

Appendix-2

Outline of Seven Existing WWTPs

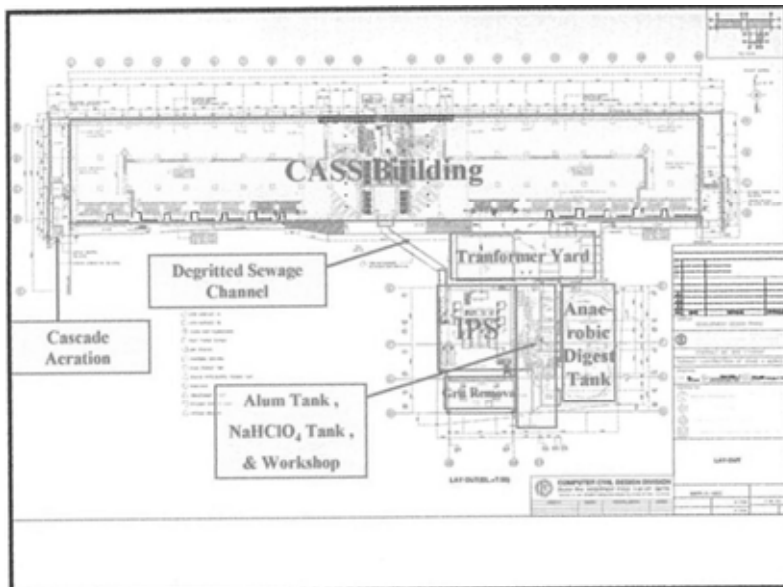
- 1) **Chatuchak WWTP**
- 2) **Chong Nonsi WWTP**
- 3) **Din Daeng WWTP**
- 4) **Nong Khaem WWTP**
- 5) **Rattanakosin WWTP**
- 6) **Si Praya WWTP**
- 7) **Thung Khru WWTP**

1) Chatuchak WWTP

Outline of the Project

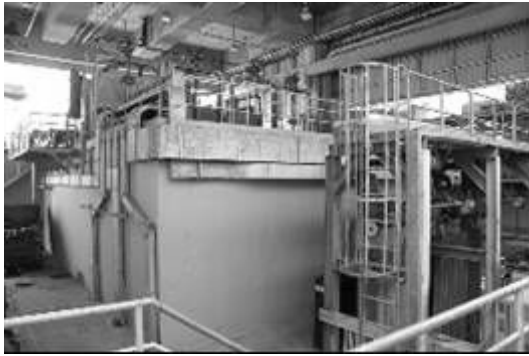
1. Start of operation	2006 O&M Contract (May, 2006 to November, 2010, 54 months)
2. Treatment area:	33.4 km ²
3. Served population:	432,500 persons
4. Treatment process:	Cyclic Activated Sludge System (CASS)
5. Site area:	1.12 ha
6. Construction cost:	3,482,000,000 THB
7. Length of sewer pipes:	37.5 km(φ140 mm ~ 2,500 mm) Manhole 199, Interceptor 181, Pumping station 13
8. Design capacity:	150,000 m ³ /day
9. Current inflow:	124,000-129,000 m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

Treatment Area and Plan of WWTP



Mode of operation of SBR

Time; hr	0 - 1	1 - 2	2 - 3	3 - 4
Reactor 1	Fill – Aerate	Fill – Aerate	Fill – Settling	<u>Decant</u>
Reactor 2	Fill – Settling	<u>Decant</u>	Fill – Aerate	Fill – Aerate
Reactor 3	<u>Decant</u>	Fill – Aerate	Fill – Aerate	Fill – Settling
Reactor 4	Fill – Aerate	Fill – Settling	Decant	Fill – Aerate



Screen and grit chamber



High pressure cleaning vehicle



Approach and connecting bridge



Treated effluent to Bang Sue Klong



CRT in control room



Laboratory



Experiment of activated sludge



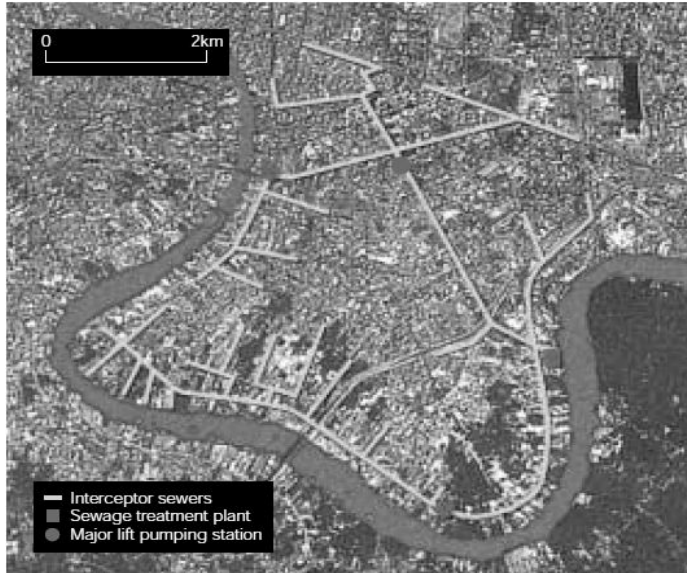
Washing equipment for chemical exposure

2) Chong Nonsi WWTP

Outline of the Project

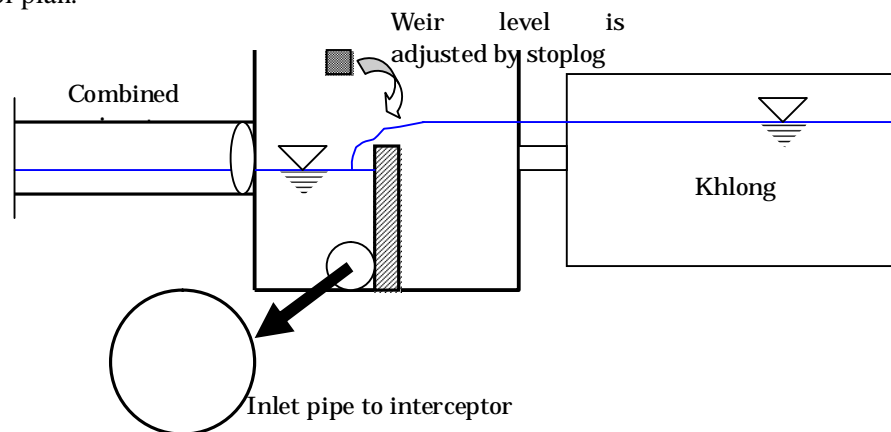
1. Start of operation	2000
2. Treatment area:	28.5 km ²
3. Served population:	580,000 persons
4. Treatment process:	Cyclic Activated Sludge System
5. Site area:	3.2 ha
6. Construction cost:	4,552,000,000 THB
7. Length of sewer pipes:	55 km
8. Design capacity:	200,000 m ³ /day
9. Current inflow:	108,638-125,000 m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

