening to an enclosed container for disposal. This has several advantages including:

- The units have a much higher efficiency that the existing screens at Biloela, to the benefit of downstream processes;
- The screening are dewatered mechanically and faecal and organic matter and removed reducing the risk of odour;
- The units and storage container can be sealed to minimise the escape of odours;

- The units are fully automated and require minimal operator attention giving Council a potential saving in operator time.

The grit removal channels at Biloela are also sub-standard and need augmentation it is recommended that a vortex grit removal system by constructed in conjunction with the upgrading of the screens. The grit vortex will provide more efficient grit removal and combined with a classifier will produce clean dewatered grit able to be discharged into a skip for removal from site.

The estimated cost of the modifications to the inlet works is $285,000

7.2 Secondary Treatment

For the Biloela STP the Environmental licence does not stipulate any BOD or nutrient limits, therefore it is not considered essential to install a new treatment unit, however efficient treatment is necessary to ensure the effluent quality is fit to ensure adequate disinfection. Elevated BOD and suspended solids concentrations can affect disinfection efficiency, and therefore it is recommended that:

- All three existing trickling filters are utilised;
- The dosing chamber is modified by the installation of baffles to reduce turbulence ensuring loading to the filters is proportioned correctly;
- Flow control of the humus return line consisting of flow meter and pump control system is installed to adjust the flow according to the influent flow, ensuring biological activity and hydraulic loading is optimised; and
- The humus return pipeline is relocated to deliver the humus return downstream of the screens and flow venturi.

The estimated cost of the above works is $195,000

7.3 Tertiary Treatment

For the Biloela STP tertiary treatment is considered necessary as a minimum to consistently achieve Class B effluent quality as required for irrigation disposal purposes. Therefore the following is recommended:

- The gravity sand filter to be converted into an additional settling unit by introduction of tube settlers and polymer dosing to reduce the suspended solids concentration and improve disinfection while reducing the amount of chlorine required to adequately disinfect;
- The final ponds to be progressively desludged to increase the volume and improve treatment efficiency;
- Implement water level control within the ponds to provide for wet weather storage of effluent; and
- Disconnect plant bypass from the ponds to prevent re-contamination of treated effluent by faecal matter and other contaminants from the unscreened sewage.

The estimated cost of the above works is $360,000

8.0 SLUDGE TREATMENT

8.1 Anaerobic Sludge Digester (Low Rate)

The sludge digesters at Biloela STP consist of three circular tanks with a vertical walled top sections above a steep cone section. These tanks are configured as two primary anaerobic digesters and one smaller secondary anaerobic digester. The process operates as a low rate process with the sludge retained for 30 – 60 days in the digester. No attempt is made to accelerate the digestion process by modifying the operation of the digester. The digesting sludge is mixed by the bubbles of bio-gas released from the sludge as they rise to the surface.

The digesters operate in the anaerobic mode to treat the sludges produced by the sewage treatment process. This sludge is withdrawn from the primary sedimentation tank daily and fed into the digester. After a period of digestion the sludge is discharged onto the drying beds.

8.1.1 Assessment of Anaerobic Digester

During the site visit the digester was observed to have a thick black mud like texture. There was noticeable mixing occurring in the tanks, which was not considered likely to entrain air and cause inhibition of the anaerobic digestion process.

Normal well operated anaerobic digesters have a thick distinguishable layer of black scum on the surface. This helps to contain odour from the sludge, and reduce oxygen penetration into the liquor. The sludge below the surface scum layer is usually black and has a creamy appearance (typical of well digested anaerobic sludge). The “tarry” odour is also typical of a well digested anaerobic sludge.

Currently the there are two digesters that are operating as primary digesters, and the centre digester is functioning as the secondary digester. The secondary digester serves the purpose of further digesting sludge from the primary digesters, and allowing further solid settlement.

The required volume of the digester was estimated in accordance to guideline standards, (Water Resources, ‘*Guidelines for Planning and Design of Sewerage Schemes*’, Vol 2, QLD, Sep 1992). The design is based on the type of treatment system, number of EP services, and location of plant. For Biloela the volume is calculated to be 0.10 m^3 / EP which is considered a “Low Rate” digester

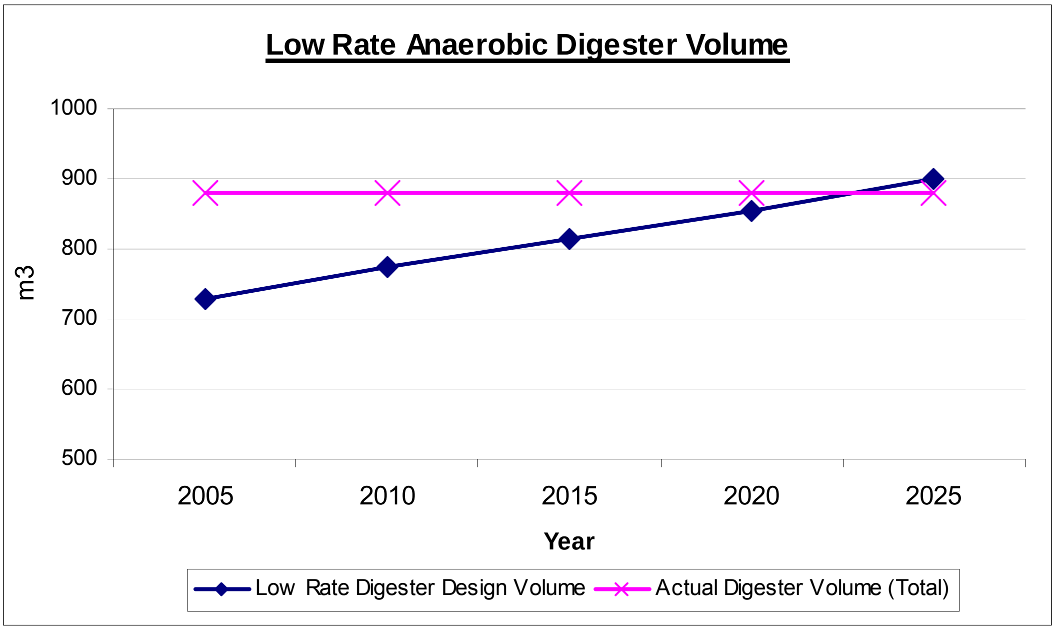

Figure 7.1: Anaerobic Digester Volume

Figure 7.1 shows the relationship between the current digester volume and the required design volume for a low rate anaerobic digester. The graph explains that the combined volume of the existing digesters is acceptable for the current loading for the Year 2005. It is predicted that by approximately Year 2020 the digesters will be considered too small and an upgrade of the sludge treatment at Biloela STP will be required.

The current configuration of the digesters is two primary digesters operate in parallel and sludge from these two units is sent to the secondary digester. This operational configuration if operated efficiently can increase the life of the digesters to beyond the Year 2020.

8.2 Recommended Sludge Treatment

The digesters are currently operating and producing adequately digested sludge, and should continue to do so until approximately Year 2020. It is recommended that the current operation of the digesters be continued, and a review of the units be done in 2015 to re-assess the loading and operational capacity of the units.

9.0 SLUDGE DEWATERING

9.1.1 Current Sludge Drying Beds

Currently the Biloela STP dewaters the digested sludge from each of the three digesters on drying beds allowing the sludge to dry to a spadable consistency before manually lifting and eventually removing from site to land fill. The sludge cake is stockpiled on site until a full load for a truck is accumulated. The sludge stockpile is not bunded.

The existing arrangement with 19 drying beds allows adequate drying time for the sludge to dry to a spadable consistency.

The successful operation of the drying beds relies on good weather to dry the sludge in the beds in around 2 (two) weeks so that it can be lifted and the bed prepared for the next filling. Should lengthy rainfall occur, the filling/drying cycle can be severely disrupted depending on the duration and intensity of the wet weather.

The treatment plant current has only 19 drying beds. 13 of the beds are 2.4m by 6.1 m, five beds are 5.1m by 8.1 m and one bed is 7.8 m by 8.1 m. The total surface area equates to 463.9m^2. The beds are constructed with low concrete walls, a simple underdrain system and sand topping. The beds are not fitted with surface drains for supernatant drainage

The existing beds were observed to be in good condition, with an adequate layer of sand and apparently sound wall structure.

Operationally the operator has to cut the drying sludge into square sections to encourage drying by exposing the wet sludge underneath.

The dried sludge is removed from the beds by manually lifting with a spade. The width of the beds, the narrow inner walls mean that the operator has difficulty accessing the sludge with a wheelbarrow for removal and use of a Bobcat or similar mechanised equipment is impractical. It is therefore recommended that consideration be given to providing mechanical sludge dewatering in the form of a belt press solely to improve workplace health and safety issues.

9.1.2 Assessment of the Sludge Drying Beds

The sludge drying beds should be sized in accordance with *Guidelines for Planning and design of sewerage schemes*, Vol 2, Qld, Sep 1992, which bases the surface area requirement on

- o Equivalent population,
- o Type of treatment system, and
- o Location - whether the treatment plant is inland or coastal.

For a low rate trickling filter – primary sludge plus humus sludge (anaerobically digested), for coastal community, a drying bed surface area of 0.01m^2/EP is required.

The actual and required drying bed surface area is shown in Figure 7.2 for current sludge production and predicted sludge production through to the year 2025.

