

**Table 7-22: Results of Air Quality Modeling for different Pollutants**

Scenario	Pollutant	Max. Concentration (µg/m <sup>3</sup> )		Max. Concentration Location	APCR, 2022 <sup>a</sup> (µg/m <sup>3</sup> )	% Of APCR 2022 standard	WHO, 2021 <sup>b</sup> (µg/m <sup>3</sup> )	% Of WHO guideline	EU Air Quality Limit (µg/m <sup>3</sup> )	% Of EU Air Quality Limit	UK EAES <sup>c</sup> (µg/m <sup>3</sup> )	% Of UK EAES
		Avg. Time	Max. Value									
Predicted Concentration (Operation of Plant)	PM <sub>10</sub>	24-hr.	1.46	224955.00 2634111.00	150	0.97	45	3.24	150	0.97	-	-
		Annual	0.071	224905.00 2635061.00	50	0.142	15	0.47	50	0.142	-	-
	NO <sub>2</sub>	24-hr.	22.8	225105.00 2634161.00	80	28.5	25	91.2	-	-	-	-
		Annual	1.3	224905.00 2635061.00	40	3.3	10	13.0	40	3.3	-	-
	SO <sub>2</sub>	1-hr.	87.8	225055.00 2634161.00	250	35.1	-	-	350	25.1	-	-
		24-hr.	7.38	224955.00 2634111.00	80	9.2	40	18.45	125	5.9	-	-
	CO	1-hr.	87.8	225055.00 2634161.00	20000	0.4	-	-	-	-	-	-
		8-hr.	22.1	224955.00 2634111.00	5000	0.4	-	-	10000	0.2	-	-
	Pb	1-hr.	0.891	225055.00 2634161.00	-	-	-	-	-	-	-	-
		24-hr.	0.075	224955.00 2634111.00	0.5	15.0	-	-	-	-	-	-
		Annual	0.0037	225455.00 2634511.00	0.25	1.5	-	-	0.5	0.7	-	-

Scenario	Pollutant	Max. Concentration (µg/m <sup>3</sup> )		Max. Concentration Location	APCR, 2022 <sup>a</sup> (µg/m <sup>3</sup> )	% Of APCR 2022 standard	WHO, 2021 <sup>b</sup> (µg/m <sup>3</sup> )	% Of WHO guideline	EU Air Quality Limit (µg/m <sup>3</sup> )	% Of EU Air Quality Limit	UK EAES <sup>c</sup> (µg/m <sup>3</sup> )	% Of UK EAES
		Avg. Time	Max. Value									
HCL	1-hr.	17.4		225055.00 2634161.00	-	-	-	-	-	-	750	2.3
	24-hr.	1.46		224955.00 2634111.00	-	-	-	-	-	-	-	-
	Annual	0.071		224905.00 2635061.00	-	-	-	-	-	-	-	-
Hg	1-hr.	0.08		225055.00 2634161.00	-	-	-	-	-	-	7.5	1.07
	24-hr.	0.0075		224955.00 2634111.00	-	-	-	-	-	-	-	-
	Annual	0.00037		224905.00 2635061.00	-	-	-	-	-	-	0.25	0.15
HF	1-hr.	1.78		225055.00 2634161.00	-	-	-	-	-	-	160	1.11
	24-hr.	0.15		224955.00 2634111.00	-	-	-	-	-	-	-	-
	Annual	0.0073		224905.00 2635061.00	-	-	-	-	-	-	-	-
DF	1-hr.	0.178		225055.00 2634161.00	-	-	-	-	-	-	-	-
	24-hr.	0.015		224955.00 2634111.00	-	-	-	-	-	-	-	-

Scenario	Pollutant	Max. Concentration ( $\mu\text{g}/\text{m}^3$ )		Max. Concentration Location	APCR, 2022 <sup>a</sup> ( $\mu\text{g}/\text{m}^3$ )	% Of APCR 2022 standard	WHO, 2021 <sup>b</sup> ( $\mu\text{g}/\text{m}^3$ )	% Of WHO guideline	EU Air Quality Limit ( $\mu\text{g}/\text{m}^3$ )	% Of EU Air Quality Limit	UK EAES <sup>c</sup> ( $\mu\text{g}/\text{m}^3$ )	% Of UK EAES
		Avg. Time	Max. Value									
		Annual	0.00073	224905.00 2635061.00	-	-	-	-	-	-	-	-
Baseline Concentration * ( $\mu\text{g}/\text{m}^3$ )	PM <sub>10</sub>	24-hr.	335.0		150	223.3	45	744.4				
		Annual	67.0		50	134.0	15	446.7				
	NO <sub>2</sub>	24-hr.	210.4		80	263.0	25	841.6				
		Annual	42.1		40	105.3	10	421.0				
	SO <sub>2</sub>	1-hr.	202.6		250	81.0	-	-				
		24-hr.	81.0		80	101.3	40	202.5				
	CO	1-hr.	11156.0		20000	55.8	-	-				
		8-hr.	6680.0		5000	133.6	-	-				
Total Concentration (Only Project Contribution +Baseline)	PM <sub>10</sub>	24-hr.	336.5	-	150	224.3	-	-				
		Annual	67.1	-	50	134.1	-	-				
	NO <sub>2</sub>	24-hr.	233.2		80	291.5	25	932.8				
		Annual	43.4		40	108.5	10	434.0				
	SO <sub>2</sub>	1-hr.	290.4	-	250	116.2	-	-				
		24-hr.	88.4	-	80	110.5	40	221.0				
	CO	1-hr.	11244		20000	56.2	-	-				
		8-hr.	6702.1		5000	134.0	-	-				

<sup>a</sup> Schedule-1 (Ambient Air Quality Standards), Air Pollution Control Rules 2022

<sup>b</sup> World Health Organization (WHO) Ambient Air Quality Guideline Values 2021