Trunk sewers and pumping stations



Infiltration to interceptor chamber

When water level in klong rises, klong water flow into interceptor chamber (infiltration). Level of inlet pipe and water level of klong affect intercepting of wastewater and flood control plan.



Submerged outlet pipe, pumping station



Untreated wastewater discharge

Treatment facilities



Chongnonsi WWTP



Wastewater pump house



Dynamic separator (swirl grit chamber)



Reactor (supernatant collecting device)



Laboratory



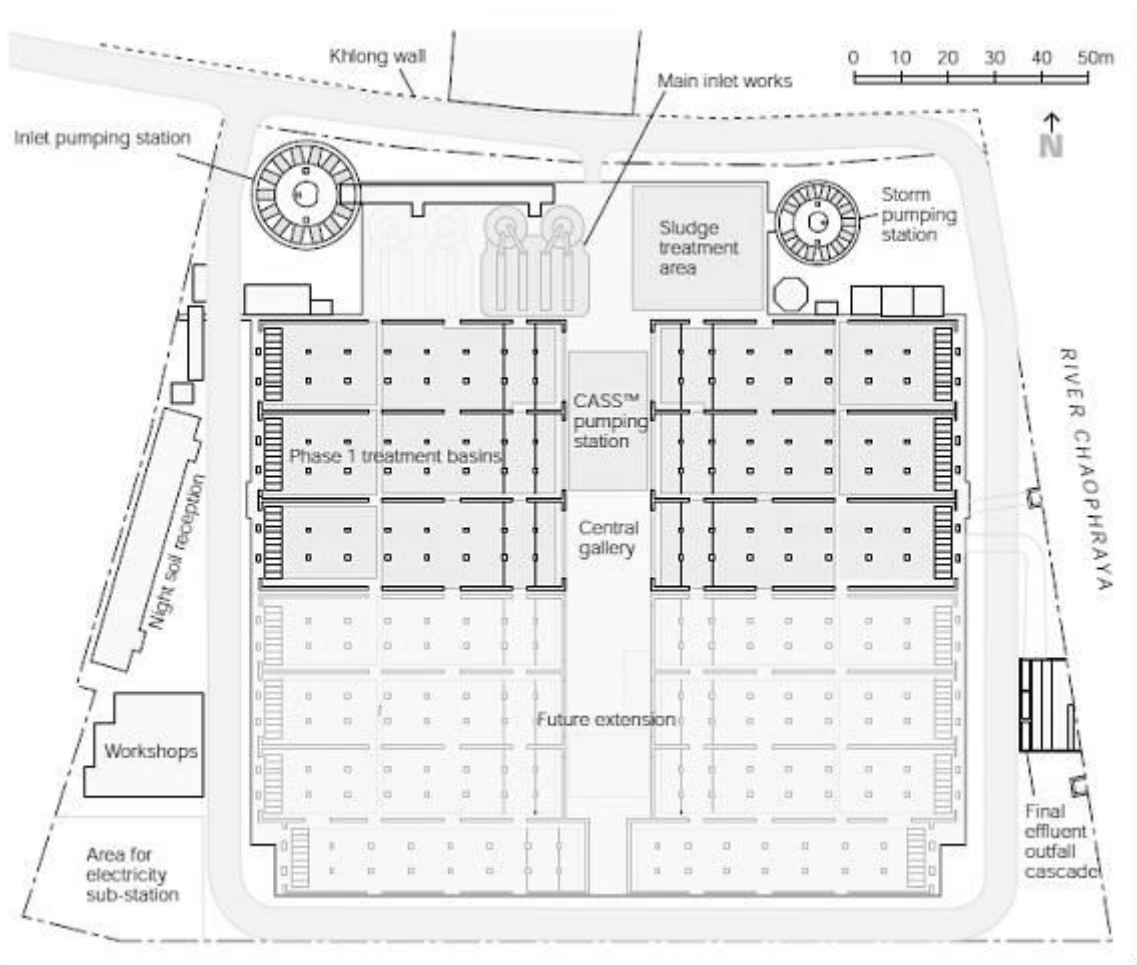
Manhole (infiltration of klong water)



BRT vehicle depot (expansion of WWTP)

