

The Chiang Mai Moat

Water quality problems and suggestions for improvement,
by John E. Conover, Jr., P.E, January 2018



History of the Moat



www.alamy.com - DF05HD

History of the moat:

“King Meng Rai was a powerful and successful ruler and Lanna prospered under his rule (1259-1317). He formed a great friendship with King Ramkhamhaeng of Sukhothai and King Ngam Muang of Phayao, and enjoyed considerable support from these allies in the face of threats from outsiders. The Mon, who had inhabited the valleys of the Ping, Wang and other rivers of the region since the 8th century, were absorbed into the Lanna Kingdom, along with their culture and skills. Over time a distinctive people emerged, known as the Khon Mueng, who had their own dialect of Thai language.

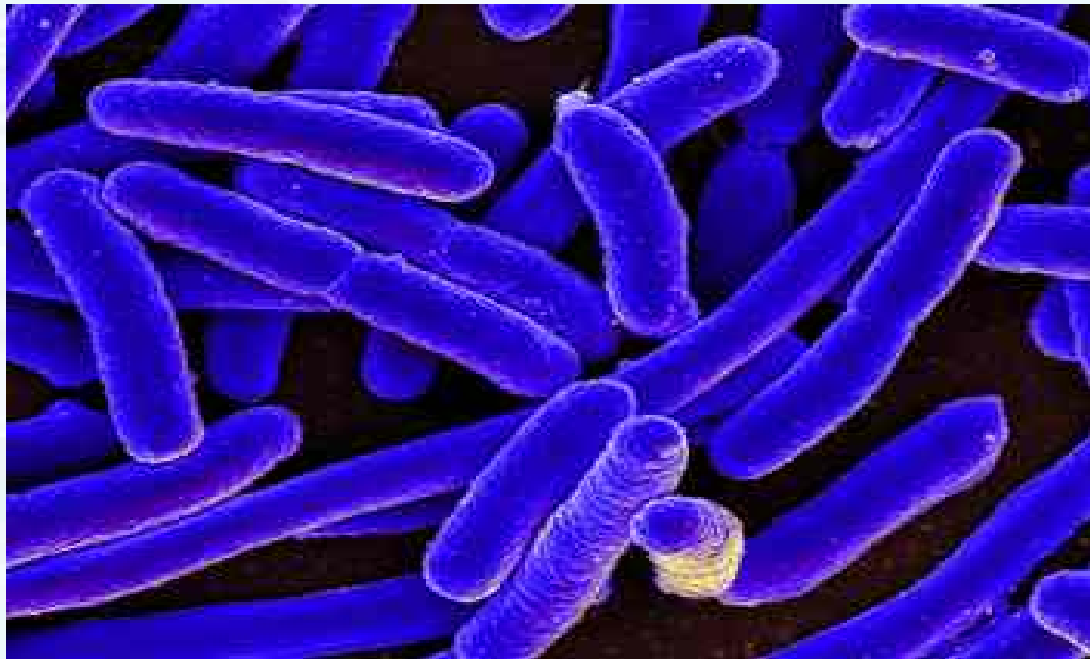
Lanna’s new capital soon became an important cultural and religious centre and remained so for several centuries.

The city was laid out over roughly a square mile; temples were built – Wat Chiang Man, dates back to the early 14th century, and still remains; while Wat Phra Singh followed in 1345 – and the distinctive moat and bastions were added. The wealth of the kingdom left behind legacies, such as Wat Suan Dawk with its towering chedis and Wat Jet Yod, which was built for the Eight World Buddhist council in 1477. “ (reference m 13)

The moat is contaminated with fecal coliform

“.....an excess of 4,000 units of fecal coliform.....”

Fecal coliform bacteria are the most common microbiological contaminants of natural waters. Some of these bacteria can cause illnesses such as ear infections, typhoid, hepatitis A, and cholera.” (ref m1)



CAUTION

WATER QUALITY ADVISORY

A temporary advisory has been issued for this area based on recent monitoring for E. coli bacteria.

