

Appendix 3.4 Calculation of Odour emission Rate in SCISTW

Option 1 Centralized Design

Facilities:	Source ID	Total Surface Area in duty (m ²)	Emission rates (ou/m ² /s)	Emission rates (ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of stacks	Emission rate for each stack (ou/s)
Stage 1 Main Pumping Station ⁽⁵⁾	S-O1-DO1	678.00	8.79	5959.69	317032.03	9510.96	4	2.378E+03
Stage 1 Riser shaft ⁽⁵⁾		63.62	8.79	559.20				
Stage 2A Main Pumping Station ⁽⁵⁾		678.00	8.79	5959.69				
Stage 2A Riser shaft ⁽⁵⁾		63.62	8.79	559.20				
Stage 1 CEPT Facilities:								
Influent Upflow Structure ⁽⁵⁾		420.00	8.79	3691.84				
Rapid Mixing tanks ⁽⁵⁾		200.00	8.79	1758.02				
Flocculation tanks		3584.00	7.44	26667.83				
Distribution channels		1800.00	8.79	15822.18				
Sedimentation tanks		15232.00	9.08	138280.67				
Scum pit ⁽⁶⁾		90.00	9.08	817.05				
Effluent drop structure ⁽¹⁾		-	-	35745.09				
Stage 2 CEPT Facilities:								
Influent Upflow Structure ⁽⁵⁾		54.00	8.79	474.67				
Rapid Mixing tanks ⁽⁵⁾		216.00	8.79	1898.66				
Flocculation tanks		2048.00	7.44	15238.76				
Distribution channels		522.00	8.79	4588.43				
Sedi tanks		2688.00	9.08	24402.47				
Scum pit ⁽⁶⁾		24.00	9.08	217.88				
Effluent drop structure ⁽¹⁾		-	-	8410.61				
Sludge Storage Tanks	307.88	26.42	8134.92					
Sludge Dewatering Building 1 ⁽³⁾⁽⁷⁾	104.59	26.42	2763.57					
Sludge Dewatering Building 2 ⁽³⁾⁽⁷⁾	104.59	26.42	2763.57					
NWKPS	223.00	16.10	3590.28					
NWKPS O/F chambers	40.00	16.10	644.00					
Flow Distribution Chambers	151.10	8.89	1344.01					
New Flow Distribution Chambers	151.10	8.89	1344.01					
Existing Sludge Cake Silos ⁽⁴⁾	136.14	26.42	3597.18					
New Sludge Cake Silos ⁽⁴⁾	68.07	26.42	1798.59					
NWKPTW	S-O1-DO2	1240.00	16.10	19963.88	19963.88	598.92	8	7.486E+01
Chlorination Plant ⁽⁸⁾	S-C-DO1	4247.00	8.89	37776.64	37776.64	1133.30	4	2.833E+02
Proposed Chamber 15A & Drop shaft ⁽²⁾	S-C-DO2	295.70	8.89	2630.22	2630.22	263.02	2	1.315E+02

Note:

- (1) Please refer to calculation of weir emission rate.
- (2) 90% removal efficiency used
- (3) Included surface area of the sludge conveyor belt
- (4) Included surface areas of sludge cake silos and sludge tanks
- (5) Based on the site observation, the odour strength at the flow distribution chamber of the sedimentation tank is worse than that of the main pumping station, riser shaft, influent upflow structure and rapid mixing tank. Furthermore, the sewage movement characteristic is similar to the flow distribution channel. Therefore the measured odour emission rate of distribution channel was applied to main pumping station, riser shaft, influent upflow structure and rapid mixing tank.
- (6) It is due to the accessibility, measurement cannot be carried out at the scum pit. Since the sewage is flowing into the scum pit right after the sedimentation tank, the odour emission rate of sedimentation tank was applied for the scum pit.
- (7) The major odour source of the sludge dewatering building is the fresh dewatering sludge. Therefore, the measured odour emission rate of fresh dewatering sludge was adopted for the sludge dewatering building in the assessment.
- (8) It is expected the odour strength of the treated effluent at chlorination plant, chamber 15A and drop shaft will be lower than the effluent flowing in SCISTW. The sewage movement characteristic is similar to the flow distribution channel. For conservative analysis, the emission rate of flow distribution channel was adopted in the assessment for the chlorination plant, chamber 15A and drop shaft.