° UK Environmental Agency Environmental Standard

**Table 7-23: Predicted Concentration of Pollutants at Receptor Locations**

Pollutants	Avg. Time	Concentration at Receptor Points (µg/m <sup>3</sup> )																			APCR, 2022 <sup>a</sup> (µg/m <sup>3</sup> )	WHO, 2021 <sup>b</sup> (µg/m <sup>3</sup> )	EU Air Quality Limit (µg/m <sup>3</sup> )	UK EAES <sup>c</sup> (µg/m <sup>3</sup> )
		AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11				
PM	24-hr.	0.79	0.34	0.31	0.45	0.47	0.58	0.26	0.34	0.29	0.53	0.58	0.19	0.26	0.20	0.21	0.31	0.46	0.33	0.07	150	45	150	-
	Annual	0.024	0.033	0.033	0.030	0.062	0.046	0.028	0.032	0.028	0.032	0.046	0.015	0.015	0.014	0.016	0.023	0.046	0.032	0.008	50	15	50	-
NO <sub>2</sub>	24-hr.	11.5	4.9	4.6	6.6	6.8	8.5	3.7	5.0	4.2	7.6	8.4	2.7	3.8	2.9	3.1	4.5	6.7	4.8	1.1	80	25	-	-
	Annual	0.35	0.48	0.47	0.43	0.90	0.67	0.40	0.46	0.40	0.46	0.66	0.22	0.22	0.21	0.23	0.34	0.67	0.46	0.11	40	10	40	-
SO <sub>2</sub>	1-hr.	20.1	8.3	9.3	10.2	15.5	10.2	8.8	8.3	8.0	21.2	10.2	7.9	13.8	12.0	13.1	18.6	8.9	7.2	4.2	250	-	350	-
	24-hr.	4.0	1.7	1.6	2.3	2.4	2.9	1.3	1.7	1.5	2.7	2.9	1.0	1.3	1.0	1.1	1.6	2.3	1.7	0.4	80	40	125	-
CO	1-hr.	20.1	8.3	9.3	10.2	15.5	10.2	8.8	8.3	8.0	21.2	10.2	7.9	13.8	12.0	13.1	18.6	8.9	7.2	4.2	20000	-	-	-
	8-hr.	12.0	4.6	4.3	4.1	3.4	6.8	2.8	2.3	4.0	6.5	6.7	2.8	3.0	1.7	1.9	3.8	3.9	4.8	0.9	5000	-	10000	-
Pb	1-hr.	0.204	0.084	0.094	0.103	0.157	0.104	0.089	0.084	0.081	0.215	0.104	0.080	0.140	0.122	0.133	0.189	0.091	0.073	0.043	-	-	-	-
	24-hr.	0.041	0.017	0.016	0.023	0.024	0.030	0.013	0.018	0.015	0.027	0.030	0.010	0.013	0.010	0.011	0.016	0.024	0.017	0.004	0.5	-	-	-
	Annual	0.0025	0.0021	0.0022	0.0024	0.0066	0.0037	0.0021	0.0024	0.0014	0.0016	0.0023	0.0008	0.0008	0.0007	0.0008	0.0012	0.0024	0.0016	0.0004	0.25	-	0.5	-
HCL	1-hr.	3.99	1.64	1.84	2.02	3.06	2.02	1.74	1.64	1.58	4.19	2.02	1.56	2.72	2.37	2.59	3.69	1.77	1.43	0.84	-	-	-	750
	24-hr.	0.79	0.34	0.31	0.45	0.47	0.58	0.26	0.34	0.29	0.53	0.58	0.19	0.26	0.20	0.21	0.31	0.46	0.33	0.07	-	-	-	-
	Annual	0.024	0.033	0.033	0.030	0.062	0.046	0.028	0.032	0.028	0.032	0.046	0.015	0.015	0.014	0.016	0.023	0.046	0.032	0.008	-	-	-	-
Hg	1-hr.	0.020	0.008	0.009	0.010	0.016	0.010	0.009	0.008	0.008	0.022	0.010	0.008	0.014	0.012	0.013	0.019	0.009	0.007	0.004	-	-	-	7.5
	24-hr.	0.0041	0.0017	0.0016	0.0023	0.0024	0.0030	0.0013	0.0018	0.0015	0.0027	0.0030	0.0010	0.0014	0.0010	0.0011	0.0016	0.0024	0.0017	0.0004	-	-	-	-
	Annual	0.00012	0.00017	0.00017	0.00015	0.00032	0.00024	0.00014	0.00016	0.00014	0.00016	0.00023	0.00008	0.00008	0.00007	0.00008	0.00012	0.00024	0.00016	0.00004	-	-	-	0.25
HF	1-hr.	0.41	0.17	0.19	0.21	0.31	0.21	0.18	0.17	0.16	0.43	0.21	0.16	0.28	0.24	0.27	0.38	0.18	0.15	0.09	-	-	-	160
	24-hr.	0.081	0.035	0.032	0.046	0.048	0.060	0.026	0.035	0.029	0.054	0.059	0.019	0.027	0.021	0.022	0.032	0.047	0.034	0.007	-	-	-	-
	Annual	0.0025	0.0034	0.0034	0.0030	0.0063	0.0047	0.0028	0.0033	0.0028	0.0033	0.0047	0.0016	0.0015	0.0015	0.0016	0.0024	0.0047	0.0032	0.0008	-	-	-	-
DF	1-hr.	0.041	0.017	0.019	0.021	0.031	0.021	0.018	0.017	0.016	0.043	0.021	0.016	0.028	0.024	0.027	0.038	0.018	0.015	0.009	-	-	-	-
	24-hr.	0.0081	0.0035	0.0032	0.0046	0.0048	0.0060	0.0026	0.0035	0.0030	0.0054	0.0059	0.0019	0.0027	0.0021	0.0022	0.0032	0.0047	0.0034	0.0007	-	-	-	-
	Annual	0.0003	0.0003	0.0003	0.0003	0.0006	0.0005	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0005	0.0002	0.0002	0.0002	0.0002	0.0005	0.0003	0.00008	-	-	-

<sup>a</sup> Schedule-1(Ambient Air Quality Standards), Air Pollution Control Rules 2022

<sup>b</sup> World Health Organization (WHO) Ambient Air Quality Guideline Values 2021

<sup>c</sup> UK Environmental Agency Environmental Standard

Based on the emission rates, operating data, meteorological data as well as the assumption given above, the following section presents the results of air quality modeling.