FOR YOUR SAFETY

- Do not ingest lake water.
No ingerir agua del lago.
- Water is unsafe for swimming and deep wading.
Agua no es segura para nadar y wading profundo.
- Wash hands after handling fish and lake water.
Lávate las manos después de manipular el pescado y el agua del lago.



For more information visit:
<http://www.ontario.ca/health/health-services/health-protection>

Contact your local health department:



If this moat was in New York State, it would probably be classified as a Class B fresh surface water. (ref m 24)

According to regulation 6 NYCRR part 701.7, the best usages of Class B waters are primary and secondary contact recreation and fishing. I believe this classification would be applicable for Sonkram activities.

The regulation that would apply in New York would be 701.3 (ref m 11) regarding the number of fecal coliforms in the water:

“The monthly geometric mean, from a minimum of five examinations, shall not exceed 200.”

The moat is also contaminated with **parasitic worms**.

“The moat, which is located in the old precinct of Muang district, hosts parasite samples that look like leeches, according to the initial lab results of Maejo Agricultural University's Faculty of Fisheries Technology and Aquatic Resources.

The university's experts detected the parasites while they were testing the water for heavy metal pollution” (ref m3)

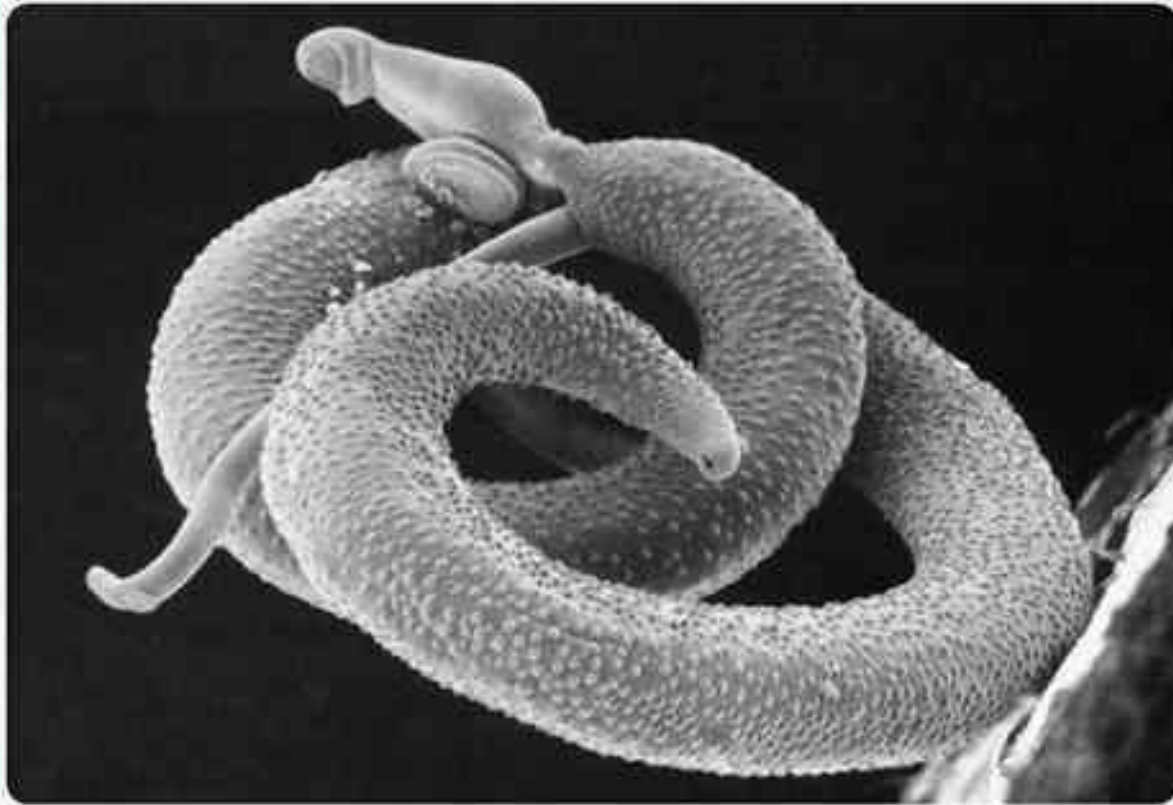
what were the results for the heavy metal testing?