Appendix 3.4 Calculation of Odour emission Rate in SCISTW

Option 2 Decentralized Design

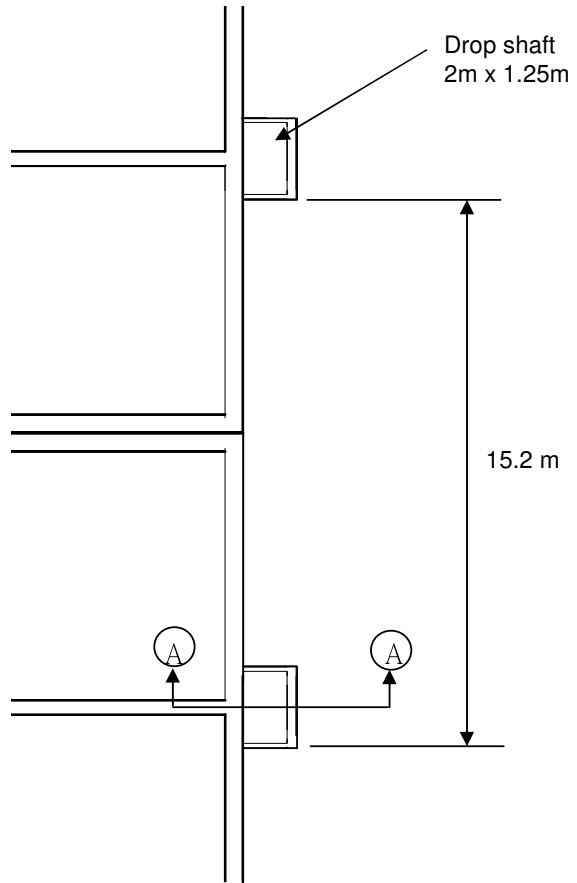
Facilities:	Source ID	Surface Area (m ²)	Emission rates (ou/m ² /s)	Emission rates (ou/s)	Total original emission (ou/s)	97% removal efficiency (ou/s)	No. of stacks	Emission rate for each stack (ou/s)
CEPT Facilities (Odd no. unit):								
Stage 1 Influent Upflow Structure ⁽⁵⁾	S-O2-DO1	420.00	8.79	3691.84	146162.21	4384.87	1	4.385E+03
Stage 1 Rapid Mixing tanks ⁽⁵⁾		200.00	8.79	1758.02				
Floculation tanks		2816.00	7.44	20953.29				
Stage 1 Distribution channels		1800.00	8.79	15822.18				
Sedi tanks		8960.00	9.08	81341.57				
Scum pit ⁽⁶⁾		57.00	9.08	517.46				
Effluent drop structure ⁽¹⁾		-	-	22077.85				
CEPT Facilities (Even no. unit):								
Stage 2 Influent Upflow Structure ⁽⁵⁾	S-O2-DO2	54.00	8.79	474.67	136086.21	4082.59	1	4.083E+03
Stage 2 Rapid Mixing tanks ⁽⁵⁾		216.00	8.79	1898.66				
Floculation tanks		2816.00	7.44	20953.29				
Stage 2 Distribution channels		522.00	8.79	4588.43				
Sedi tanks		8960.00	9.08	81341.57				
Scum pit ⁽⁶⁾		57.00	9.08	517.46				
Effluent drop structure ⁽¹⁾		-	-	22077.85				
NWKPS	223.00	16.10	3590.28	19057.82	571.73	3	1.906E+02	
NWKPS O/F chambers	40.00	16.10	644.00					
Sludge Storage Tanks	307.88	26.42	8134.92					
Sludge Dewatering Building 1 ⁽³⁾⁽⁷⁾	104.59	26.42	2763.57					
Sludge Dewatering Building 2 ⁽³⁾⁽⁷⁾	104.59	26.42	2763.57					
Existing Sludge Cake Silos ⁽⁴⁾⁽⁷⁾	136.14	26.42	3597.18					
New Sludge Cake Silos ⁽⁴⁾⁽⁷⁾	68.07	26.42	1798.59					
Stage 1 Main Pumping Station ⁽⁵⁾	S-O2-DO4	678.00	8.79	5959.69	6518.89	195.57	4	4.889E+01
Stage 1 Riser shaft ⁽⁵⁾		63.62	8.79	559.20				
Stage 2A Main Pumping Station ⁽⁵⁾	S-O2-DO5	678.00	8.79	5959.69	6518.89	195.57	4	4.889E+01
Stage 2A Riser shaft ⁽⁵⁾		63.62	8.79	559.20				
NWKPTW	S-O2-DO6	1240.00	16.10	19963.88	19963.88	598.92	8	7.486E+01
Flow Distribution Chambers	S-O2-DO7	151.10	8.89	1344.01	2688.01	80.64	2	4.032E+01
New Flow Distribution Chambers		151.10	8.89	1344.01				
Chlorination Plant ⁽⁸⁾	S-C-DO1	4247.00	8.89	37776.64	37776.64	1133.30	4	2.833E+02
Proposed Chamber 15A & Drop shaft ⁽²⁾⁽¹⁾	S-C-DO2	295.70	8.89	2630.22	2630.22	263.02	2	1.315E+02

