4. Wastewater Situation

Existing Data

From the studies that were carried out at the end of 2003, Samui Island produced approximately 7,056 cubic meters of wastewater per day. Most of the wastewater came from the eight most heavily populated areas on the Island, i.e. Nathon, Maenam-Bo Phut, Chaweng, Lamai, Hua Thanon, Na Muang, Taling Ngam, and Lipa Noi, and also hotels and bungalows.

In the past, the wastewater system was available only in residential or commercial areas, markets and other tourist attractions. There were wastewater ducts and pipelines to collect the wastes, and flowed into the reservoir for treatment before being released into rivers and then the sea. However, some accommodation services and restaurants released wastewater straight into rivers without treatment.

There was an investigation carried out by the Ministry of Environment Health in 1992 on the purity of seawater around the Chaweng beach. It was found that the quality of the seawater was up to standards. The amount of coliform bacteria measured was 0.13 MPN per 100 millilitres and the amount of faecal coliform bacteria was 0.8 MPN per 100 millilitres, which not exceed the standard value of 1,000 MPN per 100 millilitres. In 2005, there was another similar investigation was carried out. This time the Ministry of Environmental Health concentrated on heavily populated areas and big tourist attractions in the Gulf of Thailand, such as Samui Island, Phaghan, Koh Toa and Koh Nang Yuan. Samples of seawater from Samui Island were collected in April and July, respectively, with the emphasis on heavily occupied beaches, i.e. Maenam, Bo Phut, Chaweng, Chaweng Noi and Lamai. It was found that the level of coliform and faecal coliform bacteria from both sets of samples were much higher than the standard values, especially from the Chaweng beach. Not only the seawater being contaminated, it also has a secondary effect on the quality of other facilities for water storage, such as the Chaweng reservoir. Besides, the community around Lam Din has released untreated wastewater straight into the reservoir for a period of time, in fact, too long to be able to filter the water and distribute it for domestic use.

It can be clearly seen that while number of tourists visiting Samui Island is increasing, the environment problems are also amplifying, and not enough measures are performed to cover the situation. Even though the Government has prioritised these issues for a number of years and has given appropriate fundings, the problems still persist. In 1992, a project, to improve the wastewater system in residential areas or beaches, was announced but the process had been delayed and was finally submitted on 8 September 2005. Since then, there still has not been much improvement on the wastewater system.

Figure 1. Chaweng Beach

In 1993, the Public Works Department had carried out an examination on the suitability of wastewater collection system and wastewater treatment processes. One of the solutions was to construct wastewater...
treatment plants in four areas that populations are most likely to increase fastest, these are:

- Nathon
- Maenam–Bo Phut
- Chaweng
- Lamai–Hua Thanon

However, only three out of the four plants have been completed, the unfinished one was at Maenam – Bo Phut. Therefore, there are currently three Central Water Treatment Plants on Samui Island located at:

- Nathon (2,400 cubic meters per day)
- Chaweng (6,000 cubic meters per day)
- Lamai (8,600 cubic meters per day)

Each of these treatment plants has been designed to accommodate the growth and development of the Island for the next 20 years.

The Wastewater Treatment Plant at Nathon

This treatment plant is located on the west side of the Island, about 200 meters from the 4169 Road and the klong Jorake. Its area is about 4 rai which also act as a basin to collect the wastewater from the Nathon area. There are a few number of government owned buildings around the area, including the sheriff’s Office, police station, the post office and the tourism office. The main pier which is used for boats coming in from the mainland is also located in the vicinity.

The wastewater system used in Nathon is a combined sewer system, which collects both the wastewater and the rain water into the treatment plant. Its total length is 4,505 meters, which includes a water pump station, 3 interceptors and pipes running from the klong Jorake along the 4169 Road, into the treatment plant. There is also another line runs from the Win Hotel that is parallel to the beach, through the pier and the Sheriff’s Conference Room to the treatment plant.