## **Particulate Matter (PM<sub>10</sub>)**

### **Project Contribution (Project Only)**

The particulate matter emission standard of the plant is 10 mg/Nm<sup>3</sup>. Since there is no fraction of particulate matter such as PM<sub>10</sub> and PM<sub>2.5</sub> in national standards and WHO guidelines hence, it has been assumed that PM=PM<sub>10</sub>=PM<sub>2.5</sub>, waste-to-energy power plants will have the same contribution as PM<sub>2.5</sub>. **Table 7-22** shows that the 24-hourly predicted maximum PM<sub>10</sub> concentration was found as 1.46 µg/m<sup>3</sup> (0.97% of national standard and 3.24% of WHO guideline value) at 76 meters (224955.00 m E 2634111.00 m N) to the west direction from the stack location. The annual predicted maximum PM<sub>10</sub> concentration was found as 0.07 µg/m<sup>3</sup> (0.14% of national standard and 0.47% of WHO guideline value) at 958 meters (224905.00m E 2635061.00m N) to the north direction of the power plant stack location. Hence, it can be stated that the proposed waste-to-energy power plant will have a negligible contribution to the GLC of particulate matter (PM). PM<sub>10</sub> Isopleths of project contribution is shown in **Figure 7-6**.

**Table 7-23** presents that the 24-hourly maximum PM<sub>10</sub> has been found at plant area (AQ1) among 19 receptors point as 0.79 µg/m<sup>3</sup> (0.1% of national standard-APCR and 3.2% of WHO guideline value) whereas annual concentrations found as 0.062 µg/m<sup>3</sup> (0.15% of national standard and 0.62% of WHO guideline value) at AQ5 (Beraid lake city, Banagram, Savar, Dhaka). The project contribution is well within the national and WHO guideline value. However, a health impact assessment needs to be carried out before work commences to provide a baseline for monitoring health impacts and confirm no significant impact on human health.

### **Project Contribution + Background Concentration**

**Table 7-22** shows that the maximum 24-hourly background concentration was found 335.0 µg/m<sup>3</sup> (223.3% of national standard-APCR and 744.4% of WHO guideline value) which is significantly higher than the standard. Annual maximum background concentration was recorded as 67.0 µg/m<sup>3</sup> which is 134.0% of the national standard and 446.7% of the WHO guideline value. The project contribution including baseline concentration shows that the 24-hourly maximum PM<sub>10</sub> concentration stands at 336.5 µg/m<sup>3</sup> (224.3% of the national standard and 747.7% of WHO guideline value) whereas the annual maximum concentration was found 67.1 µg/m<sup>3</sup> (134.1% of national standard-APCR and 447.1% of WHO guideline value). It can be concluded that only the project will contribute very negligible concentration to the local airshed compared to the existing baseline condition. So, particulate matter emission may not impact the local environment due to the proposed plant operation. However, as stated earlier a health impact assessment needs to be carried out before commencing the construction work.

## **Particulate Matter (PM<sub>2.5</sub>)**

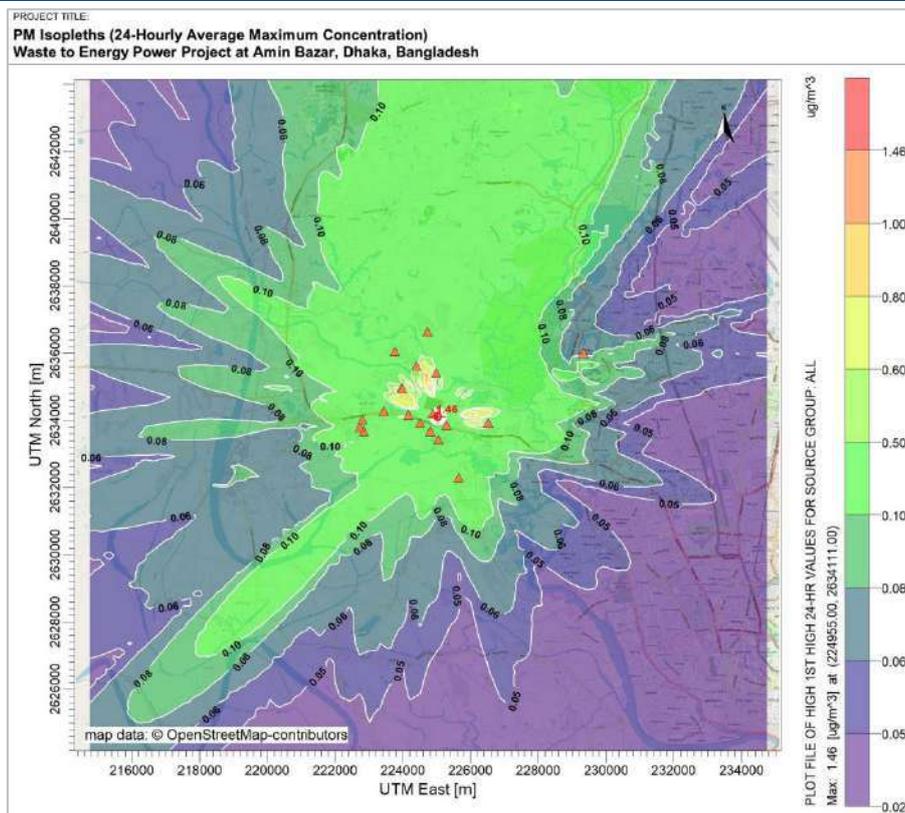
### **Project Contribution (Project Only)**