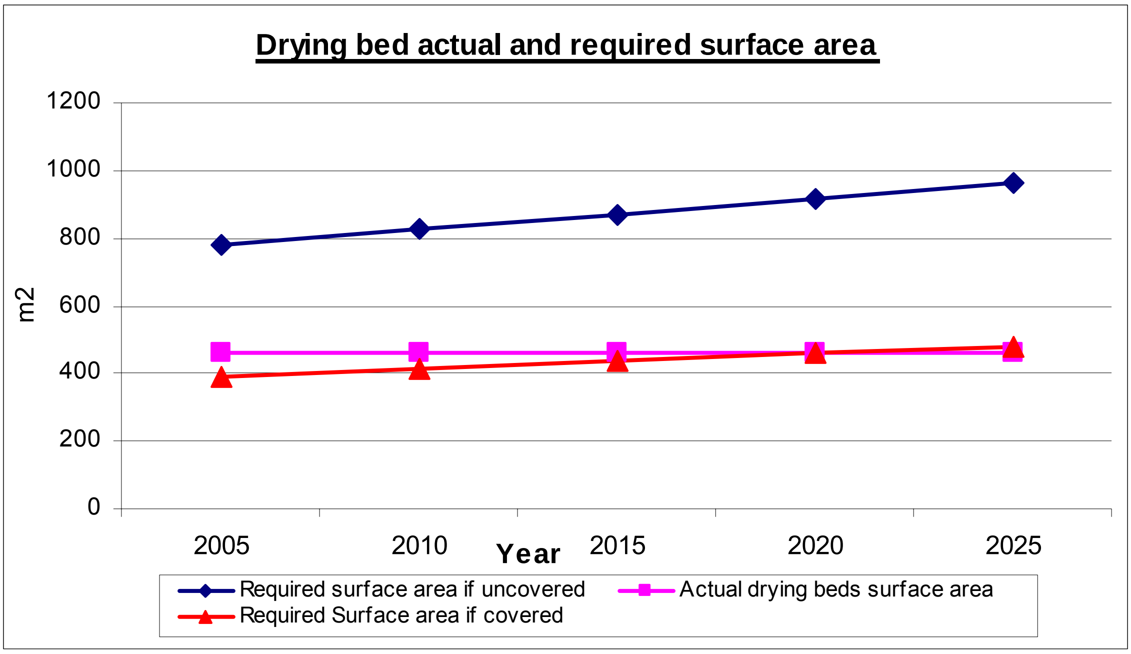

Figure 7.2: Drying bed size, actual compared to design requirements

As indicated in Figure 7.2 there is a current shortfall in drying bed area of around 320m^2. If the drying beds were covered the current capacity of the beds would be adequate for the next 20 years, however if not extra beds should be built or mechanical sludge dewatering installed. An additional 500m^2 of drying bed surface area is required to meet design requirements for the predicted load by Year 2025.

9.2 Sludge Dewatering Options

There are a number of alternatives available for dewatering (drying) or disposing of sludge. Some of these include;

- Increase the number of drying beds
- GEOTUBES ® (Enclosed porous polypropylene bags)
- Mechanical Belt press
- Centrifugal Dewatering
- Removal by external waste collectors (Zappaway, or composting/vermiculture venture)

9.2.1 Sludge Drying Beds

Drying beds are currently in use, and as explained in Section 7.2, additional drying beds are required for current and future sludge loadings.

The advantages and disadvantages of sludge drying bed are summarised below in Table 7.3.

Table 7.3: Advantages and Disadvantages for Sludge Drying Beds

Advantages	Disadvantages

• Moderate operating cost • Control of sludge discharge rate • Can be used without the need for polyelectrolyte to assist in dewatering.	• Labour intensive • Relatively high capital cost • Requires large footprint • Does not contain possible odour emissions

From Table 14 based on the Queensland Guidelines, two options can be recommended;

i) Cover the existing drying beds as to ensure sludge does not inhibit the drying process.

ii) Build additional beds, either in stages to meet demand or for the loading prediction for Year 2025.

9.2.2 Geotubes®

Geotubes® are woven polypropylene bags that can sit in existing drying beds, and accept multiple sludge fills until the bag is full.

The process generally has the ability to dewater sludge with a 3% dry solid concentration to a 20-25% sludge cake. The concept is to allow for sludge to flow into the Geotube® bag by gravity. Filtrate discharges through the pores of the Geotube®, and leaves the dewatered sludge in the bag. Filtrate discharges from all parts of the bag, not just the bottom, and the bag can accept multiple charges of sludge on top of sludge already in the bag. When the bag is full it is allowed to drain before being cut open and the sludge allowed to dry further if require.

Recent discussions with the supplier of Geotube® suggests sludge dry solids contents of 30 – 40% are being achieved.

With the installation of suitable pipe fittings, the sludge can flow directly from the digester into the bags. Although a polyelectrolyte is not required, it will increase the efficiency and dewatering rate of the sludge by releasing water from the sludge matrix before it enters the bag. The use of polyelectrolyte will allow for prolonged usage of one bag.

If a polyelectrolyte was used a small mixing vessel, dosing pump, and inline mixing zone would be required. A mixing zone is easily manufactured in the pipeline by joining a number of 90 degree elbows in the inlet pipe line.

Our calculations indicate that a single Geotube® bag sized to fit into the large drying bed (5.1m X 8.13m) at Biloela STP would last a minimum of 2 months at predicted sludge production rates.

9.2.3 Mechanical Belt presses

Belt presses are an alternative to drying bed dewatering. Belt presses have been associated with larger treatment plants however as is evidence by the proposed installation at Moura STP presses are becoming more cost effective.

The process generally has the ability to dewater sludge with a 3% dry solid concentration to a 12-20%. It is a continuous-feed process that uses the principals of thickening, gravity drainage, and mechanically applied pressure. Polyelectrolyte additives are usually required for dewatering, therefore a tank for mixing and dosing pump will be required.

The advantages and disadvantages for mechanical belt presses are summarised in Table 7.6.

Table 7.6: Advantages and Disadvantages of Belt Press Dewatering

Advantages	Disadvantages
• Relatively little power consumption, • Low noise generation, • Low maintenance requirements, • Easy to control, • Produces handle able sludge cakes**.**	• Requires wash water • Can produce greasy sludges (high levels of fat can cause handle ability problems, and reduce dewatering efficiency) • Can produce odour, however this can be reduced by enclosing the unit. • Can be labour intensive cleaning

9.2.4 Centrifugal Dewatering

Centrifuge dewatering uses the high gravitational forces generated in the centrifuge to separate the heavier solids from the water by forcing the solids to the outer walls of the bowl where they accumulate as dewatered sludge. The centrate (feed water) produced is returned to the inlet of the treatment plant, and the sludge cake, which is usually around 20-25% dry solid concentration, is discharged into a waiting storage bin. Like belt press dewatering, the dry solid content of the dewatered sludge is improved with polyelectrolyte dosing.

The advantages and disadvantages of the centrifuge are presented in Table 7.7.

Table 7.7: Advantages and Disadvantages of Centrifuge Dewatering

Advantages	Disadvantages
• Does not require wash water. • Is a clean process, requires low cleaning requirements. , • Good for greasy sludges. • Large capacity capabilities, in small space requirements.	• Has relatively high operating and capital cost. • Elevated noise levels • Requires high mechanical maintenance. • Can require a higher chemical dosing rate than belt presses.

9.2.5 External Waste Sludge Collectors

There are a number of companies in the business of collecting waste sludge from sewage plants and either treating the sludge further or offering specific disposal methods (e.g vermiculture, composting, land fill).

These services are an ongoing operating cost for the treatment plant, which creates high operational cost. The collection is required to be pre-arranged hence liquid sludge would need to be stored on-site.

The advantages and disadvantages of external collection services are summarised below in Table 7.8.

Table 7.8: Advantages and Disadvantages of External Sludge Collection Services

Advantages	Disadvantages
• No land space required • No capital cost for on-site dewatering. • Minimal odour emissions. • Sludge consistency is irrelevant	• High operating cost • Emergency dumping not possible, requires pre-arranged pick up •

9.3 On Site Sludge/Waste Storage

Upon the site visit, it was evident that some form of waste sludge was being dumped into an open land area. This is shown in figure 8.3

Figure 8.3: Contaminated waste area at Biloela STP site.

No analysis has been performed on the sludge however on visual inspection is considered highly contaminated.

The sludge and waste collection at the treatment plant at the moment is not bunded and potential exists for contaminated run-off from to enter the environment or local surface waters. This should be prevented either by bunding and including a run-off collection and recycle system to return contaminated run-off to the treatment plant inlet, or rehabilitating the area and removing waste to dedicated solid waste landfill areas.

If dried sludge and scum can not be removed immediately to land fill when dried, it is recommended that a concrete slab with nib walls be constructed to store the sludge after removal from the drying beds and before transport from site. The slab should have a drain sump and pump to return any run-off to the inlet works.

9.4 Criteria for Recommended Sludge Drying Process

When choosing the optimal sludge drying process the following criteria are considered;

- Labour requirements

- o Complexity of process
- o Capital and operating cost

9.4.1 Labour Requirements

The most labour intensive drying process is by far drying beds. The operator is required to cut the drying sludge regularly to speed up the drying process. The sludge is dried, lifted, and carried to the storage area by the operator. This process is physically demanding and requires extensive operator input.

Belt press and centrifuge dewatering require maintenance for every use, disposing of the dried sludge, as well as monitoring and servicing the mechanical parts, and cleaning the machine after each use.