Note:

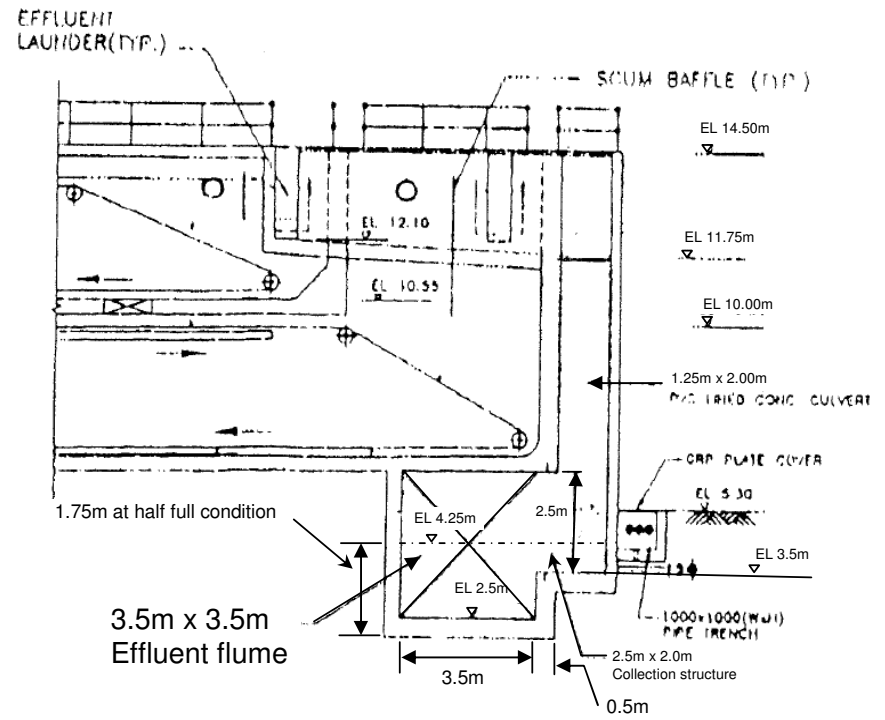
- (1) Please refer to calculation of weir emission rate.
- (2) 90% removal efficiency used
- (3) Included surface area of the sludge conveyor belt
- (4) Included surface areas of sludge cake silos and sludge tanks
- (5) Based on the site observation, the odour strength at the flow distribution chamber of the sedimentation tank is worse than that of the main pumping station, riser shaft, influent upflow structure and rapid mixing tank. Furthermore, the sewage movement characteristic is similar to the flow distribution channel. Therefore the measured odour emission rate of distribution channel was applied to main pumping station, riser shaft, influent upflow structure and rapid mixing tank.
- (6) It is due to the accessibility, measurement cannot be carried out at the scum pit. Since the sewage is flowing into the scum pit right after the sedimentation tank, the odour emission rate of sedimentation tank was applied for the scum pit.
- (7) The major odour source of the sludge dewatering building is the fresh dewatering sludge. Therefore, the measured odour emission rate of fresh dewatering sludge was adopted for the sludge dewatering building in the assessment.
- (8) It is expected the odour strength of the treated effluent at chlorination plant, chamber 15A and drop shaft will be lower than the effluent flowing in SCISTW. The sewage movement characteristic is similar to the flow distribution channel. For conservative analysis, the emission rate of flow distribution channel was adopted in the assessment for the chlorination plant, chamber 15A and drop shaft.