The particulate matter emission standard of the plant is 10 mg/Nm<sup>3</sup>. Since there is no fraction of particulate matter such as PM<sub>10</sub> and PM<sub>2.5</sub> in national standards and WHO guidelines hence, it has been assumed that PM=PM<sub>10</sub>=PM<sub>2.5</sub>, waste-to-energy power plants will have the same contribution as PM<sub>10</sub>. **Table 7-22** shows that the 24-hourly predicted maximum PM<sub>2.5</sub> concentration was found as 1.46 µg/m<sup>3</sup> (2.25% of national standard and 29.2% of WHO guideline value) at 76 meters (224955.00 m E 2634111.00 m N) to the west direction from the stack location. The annual predicted maximum PM<sub>2.5</sub> concentration was found as 0.07 µg/m<sup>3</sup> (0.47% of national standard and 0.47% of WHO guideline value) at 958 meters (224905.00m E 2635061.00m N) to the north direction of the power plant stack location. Hence, it can be stated that the proposed waste-to-energy power plant will have a negligible contribution to the GLC of particulate matter (PM).

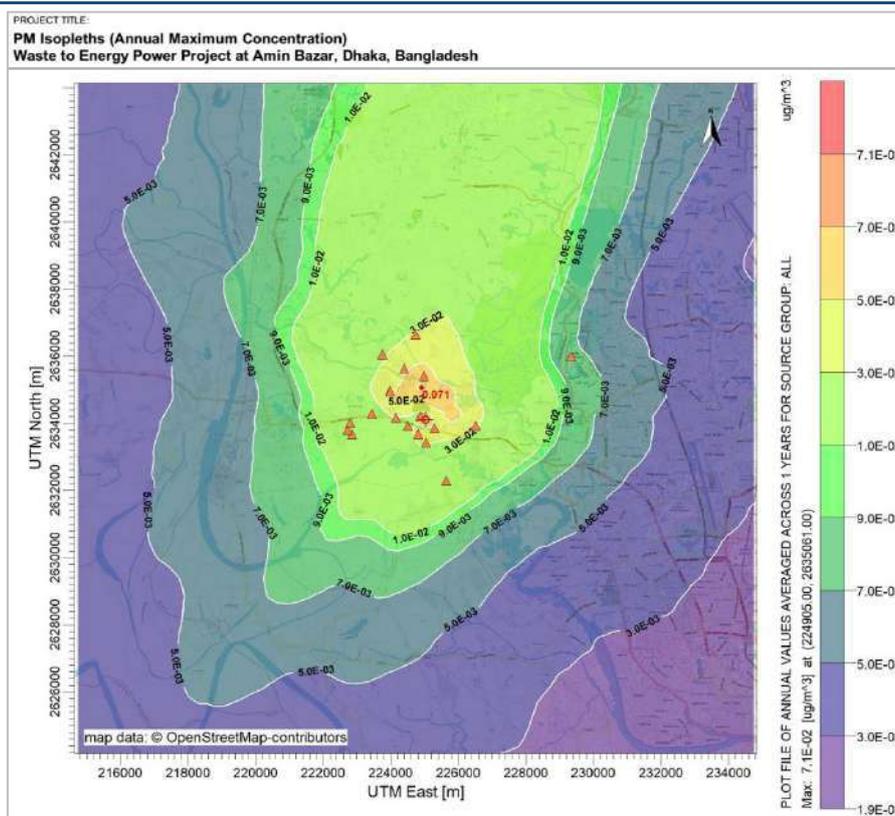
### **Project Contribution + Background Concentration**

**Table 7-22** shows that the maximum 24-hourly background concentration was found 335.0  $\mu\text{g}/\text{m}^3$  (515.38% of national standard-APCR and 6,700% of WHO guideline value) which is significantly higher than the standard. Annual maximum background concentration was recorded as 67.0  $\mu\text{g}/\text{m}^3$  which is 446.67% of the national standard and 446.67% of the WHO guideline value. The project contribution including baseline concentration shows that the 24-hourly maximum  $\text{PM}_{2.5}$  concentration stands at 336.46  $\mu\text{g}/\text{m}^3$  (517.63% of the national standard and 6,729.2% of WHO guideline value) whereas the annual maximum concentration was found 67.071  $\mu\text{g}/\text{m}^3$  (447.14% of national standard-APCR and 447.14% of WHO guideline value). It can be concluded that only the project will contribute very negligible concentration to the local airshed compared to the existing baseline condition. So, particulate matter emission may not impact the local environment due to the proposed plant operation. However, as stated earlier a health impact assessment needs to be carried out before commencing the construction work.