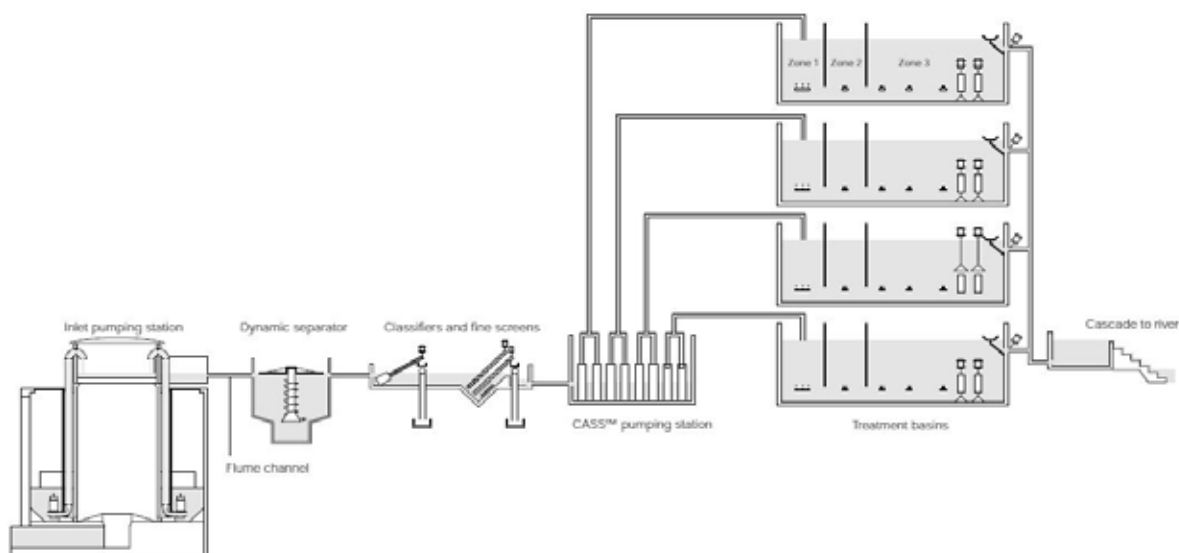


Storm water pumping station



Plan and Section of WWTP

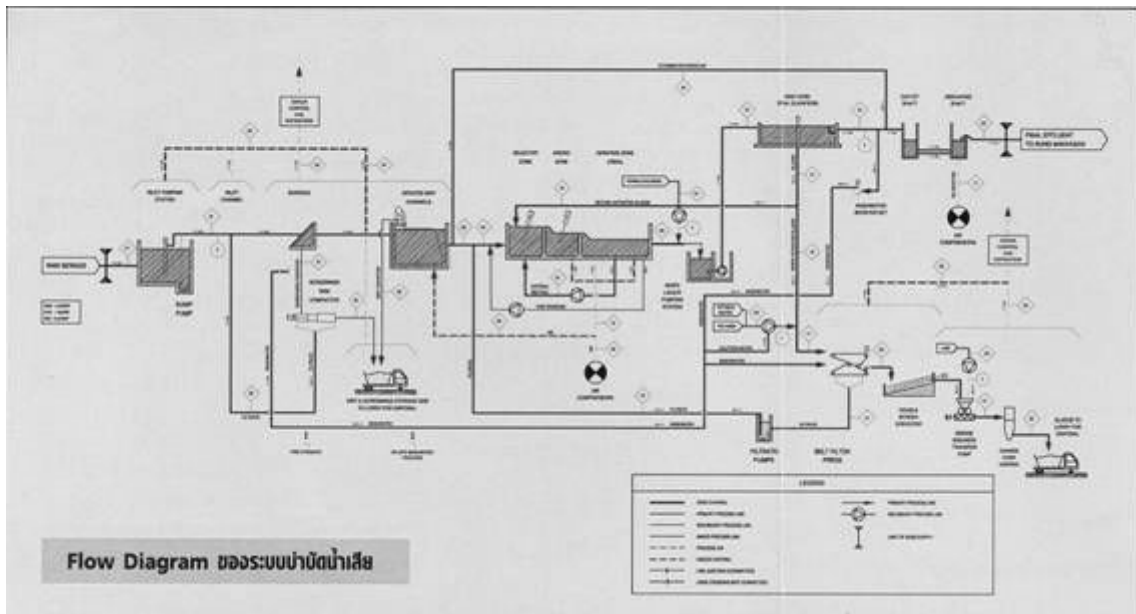
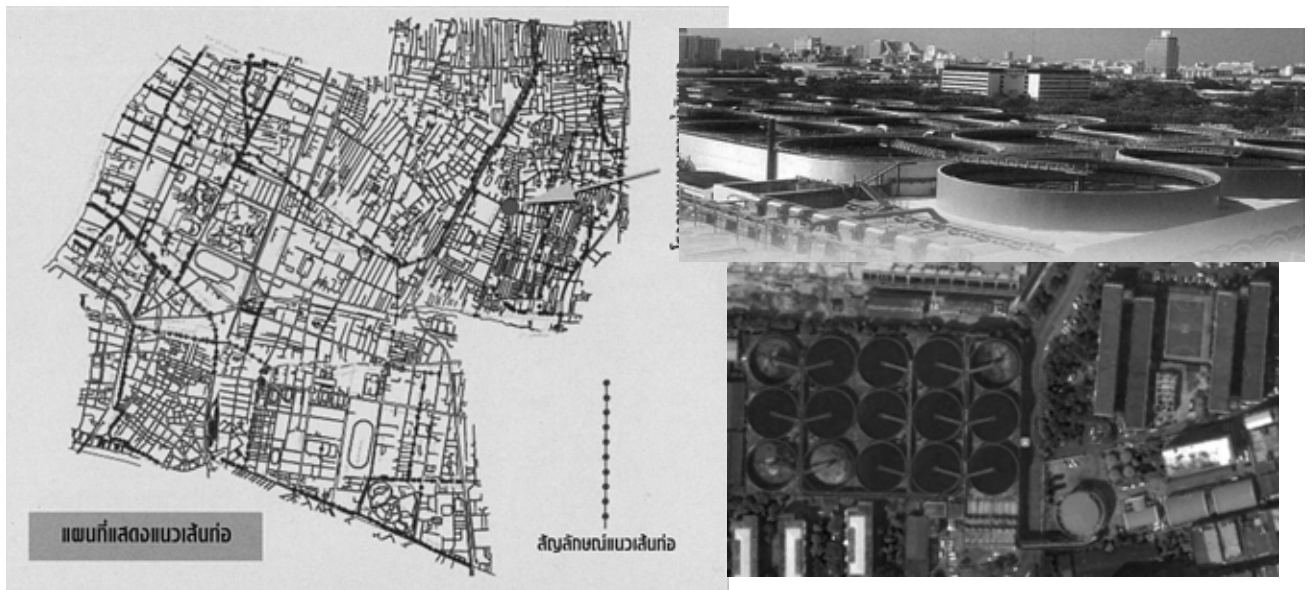
3) Din Daeng WWTP











Outline of the Project

1. Start of operation	2004
2. Treatment area:	37 km ²
3. Served population:	1,080,000 persons
4. Treatment process:	Activated Sludge with Nutrient, (Nitrogen and Phosphorus) Removal
5. Site area:	2.72 ha
6. Construction cost:	6,382,000,000 THB
7. Length of sewer pipes:	66 km
8. Design capacity:	350,000 m ³ /day
9. Current inflow:	204,000-206,000 m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