Appendix 3.4 Calculation of odour emission rates at Sedimentation Tanks' Effluent Drop Structure of SCISTW

Source	Odour Emission Rate	Calibrated Odour Emission	Parameters	Remarks
Sedimentation Tanks' Effluent Drop Structure	E _{effluent drop structure} in OU/s/m	39280.43	Odour Emission Rate at weir (OU/s/m) Odour Potential (ou/m ³) Drop shaft weir loading rate, F _{weir} (m ³ /m/h) Height of drops of liquid flow at drop shaft weir, h (m) pH correction coefficient, K _{pH}	$E = 7.16 \times 10^{-4} \times OP \times F_{weir} \times h \times K_{pH}$ 3305 from Yang, G. and Hobson, J. (1999), Validation of the Sewage Treatment Odour Production (STOP) Model Paper 1891.67 from Design Memorandum of weir loading rate 7.50 Estimated base on physical dimension of facilities (EL: 11.75 m - 2.5 m - 3.5/2m) 1.17 at pH=7
	E _{effluent drop structure} in OU/s for each drop structure	78560.86	Total weir length for each drop shaft (m)	2 from Design Memorandum
			Surface area of drop shaft structure, m ²	2.5 2 (W) X 1.25 (L)
			Height of drop shaft structure, m	11.00 Estimated base on physical dimension of facilities (EL: 14.5 m - 3.5m)
			Sewage level inside drop shaft structure, m	0.75 Estimated base on physical dimension of facilities (3.5/2m- 1m)
			Air volume inside drop shaft structure, m ³	25.63
			Area of collection structure between drop shaft and effluent flume, m ²	1 0.5 (W) x 2 (L)
			Height of collection structure, m	2.5 Based on physical dimension of facilities
			Sewage level inside collection structure, m	0.75 Estimated base on physical dimension of facilities (3.5/2m- 1m)
			Area volume, m ³	1.75
			Area of the effluent flume for each drop shaft structure, m ²	53.2 15.2 (L) x 3.5 (W)
			Height of effluent flume, m	3.5 Based on physical dimension of facilities
			Sewage level inside the effluent flume, m	1.75 Estimated base on physical dimension of facilities (3.5/2m)
			Air volume inside effluent flume, m ³	93.10
			Surface area of covered drop shaft structure, m ²	2.5 2 (W) X 1.25 (L)
		Height of covered structure, m	1	
		Covered volume, m ³	2.5	
		Total air volume for each drop shaft structure, m ³	123.0	
		Surface area of air extracted by DO unit, m ²	2.5	
		Height of air volume extracted by DO unit, m	1 As advised by the Engineer, the DO unit will design for extraction of the air volume about 1m height above the top of	
		Air volume extracted by DO unit, m ³	2.5 weir structure (i.e. 2.5m ³ air volume).	
		% of air volume extracted by DO unit	2.0329 The odour gas will be well mixed inside the whole drop shaft structure. As advised by the Engineer, the DO unit is design for extraction of the air volume about 1m height above the top of weir structure. Therefore, percentage of air volume extracted by DO unit was applied in the calculation.	
E from sewage surface for each drop shaft in ou/s	392.93		E in ou/m ² /s Total surface area of sewage, m ²	6.93 from odour survey, emisison rate from sedimentation tanks 56.7
Total E _{effluent drop structure} in OU/s for each drop structure	1605.08	2102.65	Percentage increase in odour emission rate for hot season (%)	31
Total E _{effluent drop structure} in OU/s for Stage 1 CEPT facilities		35745.09	No. of drop shaft in duty for Stage 1 CEPT facilities	17
Total E _{effluent drop structure} in OU/s for Stage 2 CEPT facilities		8410.61	No. of drop shaft in duty for Stage 2 CEPT facilities	4
Total E _{effluent drop structure} For both Stage 1 and and Stage 2		44155.70		



Plan



Section A-A