The Geotubes® require minimal operator attention on a regular basis. The Geotubes® only require the removal of the dried sludge when the bag is full, and this could occur every 3-6 months at Biloela STP.

There is no labour requirement by the operator when using external collector services.

9.4.2 Complexity of the Process

The mechanical dewatering devices rate the highest in complexity. The Geotubes® and drying beds are simple, and the external waste collecting services have the lowest complexity.

9.4.3 Capital and Operating Cost

A summary of the costs associated with the variable sludge dewatering options are summarised in Table 7.9. The operating costs shown in Table 7.8 do not off-site disposal costs.

Table 7.9: Capital Cost Estimate for Sludge Dewatering Options

Sludge Dewatering Methods	Capital Cost *	Operating Cost *
Drying bed for 2029		$14,560.00
Uncovered [$10,700/ uncovered]	$107,000.00	
Covered [$5,500 per bed covering]	$81,300.00	
Geotube® (cost of replacement tubes included in operating costs)	$6,500.00**	$12,555.00
Mechanical Belt Press	$105,000.00	$9,222.00
Centrifugal Dewatering	$211,000.00	$9,222.00
External waste collectors	None Required	$43,420.00

- Costs are preliminary estimates only and a +/- 10-30% contingency should be applied
- ** Pump and pipe work only

9.5 Recommended Sludge Dewatering Method

Council’s aim is to reduce odour emissions from the STP and sludge, and reduce the labour and maintenance required for the current drying beds.

The following comments are made:

- Drying beds are a long term economically viable solution as far as capital cost is concerned however the maintenance and service requirements for these beds are labour intensive;
- Geotubes appear to be a lower cost and less labour intensive option to drying beds but would need to be proven before being accepted.
- Belt Press dewatering is an attractive option as far as capital costs are concerned and have a reasonable operational cost.

As Belt Press dewatering is currently being installed as part of the Moura STP augmentation it is recommended that a similar process be implemented at Biloela STP.

10.0 SLUDGE STORAGE AND DISPOSAL

10.1 Sludge Disposal Options

When the sludge has been dried, it is necessary to dispose of the cake to a secure environment. There are a number of options for disposal that are considered. These include;

- Land fill
- Composting
- Vermiculture
- External Sludge Collector

10.1.1 Land Fill

This is the current method of disposal. Once the sludge is dried and lifted, it is stockpiled at the treatment plant, and taken to the local land fill.

This method is simple and low cost but requires some operator input. It does not generate any environmental concerns as the sludge is contained in an area for contaminated waste and the sludge does not require regular monitoring.

10.1.2 Composting

Bio-solids are high in nutrients and when combined with bulking agents such as garden organics, wood & timber, or sawdust a range of composting products can be produced. Unfortunately composting is labour intensive to manage the process and requires some mechanical machinery to turn the windrows at regular intervals. A major disadvantage for smaller operations is that the production costs often outweigh any revenue generated.

A composting operation would require a suitable area that is sealed and drained with run-off collection and recycle to the inlet works. The operation will produce some odour.

We would not recommend Council undertake composting itself, but potential exists if there is an already established operation in the area.

10.1.3 Vermiculture

Vermiculture (or vermicomposting) is the process of using earthworms and micro-organisms to breakdown the organic material in sewage sludge. The worms consume the organic waste to produce soil conditioner.

The sludge is required to be dried first, may need to be combined with bulking agents such as those used with composting, and applied to the worm beds. The end product will require testing and classification and used as a soil conditioner (fertilizer).

Similar comments as to those made above for composting will apply to vermiculture.

10.1.4 External Sludge Collector

This is similar to the external sludge collector as discussed in section 8.2.4, however instead of collecting “wet” sludge the “dry” sludge cake is collected and disposed of by the collector.

10.2 Criteria for Recommended Sludge Disposal

When choosing the optimal sludge disposal method, the following criteria for selection are used;

- Labour intensiveness
- Complexity of process
- Capital and operating cost

10.3 Recommended Sludge Disposal Scheme

Using the criteria for selection, the following conclusions are made, and the recommended sludge disposal scheme is given.

- The quantity of sludge produced by Biloela STP is too small to consider using the value adding sludge disposal strategies such as in-house vermiculture and composting. The cost in capital and labour would far out weigh the revenue. However composting or vermiculture by external sources is an option that should be explored by Council. Council should approach local farmers and/or composting agents to possibly supply the sludge.

- The operator is familiar with the process of disposing of the dried sludge cake to land fill, and this method has a lower operational cost than external collectors.

It is recommended that the preferred disposal option for the sludge continues to be land fill. Currently the sludge cake is taken to land fill at regular intervals.

11.0 CONCLUSIONS

In order to fulfil the request of providing a planning report for Biloela Sewage Treatment plant and effluent disposal strategy, it was necessary to review the works of the entire treatment process, and provide an assessment of the existing effluent disposal strategy.

The report provides made the following conclusions and recommendations;

Existing Sewage Treatment Plant Works

- If all existing units at the Biloela STP are put on line, the process is capable of consistently producing secondary quality effluent with an irrigation water classification of Class B. However some upgrades are recommended to ensure this is sustained in the future and the upgrading of effluent to Class A as a minimum is recommended for water diverted for use for at truck washing bays etc.

Sludge Treatment

- The current anaerobic digesters are considered adequately sized and are capable of treating current loadings. However the units will require upgrading to cater for predicted future loadings for the Year 2020 and beyond.

Sludge Dewatering

- The existing drying beds as a minimum require rain protective roofs to ensure sustainable drying capabilities during wet weather. The current method of sludge handling is manually lifting the dried sludge off the beds It is recommended that Belt Filter Press dewatering is implemented.

Effluent Disposal

- The current effluent disposal scheme used by Biloela is concluded to be long term environmentally sustainable and acceptable as long as Class B water quality is maintained. A hydraulic modelling program (MEDLI) was used to assess the sustainability of the effluent re-use scheme and an irrigation strategy and wet weather storage tank capacity is recommended from this data.

12.0 RECOMMENDATIONS

The following recommendations are made to;

- Optimise the process performance of the treatment plant
- Optimise the Sludge treatment and management for the process
- Ensure environmentally sustainable effluent disposal

The recommended augmentation will comprise:

Inlet Works

- Install a mechanical screening system and automated grit removal systems at the inlet works.

Secondary Treatment

- Rurfurbish all three trickling filters.
- Control the humus return flow rate as to ensure that the trickling filter media remains wet at all times.
- Refurbish the dosing chamber to ensure hydraulic loading to the trickling filters is evenly distributed over the entire media.

Tertiary Treatment

- Retrofit the sand filter structure as a tube settler to reduce the suspended solids load on the effluent lagoons

Sludge Treatment and Management

- Continue with the anaerobic digestion system and maintain the current high standard of operation

Sludge Disposal

- Continue with disposal to land-fill.

Effluent Disposal

- Effluent is to be adequately disinfected before being pumped to irrigation areas.
- The plant bypass should be disconnected from the lagoons to prevent recontamination of treated effluent.
- Consideration be given to providing additional treatment to the portion of effluent diverted to the proposed truck washing bay and standpipe.

References

Water Resources, Guidelines for Planning and Design of Sewerage Schemes.

Tchobanoglous G, Burton FL, Stensel DH, 'Wastewater Engineering, Treatment and Reuse' 4th edition, Metcalf and Eddy, New York, 2003

F.Wilson, 'Design Calculations in Wastewater Treatment', Richard Clay (The Chauncer Press) Ltd, Bungay, 1981.

Queensland Water Recycling Guidelines December 2005

Appendix A

EPA Licence

QUEENSLAND GOVERNMENT **Environmental Protection Agency**

Environmental Protection Act 1994

Notice of Amendment to Licence

Section 138

BANANA SHIRE COUNCIL
24 JAN 2001

Copy to		For	
MAYOR		Information	
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DES		MEETING	
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Copied By ....
File No. X-220.5
Ack ..../....../.....

Enquires to: Ian Cowley
Telephone: 07 4971 6500
Your Reference:
Our Reference: CG0036

22 January 2001

Banana Shire Council
PO Box 412
Biloela Q 4715

Dear Mr John Hooper

Re: Environmental Authority CG0036

It has been decided under section 138 of the *Environmental Protection Act 1994* to amend Banana Shire Council's environmental authority.

The amendment includes the removal of Level 2 Environmentally Relevant Activities (ERA's) 16 - Municipal Water Treatment Plant and 43 - Animal Housing, which were mistakenly issued on Banana Shire Council's environmental licence. Two separate Level 2 Approvals have been issued for these ERA's at no cost to the Council. They are:-

CG0067 - to cater for ERA 43 - Animal Housing; and
CG0068 - to cater for ERA 16 - Municipal Water Treatment Plant

Other administrative amendments include the removal of conditions stating dates by which time Management Plans were to be submitted to the Environmental Protection Agency. These reports have been received.

Information relating to a review or an appeal against this decision are attached to this notice.

Please do not hesitate to contact Mr Ian Cowley on telephone number 4971 6500 if you have queries in relation to this amendment.

Yours sincerely

H. de Groot

Heiko de Groot
District Manager (Environmental Operations) Gladstone
Delegate of Administering Authority
(Environmental Protection Act 1994)

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Extracts from the Act Regarding Reviews and Appeals

Procedure for review

202.(1) A dissatisfied person may apply for a review of an original decision.