The Nathon Wastewater Treatment Plant has a capacity of 2,400 cubic meters per day. The opted system is an Oxidation Ditch type, the BOD₅ value which is used to design a 110 milligrams per litre system consists of:

- A screen chamber
- An aerated grit chamber
- 2 units of the oxidation ditch type aeration tank
- 2 units of the sedimentation tank
- A sand drying bed
- A chlorination tank

Eight jet aerators were used to create a mixing in the aeration tank. When the system was first operated, only half of the full capacity was used, so only one set of aeration tank and the sedimentation tank were used. Currently, the system has been put on hold since the Municipality Authority is finding the private organization to take responsibility and operate this system.

Figure 2. Oxidation ditch process
Lamai is also another popular holiday destination for many tourists who visit Samui Island. It is located on the southeastern part of the Island and the beaches there prove to be the main attractions, whether the Lamai beach or the Hin Ta–Hin Yaay beach. Therefore, Lamai has become the second largest community on the Island next to Chaweng, and similarly it tends to increase rapidly.

The wastewater system used in the Lamai–Hua Thanon region is also a combined sewer system, which collects both the wastewater and the rain water into the treatment plant. Its total length is 9,226 meters, with 2 water pump stations, 5 interceptors and pipes running on both sides of the 4169 Road right to the Junction. There is also another line runs parallel to the Lamai beach and the klong Lamai road.

The Lamai – Hua Thanon Wastewater Treatment Plant has a capacity of 8,600 cubic meters per day and is the largest plant currently available on Samui Island. It is an empty land of 5 rai, located right next to the Lamai River, which is approximately 800 meters from the 4169 Ring Road. The treatment system was the Oxidation Ditch type, the same as the one used in the Nathon Treatment Plant, and the BOD₅ value is also similar. This plant has not yet operated since the Municipality Authority is finding the private organization to take responsibility and operate this system.
As mentioned earlier, Chaweng is the most popular and most populated area on Samui Island because of its long, beautiful stretches of beach, clear water and sunny. Especially after the tsunami tragedy in 2003, tourists are piling into the east side of the mainland and there has been a sharp increase in the number of visitors each year. Although there are hotels all over the Chaweng beach at present, the demand still increases leading to more clean water and the amount of wastewater generated. In addition, the increase in the number of hotels would mean more jobs available and more accommodation needed for employees. Eventually, more villages and communities would increase in and around the Chaweng area.

The wastewater system used in Chaweng is also a combined sewer system, which collects both the wastewater and the rainwater into the treatment plant. Its total length is 4,017 meters, with a water pump station and pipes running along the Had Chaweng–Cheang Mon road, right from the Wat Swarng Arom to the south entrance of the beach. It acts as a wastewater channel for all hotels, houses, restaurants and other commercial areas along the Chaweng beach.

The Chaweng Wastewater Treatment Plant has a capacity of 6,000 cubic meters per day. It is located on the southeastern of the Chaweng reservoir. Next to the reservoir is an empty land of approximately 4 rai. The treatment system was the same type using in the Nathon and Lamai Treatment Plants, the oxidation ditch type. This plant has not been in operation. Moreover, some parts of the equipment, such as the water pump and the valve on the control panel, were damaged by major flooding in the year 2005.
For most of the populated regions such as Chaweng, Maenam, Lipa Noi, etc., there tends to be a wastewater system installed for domestic use. The laws of Thailand stated that the amount of wastewater must be congruent with the size of the building. For those in the rural areas who have not been provided with the central treatment plant system, the most common solution is to use cement pipes and to construct a little basin for trapping wastewater and then leaving it to dissolve into rivers and the sea.

**Figure 5.** Chaweng Wastewater treatment plant
Figure 6. Existing Wastewater treatment plant locations on Samui Island
Conclusion

At the beginning, the control of the wastewater management system was not as strict as they should be, because there has not been much growth on Samui Island and natural resources can easily accommodate the toxics released. However, when the tourism industry grows, the amount of wastes and their intensity will increase to the level that it cannot be handle naturally. This has a primary effect on the purity of the seawater, which can be seen from samples that were collected and tested in the previous year.