Treatment Area and Treatment Facilities



	
<p style="text-align: center;">Pump pit (garbage)</p> 	<p style="text-align: center;">Screen</p> 
<p style="text-align: center;">Pump to reactor</p> 	<p style="text-align: center;">Treated effluent</p> 
<p style="text-align: center;">Tank lorry for reuse of treated wastewater</p> 	<p style="text-align: center;">High pressure cleaning truck</p> 
<p style="text-align: center;">Relay pumping station</p>	<p style="text-align: center;">Countermeasures against flooding, residence</p>

4) Nong Khaem WWTP

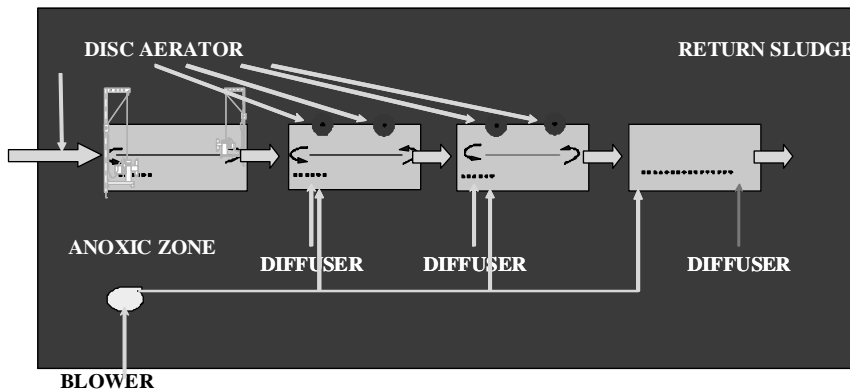
Outline of the Project

1. Start of operation	2002
2. Treatment area:	44 km ²
3. Served population:	520,000 persons
4. Treatment process:	Vertical Loop Reactor Activated Sludge
5. Site area:	8.64 ha
6. Construction cost:	2,348,000,000 THB
7. Length of sewer pipes:	46 km Manhole 411, pumping station 8
8. Design capacity:	157,000 m ³ /day Excess flow over the maximum capacity 235,500 m ³ /day (1.5DWF) is bypassed Sludge treatment 500 m ³ /day (from other WWTPs)
9. Current inflow:	122,965 -132,605 m ³ /d
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	< 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l



Panoramic view of WWTP

Process in reactor: Vertical Loop Reactor Process (4 ponds x 2 trains)
 HRT 4 ~ 8hr、 For phosphorus removal FeCl_3 is added



Inflow:

80,000 ~ 100,000 m³/day in dry weather, 150,000 ~ 200,000 m³/day in wet weather

Parameter	Design		Actual	
	Influent	Effluent	Influent	Effluent
BOD (mg/l)	150	20	40-80	5-10
T-N (mg/l)	20	10	10-15	7-8
NH ₃ -N (mg/l)	15	5	6-8	0-1
T-P (mg/l)	10	2	1-2	0.5-1
DO (mg/l)	-	5	-	5.5-6.5
TSS (mg/l)	200	30	60-100	5-10

Sludge treatment

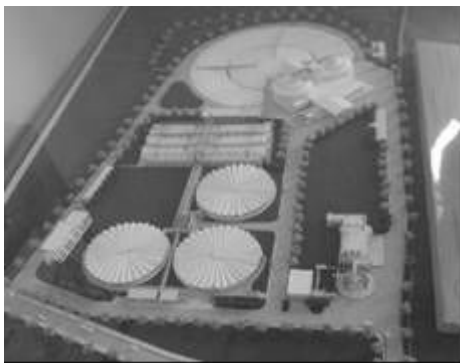
- Sludge cake: 500 m³/day
- Sludge from other WWTPs (moisture content 80 %) is mixed with that produced from this WWTP and is put into digester
- Thickening by belt thickener (solid content 5 %)
- Sludge composting: 30 days, production 25ton/day
- Compost: all compost is used as soil conditioner for road construction
- Digestion gas: digestion gas is used for fuel for boiler (suspended) and for electricity generation

O&M Contract: Comprehensive management contract including electricity, personnel and repair costs for operation and maintenance of treatment plant, pumping stations and sewer pipes.

Total cost = K_{fix} (personnel) + K_Q (treated wastewater) + K_B (bypassed wastewater) + K (sludge)

Actual unit cost = 1.18 THB/m³

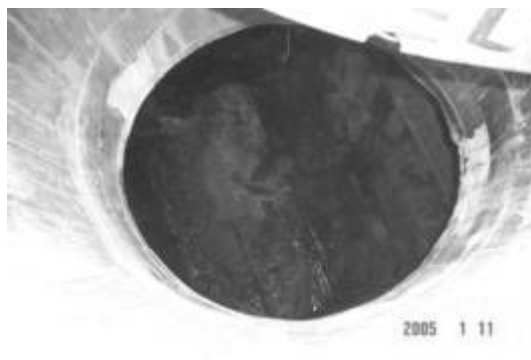
Contract period: One year contract (2 times), 5 year contract (2 times), currently second year of the second 5 year contract.



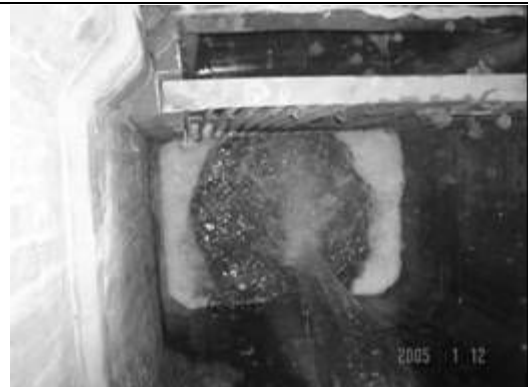
Nongkhaem WWTP (model)