(2) The application must-
- (a) be made in the approved form to the administering authority within-
  - (i) 14 days after the day on which the person receives notice of the original decision or the administering authority is taken to have made the decision (the **"review date"**); or
  - (ii) the longer period the authority in special circumstances allows not later than the review date; and
- (b) supported by enough information to enable the authority to decide the application.

(3) The applicant must give the following documents to the other persons who were given notice of the original decision-
- (a) notice of the application (the **"review notice"**); and
- (b) a copy of the application and supporting documents.

(4) The review notice must inform the recipient that submission on the application may be made to the administering authority within 7 days after the application is made to the authority.

(5) If the administering authority is satisfied the applicant has complied with subsection (2) and (3), the authority must-
- (a) review the original decision; and
- (b) make a decision (the **"review decision"**) to-
  - (i) confirm or revoke the original decision; or
  - (ii) vary the original decision in a way the administering authority considers appropriate.

(6) The application does not stay the original decision.

(7) The application must not be dealt with by-
- (a) the person who made the original decision; or
- (b) a person in a less senior office than the person who made the original decision.

(8) Within 14 days after making the decision, the administering authority must give written notice of the decision to the applicant and persons who were given notice of the original decision.

(9) The notice must-
- (a) include the reasons for the review decision; and
- (b) inform the person of their right of appeal against the decision.

(10) If the administering authority does not comply with subsection (8) within 14 days after receiving the application, the authority is taken to have made a decision at the end of the period confirming the original decision.

(11) Subsection (7) applies despite section 27A(7) of the *Acts Interpretation Act 1954.*

(12) This section does not apply to an original decision made by-
- (a) for a matter, the administration and enforcement of which has been devolved to a local government - the local government itself or the chief executive officer of the local government personally; or
- (b) for another matter-the chief executive personally.

Who may appeal

204.(1) A dissatisfied person who is dissatisfied with a review decision may appeal against the decision to the Court.

(2) The chief executive may appeal against another administering authority 's decision (whether an original or review decision) to the Court.

(3) A dissatisfied person who is dissatisfied with an original decision to which section 202 (Procedure for review) does not apply may appeal against the decision to the Court.

NOTES

1) Notice of Other Duties

Please note that in addition to this environmental authority, you may have obligations at law under the Environmental Protection Act (for example, compliance with Environmental Protection Policies), the Contaminated Land Act and other obligations at law created by the Federal, State and Local Governments.

2) Environmental Duties under the Environmental Protection Act

The **Environmental Duties** under the Environmental Protection Act are as follows:

- Section 36(1) provides that a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the "general environmental duty").
- Section 37 requires that a person who becomes aware that serious or material environmental harm is caused or threatened by an activity they are involved in, has a duty to report that harm. Employees have a duty to report the harm to their employer who then assumes the duty to notify the administering authority. Where an employer cannot be contacted the person must notify the administering authority. People are exempt from this requirement if the harm is occurring under an environmental protection policy, an environmental management program, an environmental protection order, an environmental authority or a direction from an authorised person in an emergency.

3) Amendment of a Licence

Section 49 of the Act provides for the licensee to be able to apply for an amendment of their licence. Examples where an application for a licence amendment should be submitted are:

If the licensee proposes to;

1. carry out an activity at a site which is not authorised by the licence, or
2. change the number or types of activities; or
3. increase the scale of a currently licensed activity; or
4. significantly change the way in which the activity/activities are operated, such that the licence conditions cannot be complied with.

4) Sale of a Licensee's Business

Section 53 of the Act applies if a licensee proposes to dispose of the business to someone else. Before agreeing to dispose of the business, the licensee must give written notice to the buyer that the buyer must make application under this Act for the transfer of the licence or for a new licence.

5) Ceasing to carry out the licensed activity

Section 54 of the Act provides that within 14 days after ceasing the environmentally relevant activity to which this licence relates, the licensee must give written notice of the ceasing of the activity to the administering authority.

Approval No. CG0067

Section 104(2)

Under the provisions of the *Environmental Protection Act 1994* this environmental authority is issued:

To: **Banana Shire Council**

Address: **Cnr Kroombit and Prairie Street**
Biloela Q 4715

in respect of carrying out the environmentally relevant activity:

43 **Animal Housing** - commercially operating a boarding or breeding kennel dog pound, greyhound training facility or veterinary clinic in which animals are boarded other than overnight for treatment.

at premises/place described as:

Lot 2, Plan RN479
Parish of Prairie

located at:

186 State Farm Road
Biloela Q 4715

43 **Animal Housing** - commercially operating a boarding or breeding kennel dog pound, greyhound training facility or veterinary clinic in which animals are boarded other than overnight for treatment.

at premises/place described as:

Lot 113, Plan M86326
Parish of Moura

located at:

120 Davey Street
Moura Q 4718

This environmental authority is issued subject to the conditions set out in the schedules attached to this environmental authority.

This approval takes effect from **18 February 2001** and remains in force until **18 February 2006.**

H. de Groot 22/1/01

Heiko de Groot
District Manager (Environmental Operations) Gladstone
Delegate of Administering Authority
(Environmental Protection Act 1994)

Section 104(2)

SCHEDULE A - ANIMAL HOUSING

(A1) Effluent from animal housing facilities is not to be released to surface or groundwaters.

(A2) The operation of animal burial pits must not degrade waters or groundwaters.

(A3) The operation of animal housing or animal burial pits must not create environmental nuisance beyond the boundaries of the licensed premises.

End of Conditions for Schedule A

End of Environmental Authority

Approval No. CG0068

Section 104(2)

Under the provisions of the *Environmental Protection Act 1994* this environmental authority is issued:

To: **Banana Shire Council**

Address: **Cnr Kroombit & Prairie Streets**
Biloela Q 4715

in respect of carrying out the environmentally relevant activity:

16 **Municipal water treatment plant** - treating water for domestic use (other than treatment that only involves disinfection)

at premises/place described as:

Lot 1, Plan RP617429
Parish of Prairie

located at:

Calvale Road
Biloela Q 4715

16 **Municipal water treatment plant** - treating water for domestic use (other than treatment that only involves disinfection)

at premises/place described as:

Lot 113, Plan M86326
Parish of Moura

located at:

Davey Street
Moura Q 4718

16 **Municipal water treatment plant -** treating water for domestic use (other than treatment that only involves disinfection)

at premises/place described as:

Lot 1, Plan CP883976
Parish of Benleith

located at:

Lou Drake Street
Baralaba Q 4702

16 **Municipal water treatment plant -** treating water for domestic use (other than treatment that only involves disinfection)

at premises/place described as:

Lot 3, Plan RP614821
Parish of Walloon

located at:

Nathan Street
Theodore Q 4715

This environmental authority is issued subject to the conditions set out in the schedules attached to this environmental authority.

This approval takes effect from **18 February 2001** and remains in force until **18 February 2006.**

H. de Groot 22/1/01

Heiko de Groot
District Manager (Environmental Operations) Gladstone
Delegate of Administering Authority
(Environmental Protection Act 1994)

Section 104(2)

SCHEDULE A - WATER TREATMENT

(A1) All storage of chemicals must be bunded with sufficient volume to prevent escape of contaminants off site.

(A2) Smaller volumes of chemicals (individual containers less than 210L) must be placed in roofed and bunded areas.

(A3) Any sludge derived from treatment operations must be disposed of in a manner that does not create an environmental nuisance or environmental harm.

End of Conditions for Schedule A

End of Environmental Authority

Environmental Protection Act 1994

Licence No. CG0036

Section 93(2)

Under the provisions of the *Environmental Protection Act 1994* this environmental authority is issued:

To: **Banana Shire Council**

Address: **Cnr Kroombit & Prairie Street**
Biloela Q 4715

in respect of carrying out the environmentally relevant activity:

15(d) Sewage treatment - operating a standard sewage treatment works having a peak design capacity to treat sewage of 4000 or more equivalent persons but less than 10000 equivalent persons.

at premises/place described as:

Lot 1, Plan RP 607979
Parish of Prairie

located at:

Quarrie Road
BILOELA QLD 4715

15(c) Sewage treatment - operating a standard sewage treatment works having a peak design capacity to treat sewage of 1500 or more equivalent persons but less than 4000 equivalent persons.

at premises/place described as:

Lot 91, Plan FN 493
Parish of Moura

located at:

Davey Street
MOURA QLD 4718

15(b) Sewage treatment - operating a standard sewage treatment words having a peak design capacity to treat sewage of 100 or more equivalent persons but less than 1500 equivalent persons.

at premises/place described as:

Lot 232, Plan DW 346
Parish of Walloon

located at:

Leichhardt Highway
THEODORE QLD 4719

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 146,Plan B4922
Parish of Banana

located at:

Moriarity Street
BANANA QLD 4702

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 192, Plan RN 1606
Parish of Earlsfield

located at:

Biloela - Duaringa Road
JAMBIN QLD 4702

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 231 Plan RN 412
Parish of Dundee

located at:

Leichhardt Highway
WOWAN QLD 4702

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 43, Plan FN 546
Parish of Granville

located at:

166 Biloela - Duaringa Road
KOKOTUNGO QLD 4680

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 146, Plan FN 324
Parish Benleith

located at:

BARALABA QLD 4702

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 1, Plan RP 619696
Parish of Walloon

located at:

232 Goolara-Heinekes Road
THEODORE QLD 4719

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lots 3 and 4, Plan C8203
Parish of Cracow

located at:

23 Nathan Gorge Road
CRACOW QLD 4715

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 30, Plan RP 899131
Parish of Spier

located at:

Forestry Road
BILOELA QLD 4715

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 1, Plan FN 803416
Parish of Moura

located at:

178 Dawson Highway
MOURA QLD 4718

28 Motor vehicle workshop - operating a workshop or mobile workshop in the course of which motor vehicle mechanical or panel repairs are carried out in the course of a commercial or municipal enterprise (other than on a farm) or on a commercial basis.

at premises/place described as:

Lot 276, Plan RN 1605
Parish of Prairie

located at:

272 Auburn Street
BILOELA QLD 4715

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 359, Plan RN1456
Parish of Prairie

located at:

Calvale Road
BILOELA QLD 4715

75(a)(i) Waste disposal - operating a facility for disposing of only general waste or limited regulated waste, if the facility is designed to receive waste at the rate of more than 50t but not more than 2000t per year.

at premises/place described as:

Lot 156, Plan 536
Parish of Earlsfield

located at:

Lake Pleasant Road
GOOVIGEN QLD 4702

This environmental authority is issued subject to the conditions set out in the schedules attached to this environmental authority.