**Figure 7-6:  $\text{PM}_{10}$  Isopleths of Project Contribution**



**24 Hourly  $\text{PM}_{10}$  Isopleths**



Annual PM<sub>10</sub> Isopleths

## Nitrogen Dioxide (NO<sub>2</sub>)

### Project Contribution (Project Only)

The air quality assessment is made in relation to ensuring compliance with national standards. Waste to energy plant will contribute a maximum GLC of 1.3  $\mu\text{g}/\text{m}^3$  (annual averaging time) of NO<sub>2</sub> to the airshed based on an emission concentration of 200 mg/Nm<sup>3</sup> with Tier 2 ((minimum NO<sub>2</sub>/NO<sub>x</sub> ratio- 50% and maximum NO<sub>2</sub>/NO<sub>x</sub> ratio is 90%) (Table 7-22). The annual predicted maximum NO<sub>2</sub> concentration was found as 1.3  $\mu\text{g}/\text{m}^3$  (224905.00m E 2635061.00m N) at 958 meters to the north direction of the power plant. The 24-hourly predicted maximum NO<sub>2</sub> concentration was found as 22.8  $\mu\text{g}/\text{m}^3$  (225105.00 m E 2634161.00 m N) at 58 meters to the northeast direction of the power plant. With an emissions concentration of 200 mg/Nm<sup>3</sup>, the emissions are considered to have more than a fraction of the national ambient air quality standard. Given the negligible impact on national ambient air quality standards, and the high costs involved in maintaining selective catalytic reduction to further reduce NO<sub>2</sub> levels, a 200 mg/Nm<sup>3</sup> emission standard with 100 meters of stack height can be both technical and financially viable. In terms of impact on health, the maximum project contribution to GLC with a 200 mg/Nm<sup>3</sup> emission concentration and 100 m stack height is about 3.3% and 13.0% of the annual national standard and WHO guideline for NO<sub>2</sub> considering Tier 2. The plant will contribute about 28.5% and 91.2% of the short-term 24-hr national standard and WHO guideline value. NO<sub>2</sub> Isopleths of project contribution is shown in Figure 7-7.

There are two sensitive receptors near the plant e.g. Jamuna natural park & picnic spot and Madhumati Model town in the south. Table 7-23 presents that the predicted 24-hourly and annual PM<sub>10</sub> concentration varies between 1.1-11.5  $\mu\text{g}/\text{m}^3$  and 0.11-0.9  $\mu\text{g}/\text{m}^3$  at 19 sensitive receptor locations. It reveals that predicted NO<sub>2</sub> concentrations on sensitive receptors are well within both national and WHO guidelines values. Among the 19 receptors modeled, the maximum annual GLC of 0.90  $\mu\text{g}/\text{m}^3$  (2.24 % of APCR and 8.97% of WHO guideline value) found at AQ5 (Beraid lake city, Banagram, Savar, Dhaka)

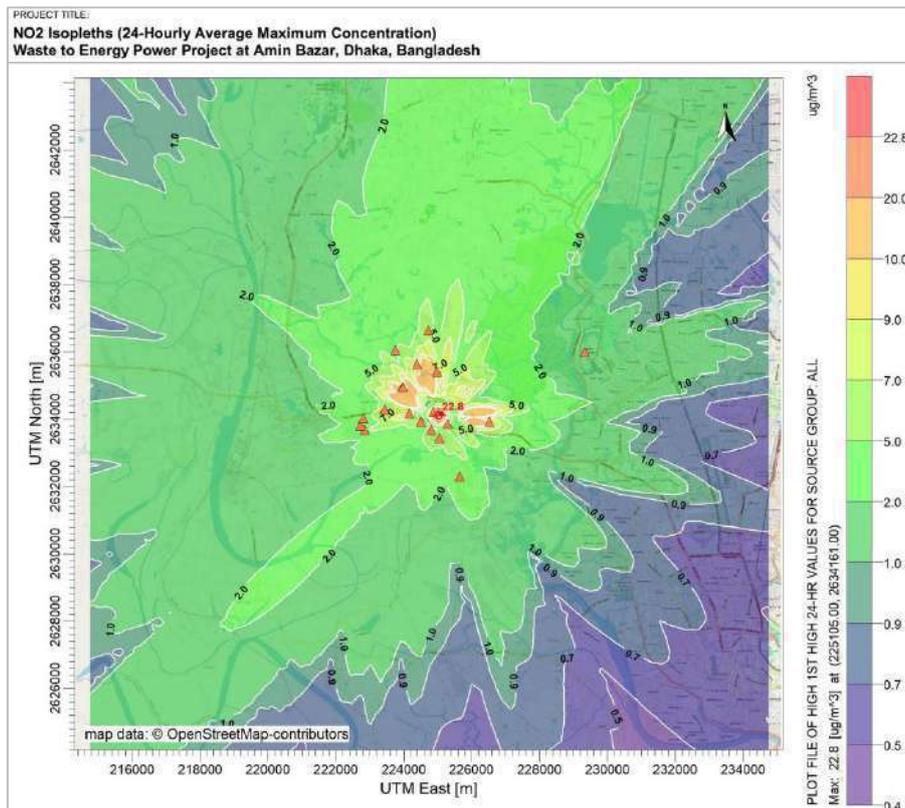
and maximum 24-hr GLC of  $11.5 \mu\text{g}/\text{m}^3$  (14.4% of APCR and 46.2% of WHO guideline value) were found at AQ1 (within the plant boundary).

Whilst the project makes a significant contribution to the short-term national and WHO guidelines in a degraded airshed, the project itself does not result in any exceedance of the guidelines. Short-term impacts on health tend to be less severe than long-term impacts (e.g., eye irritation versus increased mortality) and the maximum short-term concentration from the project whilst significant is unlikely. The government has taken initiatives to convert the existing brick kilns into more environment-friendly industries by 2025. A health impact assessment will be completed before work commences, to provide a baseline for monitoring health impacts and confirm no significant impact on human health.