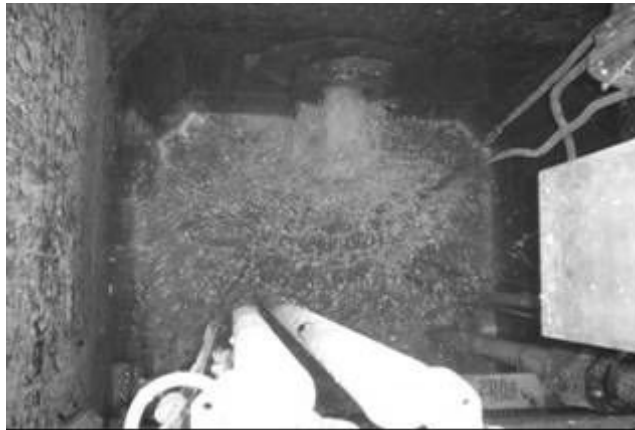
Sewer installation (model)



Inside of manhole



Inside of interceptor chamber



Relay pumping station (pump pit)



Pumping station (pump pit)



Reactor (aeration)



Disc aerator



Screw mixer



Diffuser



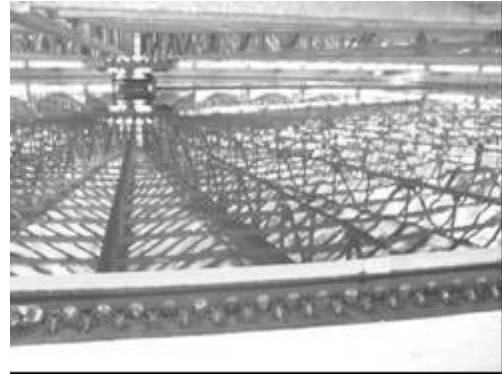
Blower



Blower house



Final sedimentation tank (covered for prevention of algae proliferation)



Final sedimentation tank (inside of cover)



Sludge stock yard



Dumping of sludge cake



Belt thickener



Digestion tank



Circulation pump



**Gas electric generator
(truck engine)**



Gas holder



Belt press dehydrater



Carrying out of sludge compost



Composting of sludge

5) Rattanakosin WWTP

Outline of the project

1. Start of operation	2000
2. Treatment area:	4.142 km ²
3. Served population:	70,000 persons
4. Treatment process:	Two stage activated sludge
5. Site area:	0.6683 ha
6. Construction cost:	883,180,000 THB
7. Length of sewer pipes:	16.25 km. (40 m/ha)
8. Design capacity:	40,000 m ³ /day
9. Current inflow:	28,000-30,000m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	200 mg/l
10.2 COD	500 mg/l
10.3 Total Nitrogen	40 mg/l
10.4 Total Phosphorus	10 mg/l
10.5 Suspended Solids	200 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

Pump up inflow up to 5DWF to screen and receiving tank on the roof.

Biologically treated up to 2.5DWF. Flow in excess of 2.5DWF is discharged after aeration grit chamber.

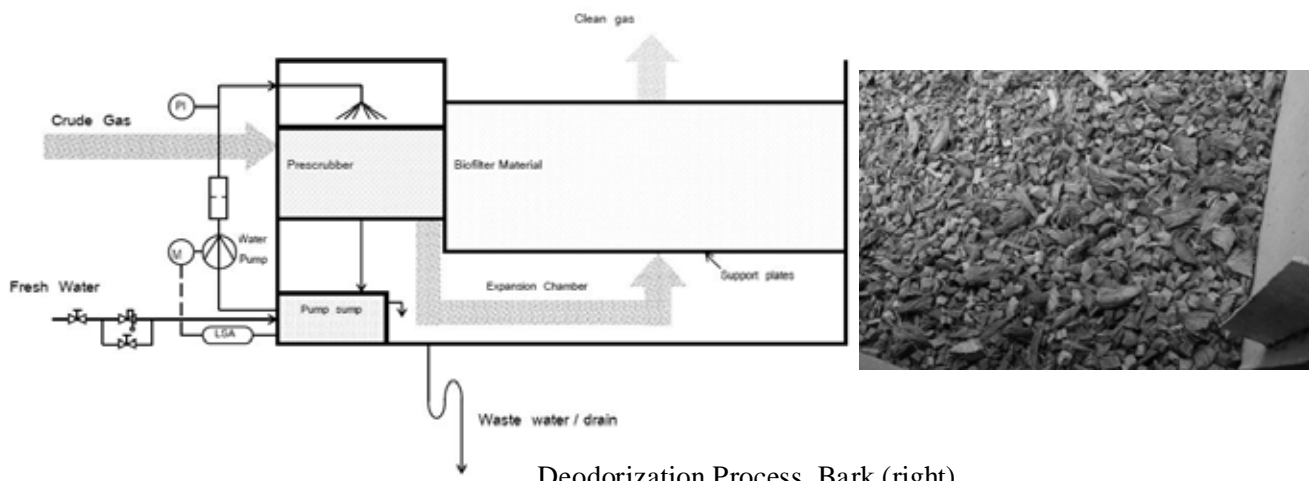
HRT: Approx. 1hr in the first reactor, and approx. 5.6 hrs in the second reactor

Sedimentation tank: 25 m³/m² for primary and 17. m³/m² for final

Deodorization facility: Biofilter (bark filling), replacement of bark every 5 years

Deodorization is done well, (however odor is weak and function yet to be evaluated)

Deodorization System (Biofilter)



Deodorization Process, Bark (right)



Rattanakosin WWTP



Pumps



Final sedimentation tank



Outlet pipes (bypass discharge)