Parasitic worms, continued

“An investigation of helminths in the Norway (brown) rat, *Rattus norvegicus*, and roof rat, *Rattus rattus*, from Chiang Mai Moat during May to August 1995, was done. Thirty-three out of thirty-eight trapped rats were infectedThe rats were infected with...helminth species of trematodes, cestodes, and nematodes. The helminths were found in the small intestines large intestine, lung, stomach, heart, and liver..”

(Ref m 25)

Helminths



Dissolved oxygen testing

The moat was tested for dissolved oxygen. In parts of the moat the dissolved oxygen levels were too low, which is an indication of wastewater pollution(ref m 4)



Where does the contamination come from?

According to acting chief of the First Regional Environment Office in Chiang Mai Mr Rapeesak Malairungsakul:

“...waste water discharge into the moat.”
(ref m 4)

Why are some areas of the moat more polluted than other areas?

This needs to be investigated. The buildings near the high contamination areas should be visited and the fate of their wastewater should be determined. Are they connected to the sewage treatment plant?

Do they have septic tanks?

Do they discharge to the moat?

Dye testing may be needed.

Where are the parts of the moat that have the most contamination?

Ref m 4: “

The worst area is in front of Chiang Mai-Ram hospital. The other two locations are in front of Watanothai Payap School...and Computer City

Ref m 1: “But at two locations, in the west or in front of Chiang Mai-Ram hospital and in the north in front of Computer City Centre, the quality of water was poor”

Ref m 2: “spot #8 (near Chiang Mai Ram hospital) and spot #9 (near Icon Square Mall) were most polluted.

Why is there more contamination near Chiang Mai Ram Hospital?



I have the following questions for Chiang Mai Ram Hospital:

1. What happens to the wastewater from the hospital?

2. Are they aware that “wastewater from health-care establishments may contain:

Microbiological pathogens

Bacteria

Viruses

Helminths

Hazardous chemicals

Pharmaceuticals

Radioactive isotopes” ?(ref m 32)

3. Does the hospital follow the safety guidelines of the World Health Organization?(ref m 32)

Safety Guidelines for hospitals from the World Health Organization (ref m 32)

Wastewater discharge to municipal sewer

Hospitals may use a sewer providing: • The sewer is connected to a plant removing 95% of bacteria • Sludge is anaerobically digested to a standard of <one helminth egg per litre • High standards of HCW(health care waste) management and low discharge of hazardous chemicals • Waste from patients treated with cytotoxic drugs is collected separately

On-site treatment of wastewater

• Primary treatment • Secondary biological purification • 90% to 95% of bacteria removed • Most helminths removed • Tertiary treatment • Lagooning or sand filter • <10 mg/l suspended organic matter • Chlorine disinfection • Especially important if effluent discharged in a coastal area

On-site sludge treatment

Options • Anaerobic digestion • Natural drying in beds, and incineration

Guidelines for safe land spreading without disinfection • <one helminth egg per kilogram • <1000 faecal coliform per 100 grammes

On-site minimal safety requirements

Lagooning • Two lagoons (minimum) followed by soil filtration If no sewage treatment: • Isolate enteric patients and disinfect excreta • No discharge of chemicals and pharmaceuticals to the sewer • Deshydrate sludges from hospital cesspools and disinfect chemically • NEVER use hospital sewage for agriculture • ”

What has been done so far to attempt to clean the moat water?

2014, "Two trucks sprayed chlorine to improve the condition of the water. Chlorine has been added to the moat as scheduled on 1st, 5th, and 9th of April, with **fountains to be operated 16-hours a day to increase the oxygen in the water.**"ref m 28)

2014, "They already drained the moat and added chlorine and Hydraulic lime into the water. The fountains around the moat are adding oxygen to the water." ref m 2

2013-"He said authorities successfully used microorganism balls to improve oxygen levels and water quality in the city's moat last year."ref m 4

(what was in the microorganism balls? If they were effective, why not use again?)