To be prepared, the Government and the Public Works Department issued investigations and planned out possible methods to manage all these wastewater since 1993. They have divided the Island into 7 different and classified them into two categories: heavily populated areas (Chaweng, Lamai–Hua Thanon, Nathon and Maenam–Bo Phut) and rural areas (Lipa Noi, Taling Ngam and Na Muang).

The Public Works Department has arranged an appropriate funding to proceed the improvement of the central wastewater treatment system for three heavily populated areas. Which are currently:

- Nathon  (2,400 cubic meters per day)
- Chaweng  (6,000 cubic meters per day)
- Lamai    (8,600 cubic meters per day)

The system required is an aeration tank using the oxidation ditch type and the inlet BOD5 value must not exceed 110 milligrams per litre. The three mentioned treatment plants were constructed in 2005. The Public Works Department has designated the local authorities on Samui Island to take responsibility in September of that year. The only reason that the plants are not functioning at the moment is that there has not been a third party to operate and maintain the plants. If the wastewater management system on Samui Island have been improved, it will be much more efficient and this will make the purity of water be much better than in the past.

Data Analysis & Forecasting

The construction process issued by the Public Works Department to improve the wastewater management system involves 3 heavily populated areas: Nathon, Lamai–Hua Thanon and Chaweng. The construction was completed in 2005, hence the overall wastewater management system was expected to be improved. However, the wastewater treatment plant and its water pipe system constructed do not cover the whole of Samui Island. The most particular concern was Maenam–Bo Phut area, which was include in the original plan but finally left unconstructed.

The prediction for the amount of wastewater on the Island for the planning process in the future development of the wastewater system has been taken from the Public Works Department. In 1993, they divided the Island into seven different areas and grouped them into two categories: heavily populated areas (Chaweng, Lamai–Hua Thanon, Nathon and Maenam–Bo Phut) and rural areas (Lipa Noi, Taling Ngam and Na Muang). When comparing various factors concerning the suitability of the treatment process, it was found that the areas, which are heavily populated, should use the central treatment plant with the oxidation ditch system, the BOD value should not exceed 110 milligrams per litre, and the collection system should be the combined sewer. In rural areas, an onsite treatment plant system should be used. This involves the applying of an anaerobic filter tank together with the use of cement pipes, which can be commonly found.

From this investigation, the amount of wastewater for the next 20 years in each area can be predicted. The figures are as follows:
- Nathon 2,235 cubic meters per day
- Chaweng 10,511 cubic meters per day
- Lamai–Hua Thanon 8,646 cubic meters per day
- Maenam–Bo Phut 4,597 cubic meters per day

In 20 year’s time, there will be approximately 25,989 cubic meters per day of wastewater. When comparing this figure to the level of demand predicted by the PWA at 19,700 cubic meters, it can be seen that it is considerably more than the system can handle. Therefore, the Action Team have used the above values in forecasting the condition of the wastewater system on Samui Island in the future.

The Action Team has taken each individual district and analyze them separately, since these areas vary in size and the growth rate is also different. Samui Island is rather big and each community is located separate from another, hence each community should have its own wastewater treatment plant.

**The Wastewater Management System at Nathon**

Nathon situates many government owned-buildings within its vicinity; it also holds the pier from which tourists use to get to and from the mainland and there are a number of markets and other commercial areas. However, there are not many tourists in this area because its beaches are not suitable for recreation. Therefore, there is a very slow growth rate in this area, and the existing wastewater treatment plant with the capacity of 2,400 cubic meters per day is more than proficient in handling the amount of wastewater released. The only issue that needs to be addressed is the expansion of water pipes to cover all areas within Nathon.
Figure 7. Existing Wastewater treatment plant and Covered area at Nathon

Figure 8. Nathon community
The Wastewater Management System at Lamai – Hua Thanon

The growth rate of these two areas varies, especially at Lamai, where one main part is located on the east side of the 4169 Ring Road and another on the road, which run parallel to the Lamai Beach. These are mostly commercial areas and usually full of tourists. The wastewater pipe system covers most of the area of Lamai, but it does not yet cover most of Hua Thanon, which is a smaller district and its growth rate is very slow, and there is no pipeline connects the wastewater basin to the treatment plant in Lamai as planned. It is recommended that this pipeline should be built so that the wastewater systems in these two areas can be connected which will improve the overall efficiency of the wastewater system.