Discharge from interceptor chamber in dry weather



Overflow from interceptor chamber



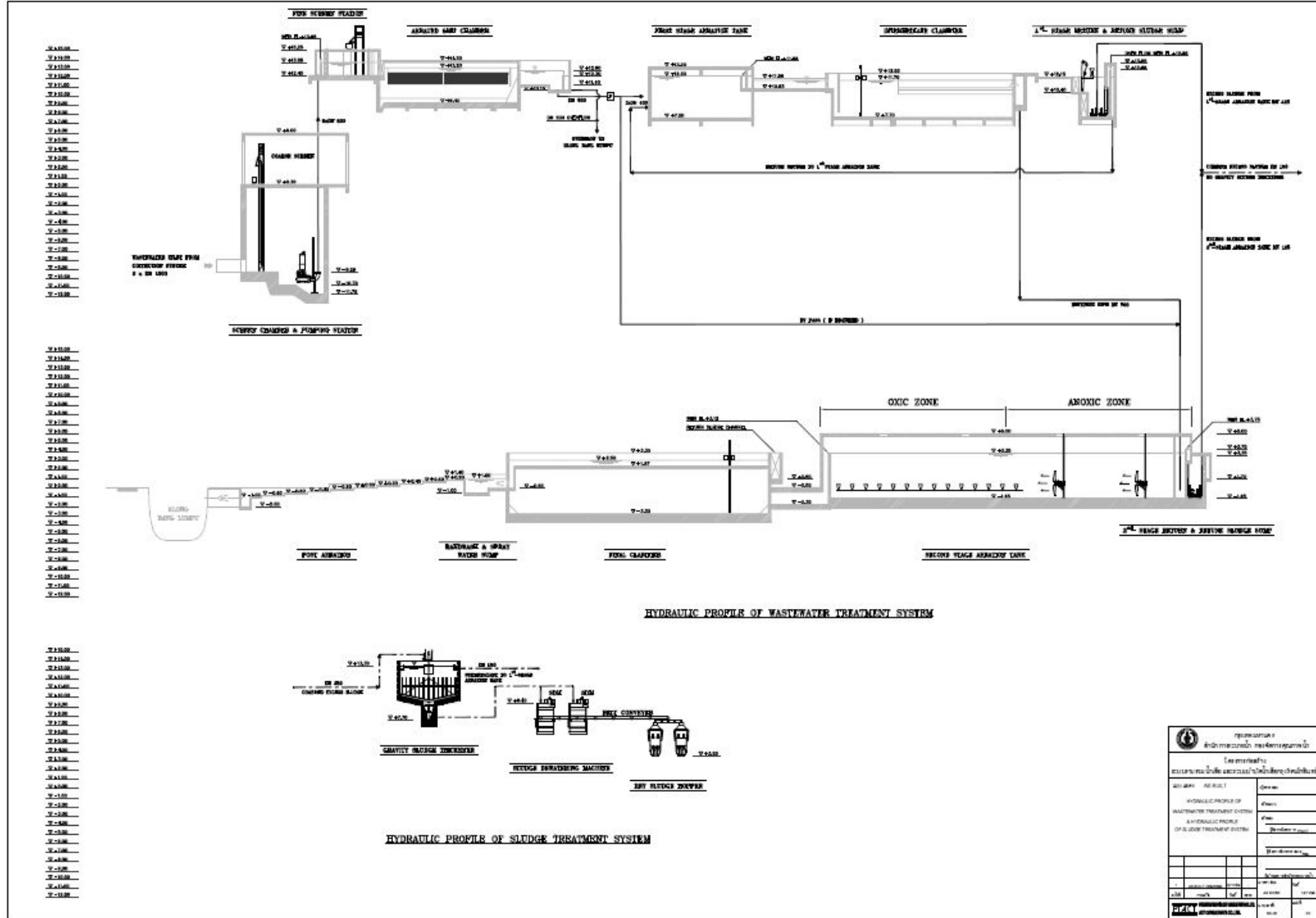
Nontreated wastewater discharge from neighboring treatment area



Ventilation for drainage pipe

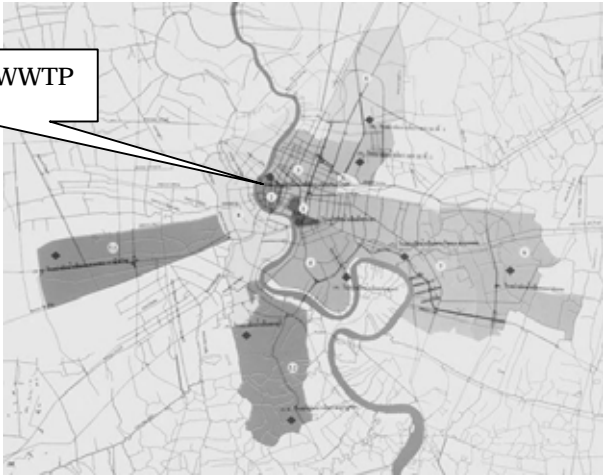
Treatment Flow (Rattanakosin WWTP)