The amendment of this licence takes effect from **18 February 2001**. The anniversary date for this licence, however, remains at **20 November** each year.

H. de Groot 22/01/01

Heiko de Groot
District Manager (Environmental Operations) Gladstone
Delegate of Administering Authority
(Environmental Protection Act 1994)

Section 93(2)

This environmental authority consists of the following schedules-

Schedule A - General Conditions

Schedule B - Air

Schedule C - General Waste Disposal Facilities

Schedule D - Sewage Treatment

Schedule E - Water Treatment

Schedule F - Council Workshops

Schedule G - Council Gravel Pits

Schedule H - Monitoring and Reporting

Schedule I - Noise

Section 93(2)

SCHEDULE A - GENERAL CONDITIONS

Display of Environmental Authority

(A1) A copy of this environmental authority must be kept in a location readily accessible to personnel carrying out the activity.

Records

(A2) Any record or document required to be kept by a condition of this environmental authority must be kept at the licensed place for a period of at least five years and be available for examination by an authorised person. The record retention requirements of this condition will be satisfied if any daily and weekly records are kept for a period of at least three (3) years and these records are then kept in the form of annual summaries after that period.

(A3) Copies of any record required to be kept by a condition of this environmental authority must be provided to any authorised person or the administering authority on request.

Integrated Environmental Management System (IEMS)

(A4) The holder of this environmental authority must:

(a) implement the IEMS which provides for the following functions:

- the monitoring of releases of contaminants into the environment and an environmental assessment of the releases; and
- staff training and awareness of environmental issues; and
- the conduct of environmental and energy audits; and
- waste prevention, treatment and disposal; and

(A5) A copy of the IEMS must be kept at the licensed place where practical.

End of Conditions for Schedule A

SCHEDULE B - AIR

(B1) Except as otherwise provided by the conditions of the air schedule of this environmental authority, the environmentally relevant activity must be carried out by such practicable means necessary to prevent the release or likelihood of release of contaminants to the atmosphere.

End of Conditions for Schedule B

SCHEDULE C- GENERAL WASTE DISPOSAL FACILITIES

(C1) Site Based Management Plans must address the following issues:-

- Day to day operation
- potential recycling initiatives
- Burial of exposed waste
- Fencing and Identification of tipping sites
- Prevention of tip face fires and a fire action plan
- Access roads
- Monitoring of leachates.
- Minimising contaminated water discharges off the site and prevention of groundwater. contamination.
- Contingency plans for emergency situations
- Post closure rehabilitation, landfill monitoring and management of the site.

(C2) The Site Based Waste Management Plan must be implemented.

(C3) A copy of the final site based management plan must be kept at the licensed premises where practical.

(C4) Burning of refuse in the landfill precincts is prohibited.

(C5) All refuse deposited on the site be effectively covered with at least 200mm of suitable covering material at the end of each days operations as far as practicable.

(C6) Disposal of refuse should be conducted in such a way to minimise environmental and health nuisance. This includes insect, rat, odour and dust nuisance.

(C7) The tipping area is to be protected from stormwater entry by diversion embankments where necessary.

SEWERAGE EFFLUENT PITS

(C8) New sewerage effluent pits are to have management plans developed prior to operation. These management plans are to include:

- Full soil capability and assimilative capacity determinations
- Frequency of application and volumes of effluent disposed of
- Determination of groundwater and surface water proximity
- Exclusion of stormwater
- Performance monitoring and post closure rehabilitation
- Fencing, signage and access
- Contingency plans for emergencies

Section 93(2)

A Sewage Effluent Pit Management Plan is to be implemented on an individual or shire wide basis. The management plan is to include but not limited to:

- Full soil capability and assimilative capacity determinations.
- Frequency of application and volumes of effluent disposed of
- Determination of groundwater and surface water proximity.
- Determination of nutrient and pathogenic organism status in groundwater.
- Exclusion of stormwater
- Performance monitoring and post closure rehabilitation
- Fencing, signage and access.
- Contingency plans for emergencies.

Existing Sewage Effluent Pits.

(C9) Effluent pits will not be placed within 100 Metres from a permanent watercourse or 50 Metres from an ephemeral watercourse.

End of Conditions for Schedule C

SCHEDULE D - SEWERAGE TREATMENT

(D1) Contaminants must not be released to any waters either directly or indirectly or the bed and banks of any waters except as permitted under this schedule.

(D2) Sewage treatment plants exist at:

A) Biloela
B) Moura
C) Theodore

(D3) A management plan for the Biloela, Moura and Theodore STP effluent irrigation must be implemented.

(D4) The management plan shall detail the following.

- Soil capability and assimilative capacity
- Depth to groundwater and effect effluent is having on groundwater
- Nutrient loading and nutrient harvesting.
- Sustainability of irrigation practices.
- Alternatives to current practices.

(D5) The final effluent irrigation management plan must be implemented.

(D6) A copy of the final site based management plan must be kept at the licensed premises where practical

(D7) If a complaint is received by the administering authority regarding odour, the holder of this environmental authority must undertake some form of action to reduce odour levels within a reasonable time.

End of Conditions for Schedule D

SCHEDULE E - WATER TREATMENT

(E1) All storage of chemicals must be bunded with sufficient volume to prevent escape of contaminants off site.

(E2) Smaller volumes of chemicals (individual containers less than 210L) must be placed in roofed and bunded areas.

(E3) Any sludge derived from treatment operations must be disposed of in a manner that does not create an environmental nuisance or environmental harm.

End of Conditions for Schedule E

SCHEDULE F - COUNCIL WORKSHOPS

(F1) Contaminants not expressly provided for in this environmental authority which will or may cause environmental harm must not be released to the environment.

(F2) All fuel and chemical containers of a total volume of less that 200L must be placed in a roofed and bunded area. Bunding should be free from gaps and be sufficient height to prevent contents escaping to the wider environment.

(F3) All fuel and chemical containers of a total volume of greater than or equal to 200L must be placed in a bunded area. Bunding should be free from gaps and be sufficient height to prevent contents escaping to the wider environment.

(F4) The holder of this environmental authority must:

(a) implement a stormwater management plan which provides for the following functions:

- avoidance and minimisation of contaminated stormwater; and
- reuse, treatment and disposal of contaminated stormwater.

(F5) A copy of the completed Stormwater Management Plan must be kept at the licensed place.

(F6) Vehicle washdown and maintenance must take place in designated areas.

(F7) Effluent from vehicle washdown areas must not degrade adjacent surface or groundwater or create a contaminated site.

End of Conditions for Schedule F

SCHEDULE G - COUNCIL GRAVEL PITS

Dust Control

(G1) In the event of a complaint about dust that the administering authority considers is not frivolous or vexatious, watering must be undertaken to prevent wind blown or traffic generated dust from creating an environmental nuisance.

(G2) In the event of a complaint about noise that the administering authority considers is not frivolous or vexatious, then a noise management plan or some other works must be undertaken to adequately address the complaint.

(G3) Sediment and silt from quarry operations is not to leave the quarry site.

(G4) Appropriate measures must be undertaken to prevent erosion of the site when operational.

(G5) A post closure plan must be developed prior to finalising quarrying operations at a particular site. The post closure plan must include:

- Stabilisation of worked areas.
- Rehabilitation of worked areas.

End of Conditions for Schedule G

SCHEDULE H - MONITORING AND REPORTING

Complaint Recording

(H1) All environmental complaints received by the holder of this environmental authority relating to releases of contaminants from operations at the licensed place must be recorded in a log book with the following details:

(i) time, date and nature of complaint;
(ii) type of communication (telephone, letter, personal etc.);
(iii) name, contact address and contact telephone number of complainant (Note: if the complainant does not wish to be identified then "Not identified" is to be recorded);
(iv) response and investigation undertaken as a result of the complaint;
(v) name of person responsible for investigating complaint; and
(vi) action taken as a result of the complaint investigation and signature of responsible person.

(H2) The complaints record required by condition number H1 must be maintained for a period of not less than 3 years.

End of Conditions for Schedule H

SCHEDULE I - NOISE
General Provisions for other work areas excluding gravel pits.

Emission of Noise

(I1) The environmentally relevant activity must be carried out by such practicable means necessary to prevent the emission or likelihood of emission of noise that constitutes environmental nuisance.