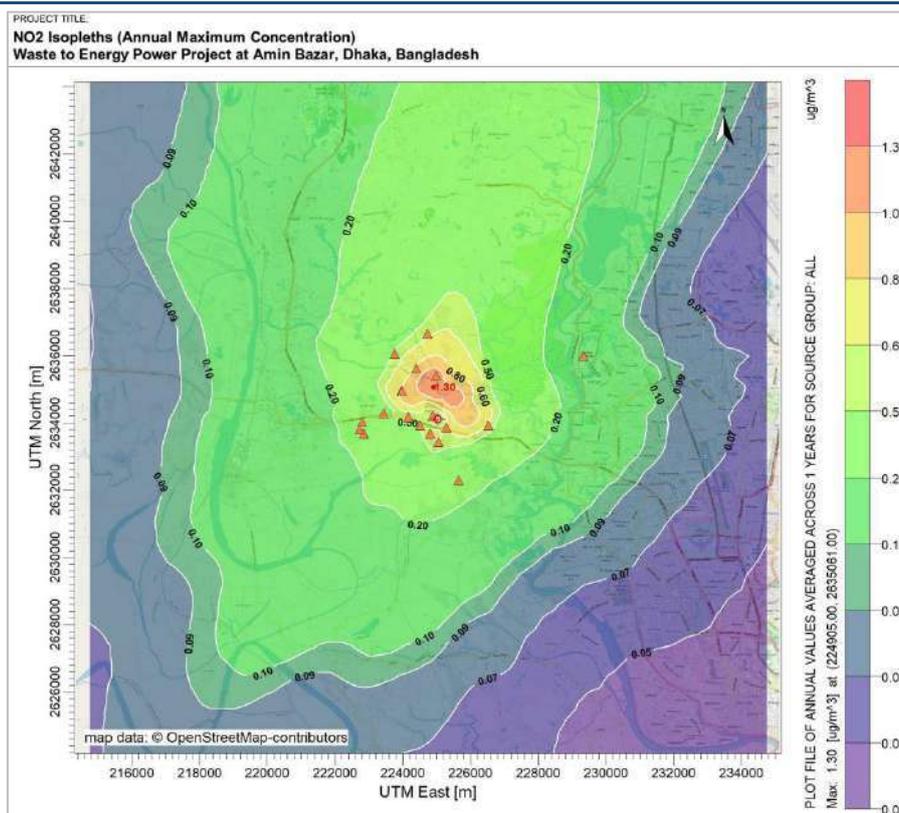
**Project Contribution + Background Concentration**

During the scenario-2 analysis, the highest background concentration has been taken for worst-case analysis (Table 7-22). Annual maximum baseline concentration was recorded as  $42.1 \mu\text{g}/\text{m}^3$  which is 105.3% of the national standard and 421.0% of the WHO guideline value whereas short-term 24-hourly concentration was  $210.4 \mu\text{g}/\text{m}^3$  (263% of national standard-APCR and 841.6% of WHO guideline value). Hence, the background maximum  $\text{NO}_2$  concentration is significantly higher. The project contribution including baseline concentration shows that the annual and 24-hour maximum concentration stands at  $43.4 \mu\text{g}/\text{m}^3$  (108.5% of national standard and 434.0% of WHO guideline value) and  $233.2 \mu\text{g}/\text{m}^3$  (291.5% of national standard-APCR and 932.8% of WHO guideline value). It seems that only the project will contribute less to the airshed compared to the existing baseline condition.

**Figure 7-7:  $\text{NO}_2$  Isopleths of Project Contribution**



**24 Hourly  $\text{NO}_2$  Isopleths**



**Annual NO<sub>2</sub> Isopleths**

## Carbon Monoxide (CO)

### Project Contribution (Project Only)

Major sources of CO in the study area are brick kilns, vehicles, cooking, etc. During the operation of the power plant, there will be a negligible contribution to the GLC of CO. **Table 7-22** shows that plant operation will contribute 1- hourly maximum CO concentration as 87.8 µg/m<sup>3</sup> (0.4% of national standard) at 50.9 m (225055.00 m E 2634161.00 m N) north direction from the stack location which is within the project boundary. Whereas 8-hourly maximum CO concentration was found at 22.1 µg/m<sup>3</sup> (0.4% of national standard) at a distance of 76.5 m west direction from the stack location and also within the project boundary (224955.00m E 2634111.00 m N). CO Isopleths of project contribution is shown in **Figure 7-8**.

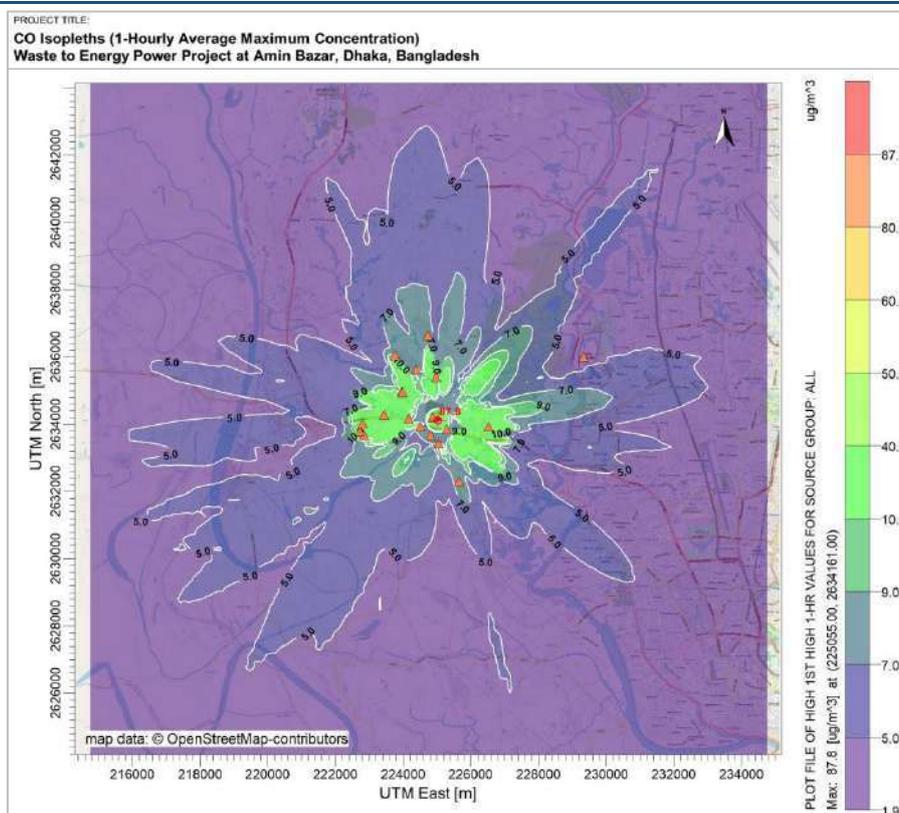
The 1 hourly CO concentration varies at 19 receptor locations between 4.2-21.2 µg/m<sup>3</sup> (0.02-0.11% of national standard) whereas 8-hourly CO concentration varies from 0.9-12.0 µg/m<sup>3</sup> (0.02 - 0.24% of national standard). The 1-hourly maximum concentration (21.2 µg/m<sup>3</sup>) was found at S2 (University of South Asia), and the 8-hourly maximum concentration (12.0 µg/m<sup>3</sup>) was found at AQ1 (within the project location). It reveals that CO concentration on sensitive receptors will be negligible due to the operation of proposed waste-to-energy power plants. The pollution concentration on sensitive receptors is presented in **Table 7-23**.