Appendix 2-21

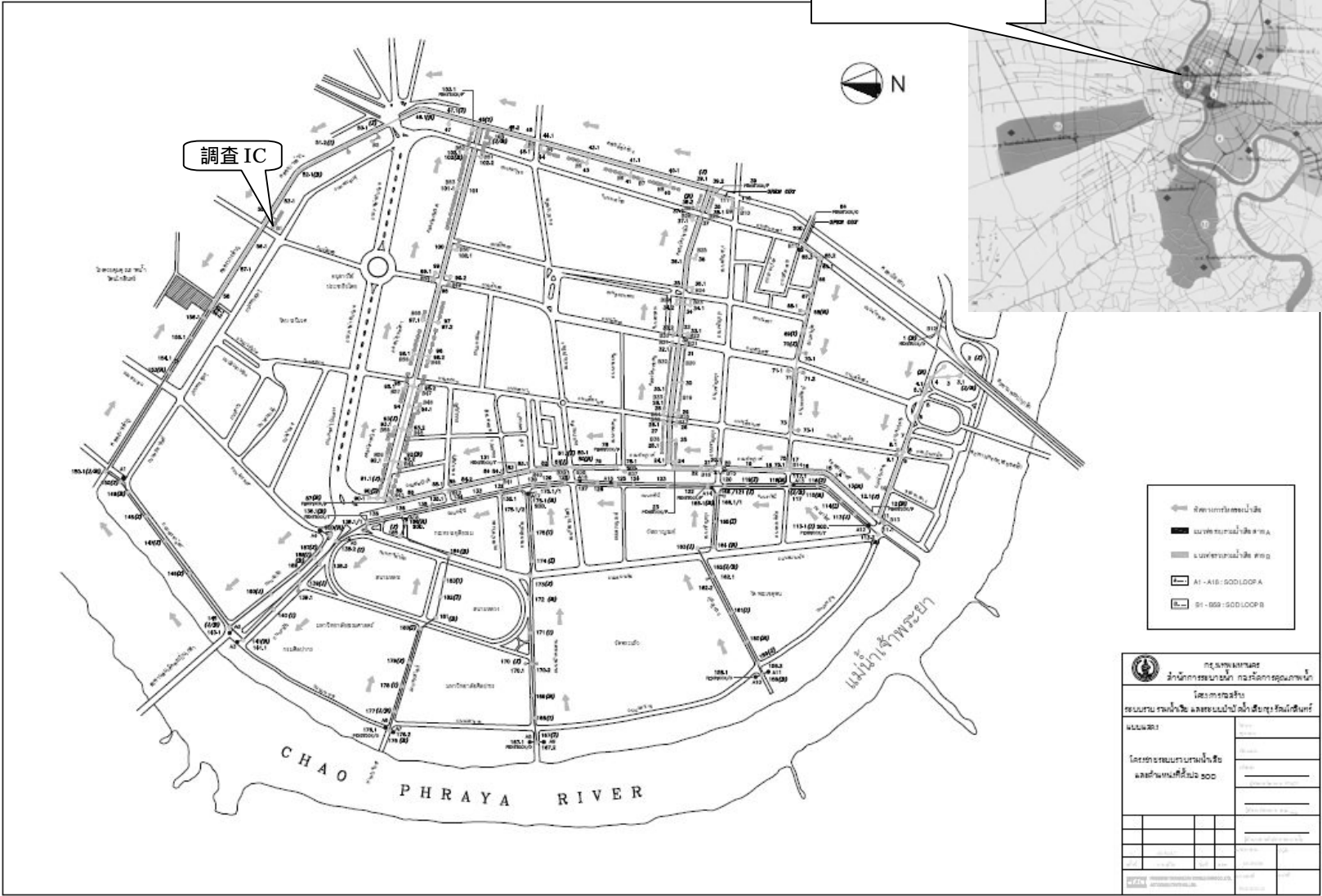


Interceptor Sewerage System (Rattanakosin WWTP)

Rattanakosin WWTP



調査IC



- ← ศึกษาระบบเบื้องต้น
- เขตพัฒนาเมืองเก่า
- ▨ เขตพัฒนาเมืองใหม่
- A1-A18: SOD LOOP A
- B1-B59: SOD LOOP B

<p>กรมทรัพยากรธรรมชาติและสิ่งแวดล้อม สำนักงานทรัพยากรน้ำ กรมโยธาธิการและผังเมือง</p>	
<p>โครงการศึกษา ระบบระบายน้ำเมืองเก่าและเมืองใหม่ สืบเนื่องโครงการพัฒนาระบบ ฝนหลวง 2511</p>	
<p>โครงการพัฒนาระบบน้ำเสีย และบำบัดน้ำเสียเมือง 500</p>	
<p>.....</p>	
<p>.....</p>	
<p>.....</p>	
<p>.....</p>	
<p>.....</p>	
<p>.....</p>	
<p>.....</p>	

6) Si Praya WWTP

Outline of the Project

1. Start of operation	1994
2. Treatment area:	2.7 km ²
3. Served population:	120,000 persons
4. Treatment process:	Contact Stabilization Activated Sludge
5. Site area:	0.28 ha
6. Construction cost:	464,000,000 THB
7. Length of sewer pipes:	2.3 km
8. Design capacity:	30,000 m ³ /day
9. Current inflow:	13,306 – 20,961 m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

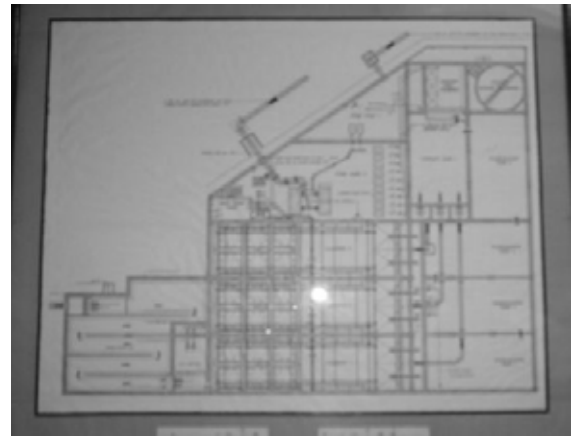
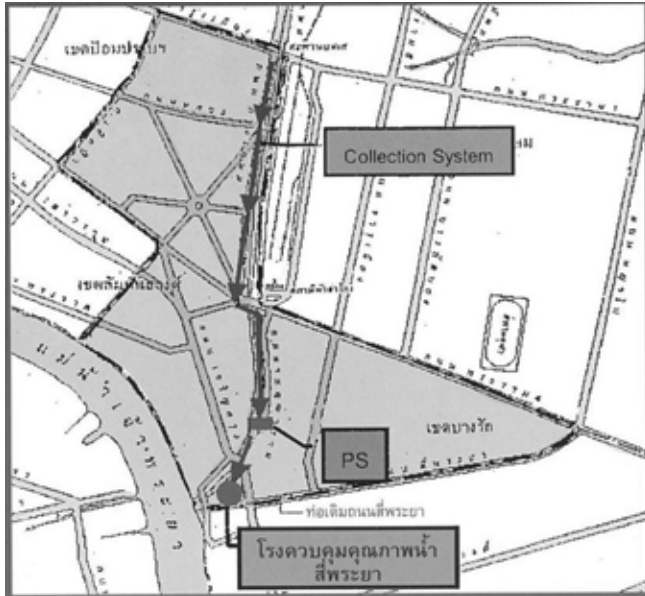
Contact Stabilization Activated Sludge:

Stabilization tank: HRT 4hr, (MLSS design 9,000 mg/l actual operation 6,000 mg/l)