(I2) Where it is not practicable to prevent any emission of noise as required by condition I1, the environmentally relevant activity must be carried out by such practicable means necessary to minimise any such emission of noise that constitutes annoyance.

(I3) In the event of a complaint about noise being made to the administering authority, that the administering authority considers is not frivolous or vexatious, then a noise management plan is to be developed for that activity generating the complaint.

End of Conditions for Schedule I

End of Environmental Authority

REQUEST FOR STATUTORY APPROVAL
RSA NO. C900036

AMENDMENT OF ENVIRONMENTAL AUTHORITY

UNDER SECTION 50(1)(A) OF THE ENVIRONMENT PROTECTION ACT 1994

Name of Applicant:	Banana Shire Council
Trading as:	Banana Shire Council
Address:	Cnr Kroombit and Prairie Streets BILOELA Q 4715
Telephone:	(07) 4992 9500

CONSULTATION:

Consultation has been ongoing with the Environmental Health Manager at Banana Shire Council. The amendment also includes splitting off of the approvals for Water treatment (ERA 16) and Animal Housing (ERA 63).

BACKGROUND

This is a continuation of fine tuning the EA to suit both the EPA and Council's needs. No change in environmental risk is noted. Most changes are administrative only.

ASSESSMENT OF STANDARD CRITERIA:

No change in risk - refer to original documentation.

RECOMMENDATION

I respectfully request that Banana Shire Council be granted approval to enact the amendments to their environmental authority.

Originator:	Reviewed:	Approved:
		22/11/01
Ian Cowley **Environmental Officer**	**Jonathon Dalton** **Senior Inspector**	**Heiko de Groot** **District Manager** **(Env Ops)**

Appendix B

Analytical Results for Samples Taken Throughout the Process System

Project No 7612/01
Project name: Banana Shire Council - STP Review and Augmentation
Particular: Biloela Analytical Results
By: Dominique Keirens

Biloela Raw Sewage		8/03/2005	19/04/2005	4/05/2005	14/06/2005	
Contaminants	**Units**	**Raw**	**Raw**	**Raw**	**Raw**	**AVERAGE (Raw)**
Ammonia as N	mg/L		40	33	50	*41.0*
Nitrate as NO3	mg/L		0.5	0.5	0.5	*0.5*
Nitrate as N			0.1	0.1	0.1	*0.1*
BOD	mg/L	288	159	119	147	*178.3*
COD	mg/L	810	420	330	390	*487.5*
TN as N	mg/L	64	56	49	63	*58.0*
Calculated Organic N			15.9	15.9	12.9	*14.9*
Conductivity	uS/cm	1200	1300	1100	1200	*1200.0*
Elements (Phosphorous)	mg/L	17	8.8	8.6	12	*11.6*
Mercury	mg/L		0.001	0.001	0.001	*0.0*
Arsenic	mg/L		0.005	0.005	0.005	*0.0*
Cadmium	mg/L		0.005	0.005	0.005	*0.0*
Chromium	mg/L		0.005	0.005	0.007	*0.0*
Copper	mg/L		0.041	0.005	0.11	*0.1*
Lead	mg/L		0.005	0.005	0.008	*0.0*
Nickel	mg/L		0.005	0.005	0.006	*0.0*
Zinc	mg/L		0.028	0.019	0.14	*0.1*
pH	-	6.8	7.5	7.5	7.9	*7.4*
Total Dissolved Solids (TDS)	mg/L	720	580	740	590	*657.5*
Total Suspended Solids (TSS)	mg/L	640	250	120	280	*322.5*

Biloela PST Effluent		8/03/2005	19/04/2005	4/05/2005	14/06/2005	
Contaminants	**Units**	**PST**	**PST**	**PST**	**PST**	***AVERAGE (PST)***
Ammonia as N	mg/L		40	29	47	*38.7*
Nitrate as NO3	mg/L		0.5	0.8	0.5	*0.6*
Nitrate as N			0.1	0.2	0.1	*0.1*
BOD	mg/L		130	79	135	*114.7*
COD	mg/L		210	180	210	*200.0*
TN as N	mg/L		54	36	55	*48.3*
Calculated Organic N			13.9	6.8	7.9	*9.5*
Conductivity	uS/cm		1300			*1300.0*
Elements (Phosphorous)	mg/L		9.2	8.9	10	*9.4*
Mercury	mg/L					
Arsenic	mg/L					
Cadmium	mg/L					
Chromium	mg/L					
Copper	mg/L					
Lead	mg/L					
Nickel	mg/L					
Zinc	mg/L					
pH	-		7.5	7.3	7.6	*7.5*
Total Dissolved Solids (TDS)	mg/L					
Total Suspended Solids (TSS)	mg/L		70	72	92	*78.0*

Project No	7612/01
Project name:	Banana Shire Council - STP Review and Augmentation
Particular:	Biloela Analytical Results
By:	Dominique Keirens

Biloela Humus Tank Effluent		8/03/2005	19/04/2005	4/05/2005	14/06/2005	
Contaminants	**Units**	**Humas Tank**	**Humus Tank**	**Humus Tank**	**Humus Tank**	***AVERAGE (Humus Tank)***
Ammonia as N	mg/L		10	18	15	*14.3*
Nitrate as NO3	mg/L		100	7.1	76	*61.0*
Nitrate as N			22.2	1.6	16.9	*13.6*
BOD	mg/L		20	25	13	*19.3*
COD	mg/L		81	90	67	*79.3*
TN as N	mg/L		40	28	44	*37.3*
Calculated organic N			7.8	8.4	12.1	*9.4*
Conductivity	uS/cm		1100	980	1100	*1060.0*
Elements (Phosphorous)	mg/L		9.3	9.2	11	*9.8*
Mercury	mg/L		0.001	0.001	0.001	*0.0*
Arsenic	mg/L		0.005	0.005	0.005	*0.0*
Cadmium	mg/L		0.005	0.005	0.005	*0.0*
Chromium	mg/L		0.005	0.005	0.005	*0.0*
Copper	mg/L		0.018	0.015	0.029	*0.0*
Lead	mg/L		0.005	0.005	0.005	*0.0*
Nickel	mg/L		0.005	0.027	0.005	*0.0*
Zinc	mg/L		0.026	0.027	0.025	*0.0*
pH	-		7.6	7.5	7.9	*7.7*
Total Dissolved Solids (TDS)	mg/L		610	730	610	*650.0*
Total Suspended Solids (TSS)	mg/L		28	42	38	*36.0*

Biloela Final Ponds Effluent		8/03/2005	19/04/2005	4/05/2005	14/06/2005	
Contaminants	**Units**	**Final Ponds**	**Final Ponds**	**Final Ponds**	**Final Ponds**	***AVERAGE (Final Ponds)***
Ammonia as N	mg/L		1	4.4	9.5	*5.0*
Nitrate	mg/L		5.8	6	6.7	*6.2*
			1.3	1.3	1.5	*1.4*
BOD	mg/L		5	20	10	*11.7*
COD	mg/L		78	120	38	*78.7*
TN as N	mg/L		6.8	12	17	*11.9*
Calculates organic N			4.5	6.3	6.0	*5.6*
Conductivity	uS/cm		830	770	1000	*866.7*
Elements (Phosphorous)	mg/L		0.7	2	4.9	2.5
Mercury	mg/L					
Arsenic	mg/L					
Cadmium	mg/L					
Chromium	mg/L					
Copper	mg/L					
Lead	mg/L					
Nickel	mg/L					
Zinc	mg/L					
pH	-		9.7	7.5	8	*8.4*
Total Dissolved Solids (TDS)	mg/L		460	610	580	*550.0*
Total Suspended Solids (TSS)	mg/L		40	38	24	*34.0*

Environmental, Health & Safety Services
Bureau Veritas - International Trade Australia
ABN: 64 001 285 927
46 RAEDON ST
BILOELA QLD 4715
PH: 07 49925600 FAX: 07 49925115
biloela.reporting@au.bureauveritas.com

ORIGIN: **Biloela Sewage Treatment Plant & Biloela Lagoon**

JOB NO: **Bi3203**

DESCRIPTION: **Water Analysis**

REC'D: **Feb-2008**

REPORTED TO: **Anthony Lipsys**

DATE REPORTED: **5/03/2008**

Sample ID		Biloela Lagoon	Biloela STP Final Effluent
Date Sampled		28/02/08	28/02/08
Time Sampled		-	-
Sample No.		Mi1671	Mi1672
Faecal Coliforms	CFU/100mL	64	39
E. coli	CFU/100mL	39	6

Bacteriological Analysis performed by Biotech Laboratories Report Number: 265936

Sample analysed as supplied by client.

This is a preliminary report.
This report shall not be reproduced except in full.

Reported by:

Michael Armstrong
Senior Environmental Officer
Bureau Veritas International Trade - Biloela Laboratory.