Figure 9. Existing Wastewater treatment plant and Covered area at Lamai
The Wastewater Management System at Chaweng

Chaweng has the most rapid growth rate on Samui Island due to its reputation and its beautiful beaches. More and more tourists are coming to visit this part of the Island every year and obviously this has a primary effect on the labour industry. More jobs are being created and more people will be needed to fill these gaps. The exact number of labour migrants is still uncertain, but it is undeniable that it is on the rise, and most of them are located either in or around the Chaweng region. Together with the rapidly increasing number of tourists, this will have a huge effect on the amount of wastewater being generated per year. From the investigation that was carried out in 1992 by the Public Works Department, the desired level of the capacity of the treatment plant in the next 20 years is 10,500 cubic meters per day, but presently after the construction, its capacity is only 6,000 cubic meters per day. Therefore, larger treatment facility is required to accommodate the predicted value.

Presently, the wastewater system only covers the area which runs parallel to the Chaweng beach where it is the busiest part in Chaweng and indeed the whole Island. However, for most parts of the community on the 4169 ring road which goes around Samui Island, there is still a lack of suitable system.

Therefore, in the future, it is necessary that the wastewater system is improved and expanded so that it can cope with this rapidly increasing growth rate. This also involves the expansion of the wastewater pipe system to cover all of the regions within the community.
Figure 11. Existing Wastewater treatment plant and Covered area at Chaweng

Figure 12. Chaweng Community
Maenam district consists mostly of residential areas that are located on flat terrain on the north side of Samui Island; the housings and shops also run along the 4169 Ring Road. Nowadays, there are increasing amounts of businesses emerging in this northern area of the Island and some of them are appearing on a big scale. The situation is similar in the Bo Phut and the Choeng Mon areas, which are located right next to Maenam. Many businesses have developed and expanded towards these areas, but at present they are still only small businesses. However, all these areas are still lacking an appropriate wastewater treatment system, and it is the only section that is included in the wastewater management plans.

From the investigation that was carried out by the Public Works Department, it is estimated that in 20 years’ time, the amount of wastewater generated will be 4,597 cubic meters per day for heavily populated areas which are still short of an adequate wastewater system. Therefore, it is vital that the development plans for this Maenam–Bo Phut area include a wastewater treatment system that can handle at least 5,000 cubic meters per day and collection pipes to cover all areas of the regions mentioned.
Figure 14. Maenam Community

Figure 15. Bophut Community
The Wastewater Management System in Rural Areas

There are three regions that have been classified as rural. They are located on the western and southwestern part of Samui Island, namely Taling Ngam, Na Muang and Lipa Noi.

Lipa Noi is located in a slightly mountainous area, and most of the locals are agriculturists; the only small commercial activity is on the Lipa Noi beach. Apart from that, there are a few stores selling which are necessary products for everyday life.

Na Muang is located in the middle of the mountains that run parallel to the 4169 Ring Road. Due to its complex terrain, and the fact that the area is far from the sea, it would be very difficult to expand, both physically and industrially.

The feature of Taling Ngam is similar to that of Lipa Noi, where the villagers live their simple life and continue to produce agricultural goods for the Island. There are a few number of restaurants located along the beach in the nearby Lam Sor–Baan Bang Kow region. The expansion is at a slow rate.

For these three areas, there are a few constraints, which include the amount of land available for expansion and their overall commercial values. There are not very many tourists visiting this part of Samui Island, so the level of wastewater generated will not be as high as in other areas. Therefore, it would be appropriate to use the onsite treatment system by applying both the aeration and natural methods, which has low investment and maintenance costs.