### Project Contribution + Background Concentration

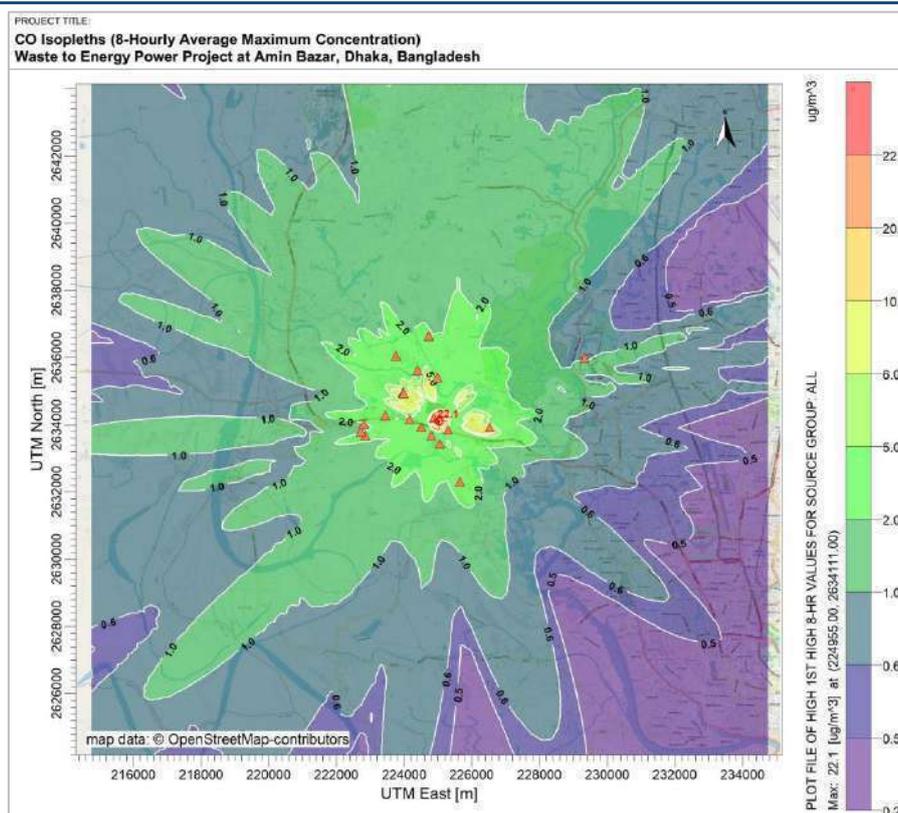
The highest background concentration from CAMS-3 has been taken for worst-case analysis (**Table 7-22**). 1-hourly and 8-hourly maximum background CO concentrations were found as 11156 µg/m<sup>3</sup> (55.8% of the national standard) and 6680 µg/m<sup>3</sup> (133.6% of the national standard). The background concentrations show that the 8-hourly CO concentration is higher than the national standard. The project contribution including baseline concentration shows that the 24-hour and annual maximum concentration stands at 11244 µg/m<sup>3</sup> (56.2% of national standard-APCR) and 6702 µg/m<sup>3</sup> (134.0% of

national standard-APCR). It can be concluded that the only project contribution is insignificant due to the plant operation compared to the background CO concentration.