2017- " The plan is to reduce the water levels by 30 centimetres per day for a period of one week when the water levels will be low enough to 200,000 cubic metres of fresh water to enter the moat at the front of Chiangmai Ram Hospital to flush it out"(ref m6)

Does the efficiency of the sewage treatment plant affect the water quality of the moat?

“The Chiang Mai Municipality’s Wastewater Treatment Plant (WWTP) ...is inefficient due to several reasons; there are less than 50% of the households connected to the main sewer collection system, and if they are connected, usually those households will have septic tanks. The WWTP has not been running to its full designed capacity, treating only 6,000 m³/day instead of 55,000 m³/day and it is treating diluted wastewater”(Ref m 14)

If the wastewater from the buildings near the moat does not go to the WWTP, then the wastewater will go into the groundwater and then into the moat. There is also the possibility that some wastewater from some buildings might go directly to the moat

What can be done to improve the efficiency of the STP?

All buildings in the sewer district should be connected to the sewer system without using septic tanks

Why are the fountains important?

The fountains add oxygen to the water and this helps to clean the water



Do the fountains need maintenance?

How many fountains are there?

Should more fountains be added?

(testing could be done to determine the effects of fountains((i.e.shut off the fountains for x hours, test the waters for coliform, turn on the fountains for x hours , test for coliform))) **How often are the fountains operating?**(nov 30 2017 9 am fountains were not running)**should the fountains run all the time?most of the time? Some of the time?**

April 2014:“... with **fountains to be operated 16-hours a day to increase the oxygen in the water.**” ref 28 **does that mean the usual operation is less than 16 hours/day?**

Fountains , page 3

Referring to ref m 27, in 2016, “pump experts from KSB Co., Ltd and the Nexus team conducted a site survey and undertook a pump efficiency analysis for samples. It was found that these sample pumps tended to overheat and breakdown.” These experts recommended the following:

“1.Repair all 66 pumps to optimal operating condition (prevent blockages, improve ventilation, reduce humidity, re-alignment, and replace necessary parts).

2.Replace the existing pumps with submersible pumps (which could reduce overheating and vibration problems, as the pumps are underwater).

3.Replace existing pumps with the combined pump and fountain type, in which the fountain and the pump are integrated into one and float on water.” (ref m 27)

**Has any of this work been approved yet? Has work started?
If there are 66 pumps does that mean there are 66 fountains?**

Fountains page 4, inspecting the fountain pumps,
ref m 27



Agencies with jurisdiction over the moat and
the wwtp:

does the city own the moat?

Which agency has jurisdiction of the moat?

Chiang Mai Municipality

- Chiang Mai Provincial Office
- Office of Natural Resources Policy and Planning
(ONEP)
- Wastewater Management Authority (WMA)

Questions for the government agencies:

- 1 . where does the moat water come from?
- 2. when the moat is drained, where does the water go?
- 3. how much can the moat be drained ?
- 4. how often can the moat be drained and refilled?
- 5. what is the volume of water in the moat?

Questions for the agencies, page 2....

- 6. where does the stp discharge?
- 7 is there a sewer use ordinance?
- 8 if yes, is it enforced?
- 9 if there is no sewer use ordinance, can one be written?

Recommendations:

- 1. mandatory sewer connections for all buildings in the sewer district
- 2. sewer use ordinance regulation
- 3. no more septic tanks in sewer district
- 4. more fountains, improve fountains. More hours
- 5. separate the sewer collection system from the stormwater collection system(ref m20)

Recommendations page 2

- 6. Warning signs around the moat telling people to avoid contact
- 7. DO NOT ALLOW WATER TO BE USED FOR SONGKRAN
- 8. incinolet pilot program
- 9 solar power pilot program

Recommendations part 3

10. lower the moat water levels as much as possible, look for discharge pipes, close up pipes, find sources
11. increase flushing as much as possible

how to do this? Talk to govt agencies such as irrigation depts and other involved depts _____

City of Glen Cove Sewer use ordinance(ref m 30)

- 225-12 Connection to public sewer required.1.The owner(s) of all houses, buildings or properties used for human occupancy, employment or recreation, situated within the city and abutting on any street, alley or right-of-way in which there is located a public sewer, is hereby required, at the owner's expense, to connect such facilities directly with the public sewer in accordance with the provisions of this Part

-

Does the government have enough money to run the sewage treatment plant effectively?