Environmental, Health & Safety
Bureau Veritas - International
ABN: 64 001 285 927
46 RAEDON ST
BILOELA QLD 4715
PH: 07 49925600 FAX: 07 499
biloela.reporting@au.bureauve

ORIGIN: **Biloela Municipal Sewage Treatment Plant**

DESCRIPTION: **Biloela and Theodore Raw Water Analysis**

REPORTED TO: **Anthony Lipsys**

JOB NO:

RECEIVED:

ANALYSED:

PAGE:

Sample ID		Biloela Raw Water 1-2/04/08	Biloela Raw Water 2-3/04/08	Biloela Raw Water 3-4/04/08	Theodore Raw Water 6-7/04/08	Theodore Raw Water 7-8/04/08	Theodore Raw Water 8-9/04/08	Biloela No.1 Primary Digester	Theodore Raw Water 9-10/04/08	Biloela No.2 Primary Digester
Date Received		2/04/2008	3/04/2008	4/04/2008	7/04/2008	8/04/2008	9/04/2008	9/04/2008	10/04/2008	11/04/2008
Sample Number		Mi1734	Mi1735	Mi1736	Mi1737	Mi1738	Mi1739	Mi1740	Mi1741	Mi1742
Ammonia (NH_3)	mg/L	37	35	35	37	34	37	-	36	-
BOD	mg/L	68	106	219	116	202	213	-	176	-
Orthophosphate (PO_4)	mg/L	7.6	7.9	7.4	6.9	6.2	6.8	-	7.6	-
TSS	mg/L	296	484	440	186	158	196	5067	124	18900
TKN	mg/L	53.7	89.3	53.7	52.6	47.2	48.5	-	48.1	-
Total Phosphorous (P)	mg/L	10	9.6	10	8.4	8.4	8.8	-	10	-

Sample analysed as supplied by client.

TKN Analysis performed by ALS - Report No: EB0804370, EB0804723, EB0804507, EB0804652
Remainder of analysis performed by Bureau Veritas International Trade - Biloela & Gladstone Laboratories

This is preliminary report number 4
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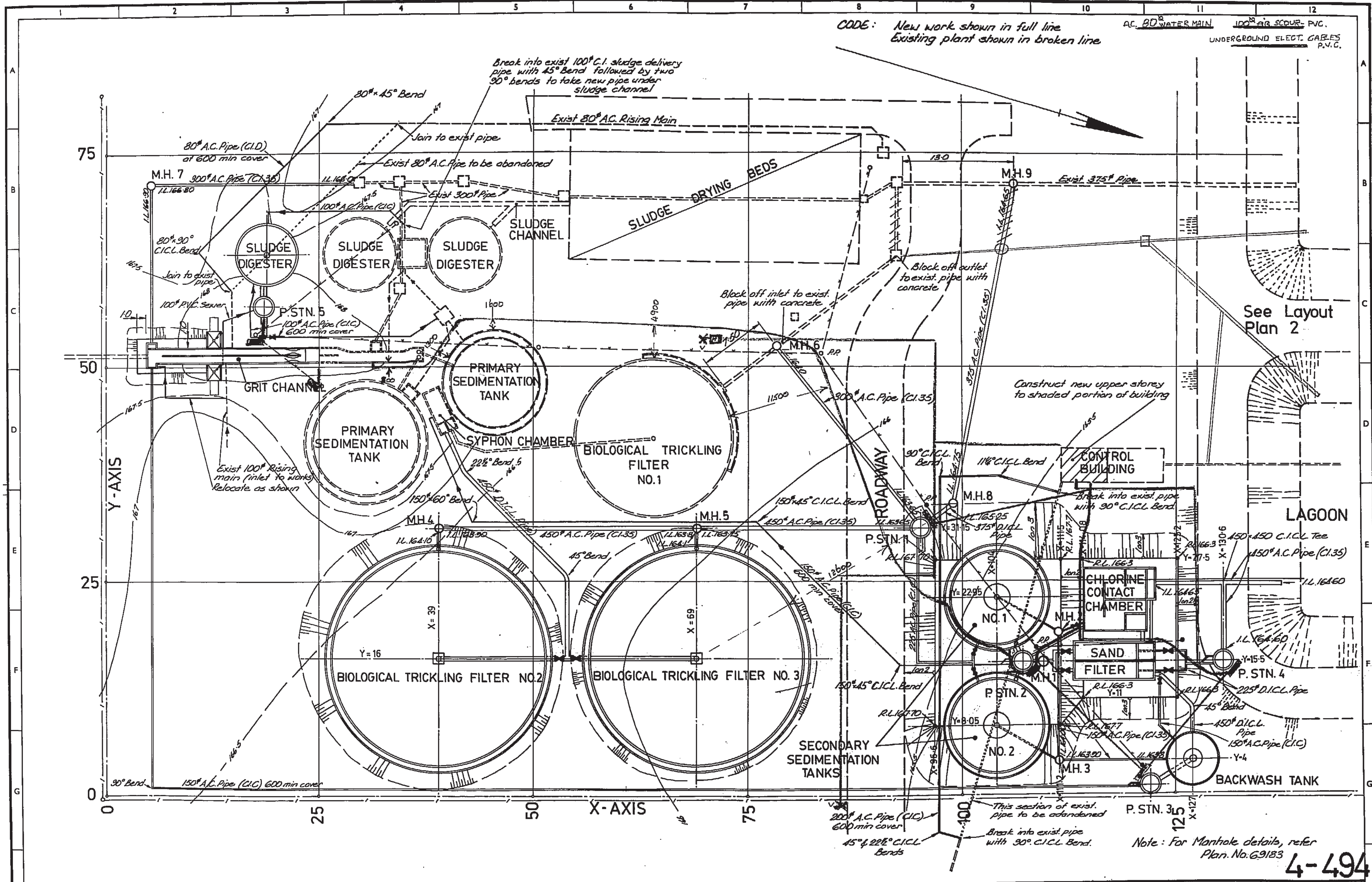
Reported by: ____________________ Date: __________

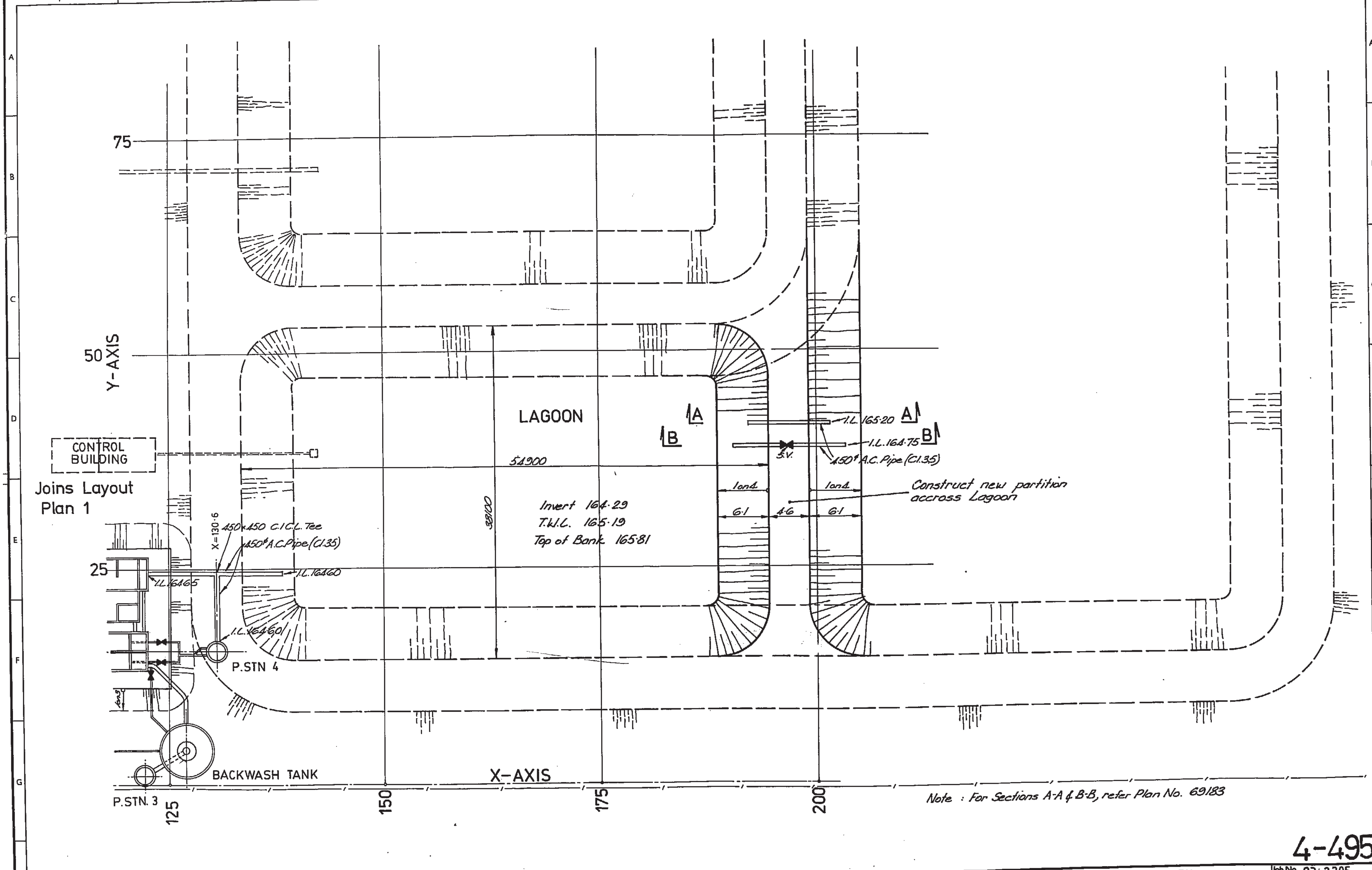
Michael Armstrong
Manager
Bureau Veritas International Trade - Biloela Laboratory