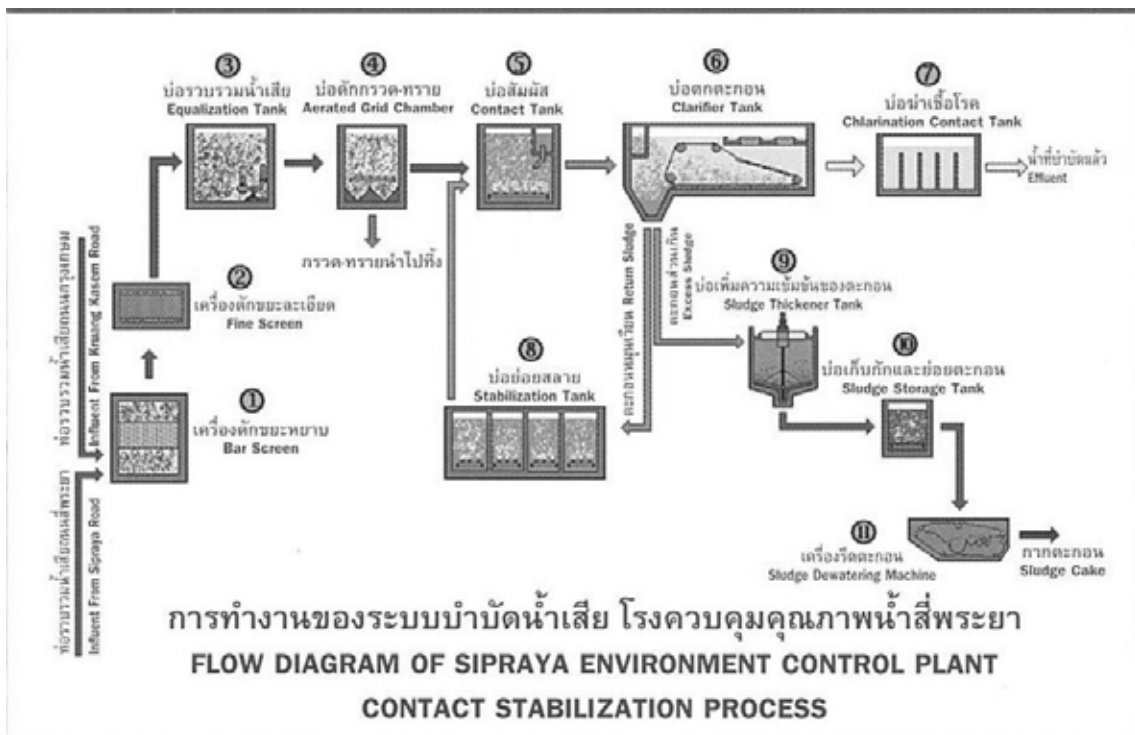
Contact tank: HRT 0.5hr, (MLSS 4,000 mg/l)

Operation and maintenance: Direct operation by DDS, BMA

It is desirable for BMA to directly operate and maintain a WWTP in order to keep their staff capability for operation and for cross checking of out sourcing cases.



Plan of Sipraya WWTP





Sipraya WWTP (next to hotel and wharf)



Pump maintenance by BMA staff



Reactor (deodorization)



Sedimentation tank



Relay Pumping station and force main



Relay pumping station (pump pit, control panel)

7) Thung Khru WWTP

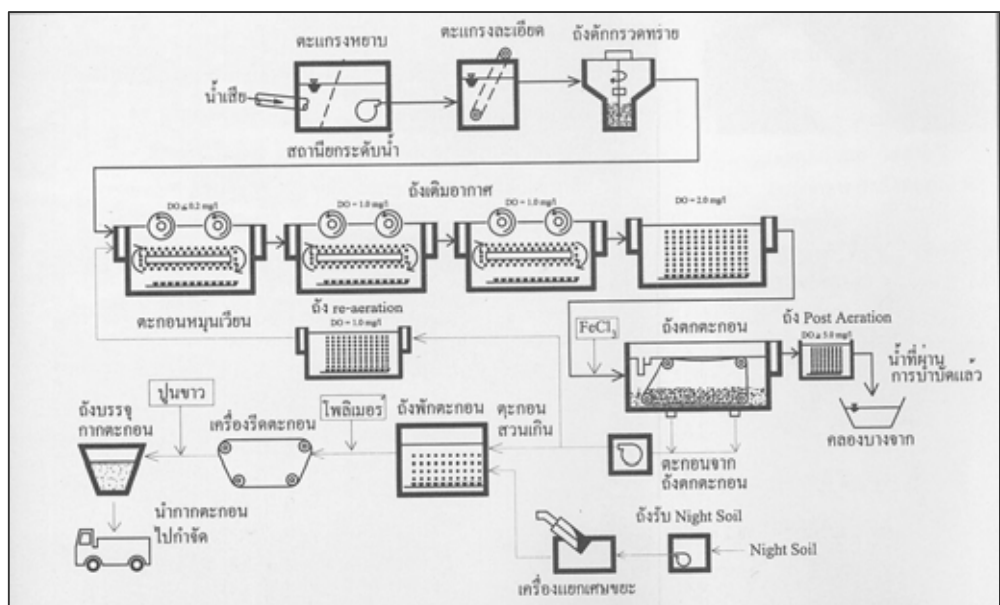
Outline of the Project

1. Start of operation	2002
2. Treatment area:	42 km ²
3. Served population:	177,000 persons
4. Treatment process:	Vertical Loop Reactor Activated Sludge (VLR-AS)
5. Site area:	0.48 ha
6. Construction cost:	1,760,000,000 THB
7. Length of sewer pipes:	26 km. Manhole 214, interceptor chamber 204, pumping station 4
8. Design capacity:	65,000 m ³ /day
9. Current inflow:	48,124-62,791 m ³ /day
10. Design Criteria for Influent Wastewater	
10.1 BOD	150 mg/l
10.2 COD	-
10.3 Total Nitrogen	30 mg/l
10.4 Total Phosphorus	8 mg/l
10.5 Suspended Solids	150 mg/l
11. Criteria for Effluent Water Standard	
11.1 Suspended Solids	≤ 30 mg/l
11.2 BOD	≤ 20 mg/l
11.3 Total Nitrogen	≤ 10 mg/l
11.4 Ammonium Nitrogen	≤ 5 mg/l
11.5 Total Phosphorus	≤ 2 mg/l
11.6 DO	≥ 5 mg/l

Located in urbanized area in neighborhood of residences, a school and a hospital
 Countermeasure for odor is covering and deodorization equipment
FeCl3 dosing equipment is provided to remove phosphorus
 Receiving of septic tank sludge is suspended



Thungkru Treatment Area





Treatment Process Flow Pump pit



Wastewater treatment



Treated effluent



Belt press dehydrator



Deodorization equipment



Pump for reuse of treated effluent



Land subsidence



Septic tank sludge receiving pit