From ref m 38:

” the government should consider collecting wastewater treatment fees from households”

Does the government have the regulatory authority to collect wastewater treatment fees?

“The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (NEQA 1992)

Municipal Wastewater Tariffs in Thailand:

“Major principals related to municipal wastewater tariffs point of view in this Act are as following : ☛
Polluter Pays Principal : The owner or possessor of the pollution source must be responsible for all costs of construction/installation and operation of his/her / p / treatment facilities, or paying the service fee for sending the wastes to central treatment/disposal plant of the government” (ref m 35)

also from ref m 35:

“Municipal Wastewater Tariffs in Thailand (cont.)

→ Objective: to sue the collected tariffs to fund the LGAs' expenditures → Goal: having cost recovery and effective tariff rates → Principle of tariffs } Covers polluters in the WWTP service areas } Charged base on only O&M costs depending on:

- Pond system 2.4 Bt/m³

- Aeration systems 3-5 Bt/m³

Activated Sludge 3-8 Bt/m³”

Estimated costs of wastewater treatment fees:

In ref 36 we learned that water use per person per day in the Philippines is 160 liters per day (no figures for Thailand, so use Philippines number for estimating costs). A house with a family of 4 would use 640 liters per day.

640 liters per day = .64 cubic meters per day

= 1.9 bahts to 3.2 bahts per day, max 100 bahts per month per house, and maybe less than 100 bahts per month per hotel room

(if water use is 160 liters per person per day, that probably includes the water for cooking and washing dishes. If a person in a hotel eats at restaurants, his hotel room water use may be less than 160 lpd, but some of his water use is transferred to the restaurants where he eats)

Waterless toilets incinerate the wastes and do not discharge any contaminated water

- But they need electricity to work



- Reference m 29

When Solar panels go down in price more, maybe people can afford
electric toilets



Thanks for listening

If you have any questions, please send me an
email:

jconoverjr11790@yahoo.com

If you would like to learn more about different
kinds of pollution and environmental
problems, please visit my website:

Jconoverjr.com

References

- M1. Chiang Mai's city moat safe for water splashing - Thai PBS English News,
<http://englishnews.thaipbs.or.th/chiang-mais-city-moat-safe-for-water-splashing/>
- M2, <http://www.chiangmaicitylife.com/news/chiang-mai-moat-water-too-dirty-for-songkran-says-environmental-office/>
- M3: <http://www.bangkokpost.com/learning/learning-news/520727/>
- M4: <http://englishnews.thaipbs.or.th/environmentalist-says-tha-phae-water-unsafe-playing-songkran/>
- M 6 ` <http://www.chiangmaicitylife.com/news/authorities-flush-moat-following-social-condemnation/>
- m 11, nycrr part 703.4
- M13 http://www.1stopchiangmai.com/about_cm/history/, History of Chiang Mai Lanna Kingdom
- M14: <http://www.unescap.org/sites/default/files/Chiang%20Mai%20Case%20Study.pdf>
- m 24 NYCRR part 701.7
- m 25 A SURVEY OF HELMINTH INFECTION IN RATS (RATTUS SPP) FROM CHIANG MAI MOAT, C Namue and C Wongsawad Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, 50200 Thailand
- m27
- M 28 <http://indothaitrade.com/chiang-mai-examines-water-quality-in-citys-moat/> Chiang Mai examines water quality in city's moat
- m 29 incinolet brochure
- m30: <https://ecode360.com/12086030#12086025>
- m32. [Www.who.int/water_sanitation_health/medicalwasteguide.pdf](http://www.who.int/water_sanitation_health/medicalwasteguide.pdf)
- m36: Average Water Use Per Person Per Day, http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757
- m 38 : <http://www.nationmultimedia.com/national/Just-one-fifth-of-wastewater-is-being-treated-30186545.html>

•