Appendix C

Plant Layout



Scales: 0 5 10 m	No.	By	Date	Description	Drawn		Date 9/83	Cameron McNamara	BANANA SHIRE COUNCIL	Job No. 83-2305
					Checked	WH	10/83	Cameron McNamara Pty Ltd (Incorporated in Queensland)	BILOELA SEWERAGE TREATMENT WORKS	Drawing No. 69181
					Designed	WH	10/83		LAYOUT PLAN NO. 1	
					Checked	R.S.S.	10/83			



4-495

Scales: 0 2 4 6 8 10 m.	No.	By	Date	Description	Drawn	Date 8/83	Cameron McNamara Pty Ltd	BANANA SHIRE COUNCIL	Job No. 83-2305
					Checked WH	10/83		BILOELA SEWERAGE TREATMENT WORKS	Drawing No. 69182
					Designed WH	10/83		LAYOUT PLAN NO. 2	
					Checked K.S.S.	10/83			

Appendix D

Classification of recycled water for use in Queensland

Table 6.1 Indicative log reductions of enteric pathogens and indicator organisms

Treatment	Indicative log reductions							
	E.coli	***Bacterial pathogens***	***Viruses***	***Phage***	***Giardia***	***Crypto***	***Clostridium perfringens***	***Helminths***
Primary Treatment	0-0.5	0-0.5	0-0.1	N/A	0.5-1.0	0-0.5	0-0.5	0-2.0
Secondary Treatment	1.0-3.0	1.0-3.0	0-2.0	0.5-2.5	0.5-1.5	0.5-1.0	0.5-1.0	0-2.0
Dual Media Filtration	0-1.0	0-1.0	0.5-3.0	1.0-4.0	1.0-3.0	1.5-2.5	0-1.0	2.0-3.0
Membrane Filtration	3.5 ->6.0	3.5->6.0	2.5->6.0	3->6.0	>6.0	>6.0	>6.0	>3.0
Lagoon Storage	1.0-5.0	1.0-5.0	1.0-4.0	1.0-4.0	3.0-4.0	1.0-3.5	N/A	1.5->3.0
Chlorination	2.0-6.0	2.0-6.0	1.0-3.0	0-2.5	0.5-1.5	0-0.5	1.0-2.0	0-1.0
Ozonation	2.0-6.0	2.0-6.0	3.0-6.0	2.0-6.0	N/A	N/A	0-0.5	N/A
UV Light	2.0->4.0	2.0->4.0	>1.0 adenovirus >3.0 enterovirus, hepatitis A	3.0-6.0	>3.0	>3.0	N/A	N/A
Wetlands – surface flow	1.5-2.5	1.0	N/A	1.5-2.0	0.5-1.5	0.5-1.0	1.5	0-2.0
Wetlands – subsurface flow	0.5-3.0	1.0-3.0	N/A	1.5-2.0	1.5-2.0	0.5-1.0	1.0-3.0	N/A

Source: Draft National Guidelines for Water Recycling (NRMMC & EPHC 2005). These are all average or typical values: actual reductions depend on specific features of each process including detention times, pore size, filter depths, disinfectant contact time etc. Other emerging technologies can also achieve high levels of log reduction, but this will generally require validation. Each treatment system needs validation under its specific operating conditions.

N/A = not available.

Table 6.2a. Recommended water quality specifications for Class A+ recycled water

Management requirements	Recycled Water Management Plan (RWMP) incorporating HACCP elements
Suitable uses	• Dual reticulation to households and industry for toilet flushing, garden irrigation, washing of cars, houses and hard surfaces and many industrial purposes (suitability determined on a case-by-case basis) • Irrigation of field crops (fruit and vegetables) eaten raw or with minimal processing
Treatment objective from raw sewage (if measured from settled, primary screened sewage 0.5 log reduction credit can be applied for bacteria and protozoa and 0.1 for viruses)	• Six log reduction of viruses (bacteriophages as indicators) • Five log reduction of bacteria (*E. coli* as indicator) • Five log reduction of protozoan parasites (*Clostridium perfringens* as indicator) • For irrigation applications, compliance with trigger values for irrigation waters in Chapter 4 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000a)
Microbiological criteria	• *E. coli* <1 cfu[1]/100mL (median); <10 cfu/100mL (95%ile) • *Clostridium perfringens* <1 cfu/100mL (median); <10 cfu/100mL (95%ile) • F-RNA bacteriophage: <1 pfu[2]/100mL (median); <10 pfu/100mL (95%ile) • Somatic coliphage: <1 pfu/100mL (median); <10 pfu/100mL (95%ile)
Physical and chemical criteria	• Turbidity <2 NTU (95%ile); 5 NTU (maximum) • For dual reticulation systems, free chlorine residual 0.2-0.5 mg/L on delivery to customer. For other Class A+ uses, the need for a chlorine residual should be determined as part of the risk assessment. • pH 6-8.5 (if disinfection relies predominantly on chlorine, but not chlorine dioxide) or 6-9.2 if other disinfection systems are used • For sustainable irrigation, salinity should be kept as low as possible, e.g. if TDS >1000 mg/L or EC>1600 µS/cm, a salinity reduction program should be implemented • Any other physical or chemical criteria that the risk assessment phase of the RWMP has identified as representing a risk to soil, crop or human health
Validation requirement	20 sampling events (with three replicate samples) that demonstrate compliance with this standard before delivery of product to customers
Verification testing	Weekly sampling (with three replicates) during first year of operation Monthly sampling (with three replicates) thereafter
Other requirements	All non-conformances with this specification to be reported to Queensland Health and addressed in accordance with RWMP All sampling and analysis to be in conformance with relevant standards (e.g. *Method 1602: Male-specific (F+) and Somatic Coliphage in Water by Single Agar Layer (SAL) Procedure* April 2001 (US EPA 2001)).

[1] cfu = colony forming units

[2] pfu = plaque forming units

Table 6.2b. Recommended water quality specifications for Class A-D recycled water[1]

Class	*E. coli* (median) cfu/100mL[2]	BOD5 mg/L median	Turbidity NTU 95% ile (max.)	SS, mg/L median	TDS, mg/L or EC, µS/cm medians TDS / EC[3]	pH
A	< 10	20	2 (5)[4]	5	1000/1600	6-8.5
B	< 100	20	—	30	1000/1600	6-8.5
C	< 1000	20	—	30	1000/1600	6-8.5
D	< 10,000	—	—	—	1000/1600	6-8.5

[1] Use of any of these classes of recycled water should involve development and implementation of a Recycled Water Management Plan incorporating risk management. The location of the sampling point for these parameters will depend on the outcome of the Recycled Water Management Plan (see Chapter 4 of these guidelines).

[2] As these values are medians, for each of these guideline values a response value should be set (e.g. 50% above the guideline value). If the response value is exceeded, another sample should be immediately taken. If this exceeds the response value again, the supply of recycled water should be suspended, and the non-conformance and corrective action process implemented, with supply not being re-established until conforming product can be guaranteed.

[3] For sustainable irrigation, salinity should be kept as low as possible. For example, if TDS >1000 mg/L or EC >1600 µS/cm, a salinity reduction program should be implemented. However, there may be some uses where salinity reduction is not required, or where other salinity management options are more practical. This should be determined during the risk assessment.

[4] Turbidity would generally be measured before the disinfection point at the treatment plant as this is the point at which low turbidity is essential. Monitoring at the treatment plant should be continuous with an alarm activated at an NTU of 2, and automatic shut-off of supply at an NTU of 5. If disinfection of Class A recycled water is achieved partly through processes that are less dependent on turbidity, an indicator other than turbidity should be used. For example, extended lagooning would use detention time in the storage as the critical limit (typically 40 days), rather than turbidity. Ozonation may use an oxidation-reduction potential (ORP) sensor, with the critical limit (in millivolts) determined by the quality of the feed water.

6.6.3 Other water quality criteria

As has been noted, the presence of suspended material in recycled water is crucial to the effectiveness of most forms of disinfection. For this reason, a critical limit for turbidity should be set as part of the Recycled Water Management Plan, particularly during production of Class A or A+ recycled water.

As noted in section 6.3.1 of these guidelines, there are complex issues involved in determining the appropriate chlorine dose, contact time and residual when disinfecting STP effluent. As a result, no single number is specified in these guidelines. Instead, each producer of recycled water sourced from STP effluent must validate their disinfection system to ensure that it is capable of achieving the microbiological criteria in Tables 6.2a&b under a range of operating conditions. Once this has been determined, appropriate critical limits should be set as part of the Recycled Water Management Plan.

Maintenance of a chlorine residual can be important to ensuring recycled water quality in pipe networks, especially when there is long residence time within pipes. However, if recycled water goes to a storage lagoon immediately after disinfection, or is used with minimal residence time in pipes, there is no need to ensure a chlorine residual. Also, there are some applications and locations (such as irrigation of crops or some grasses, irrigation of sensitive environments or internal reuse where used recycled water is returned to small treatment plants) where a chlorine residual may be detrimental to crops, the environment or treatment processes. In these cases risks associated with use of chlorine should be assessed and addressed through the Recycled Water Management Plan, and appropriate levels of disinfection should be maintained in other ways or some form of dechlorination could be used.

If a disinfection system is used that does not rely on chlorine, an alternative indicator of disinfection effectiveness should be used that ensures the equivalent disinfection reliability.

The classes of recycled water described in Table 6.2 are focused on human health risk. They do not necessarily reflect suitability for uses where human health is not the principal consideration, e.g. agricultural irrigation of non-food crops. In these circumstances other water quality