**Figure 7-8: CO Isopleths of Project Contribution**



**1 Hourly CO Isopleths**



8 Hourly CO Isoleths

## Sulfur Dioxide (SO<sub>2</sub>)

### Project Contribution (Project Only)

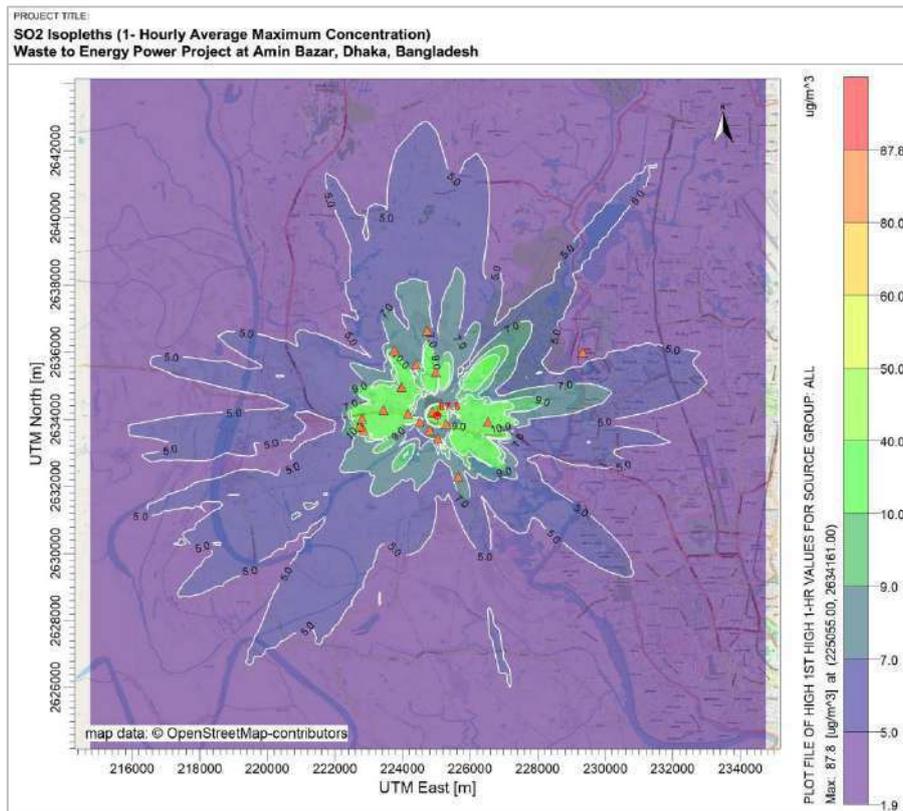
The air quality assessment is made about ensuring compliance with national standards. The major sources of SO<sub>2</sub> are brick kilns and vehicular movements. Due to the power plant operation, 1-hourly maximum SO<sub>2</sub> concentration has been found at 87.8 µg/m<sup>3</sup> (35.1% of national standard) at 50.9 m (225055.00m E 2634161.00 m N) north direction from the stack location which is within the project boundary whereas 24-hourly SO<sub>2</sub> concentration has been found 7.38 µg/m<sup>3</sup> (9.2% of national standard and 18.5% of WHO guideline value) at 76 meters (224955.00 m E 2634111.00 m N) to the west direction from the stack location (**Table 7-22**). The project alone SO<sub>2</sub> contribution to the airshed is within the standard; however, it is higher than a single project. Hence, a health impact assessment needs to be carried out before work commences to provide a baseline for monitoring health impacts and confirm no significant impact on human health. SO<sub>2</sub> Isoleths of project contribution is shown in **Figure 7-9**.

A total of 19 sensitive receptors have been modeled to find incremental SO<sub>2</sub> concentration. The 1-hourly SO<sub>2</sub> concentration varies from 4.2-21.18 µg/m<sup>3</sup> (1.7%-8.5% of the national standard-APCR) at the receptor locations whereas 24-hourly SO<sub>2</sub> concentration was found between 0.4-4.0 µg/m<sup>3</sup> (0.46%-5.0% of the national standard-APCR and 0.92%-10.0% of the WHO guidelines value). The maximum 1-hourly SO<sub>2</sub> concentration was found at S2- the University of South Asia and the 24-hourly maximum concentration was found at AQ1 (within the project boundary). According to the national standard, SO<sub>2</sub> will not contribute a significant increment to the nearest sensitive receptors. The project contribution is well within the national and WHO guideline value. On the other hand, the 24-hr increment is significant (67.3%) as per the WHO guideline value in a degraded airshed. The pollution concentration on sensitive receptors is presented in **Table 7-23**.

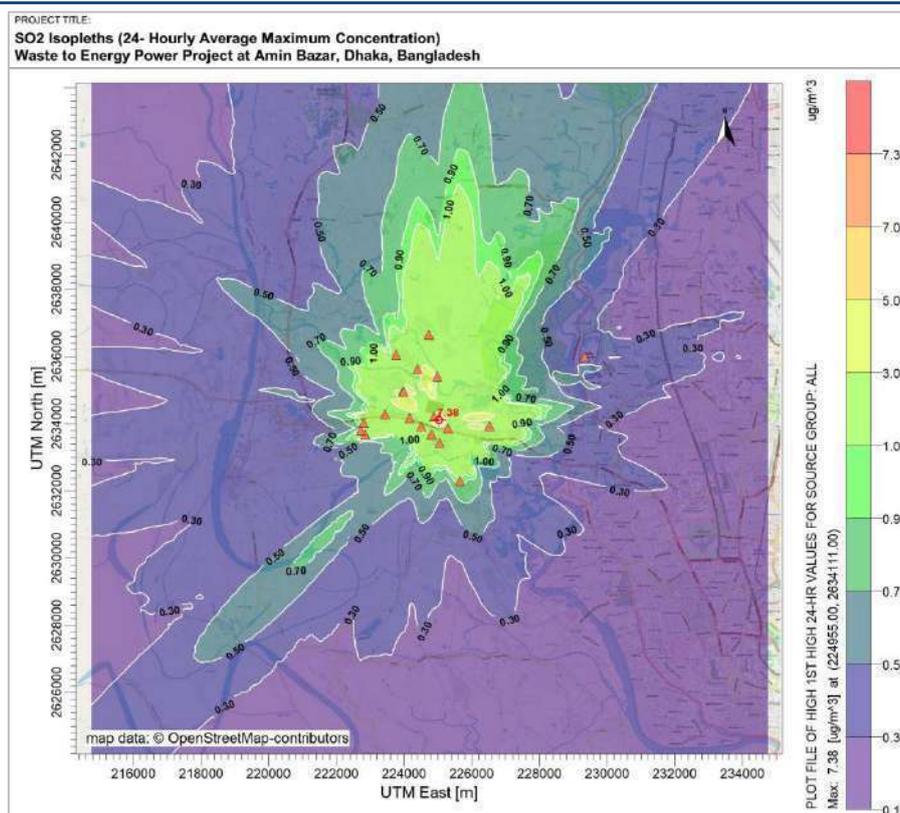
### Project Contribution + Background Concentration

**Table 7-22** shows that 1-hourly and 24-hourly maximum background SO<sub>2</sub> concentrations are 202.6 µg/m<sup>3</sup> (81.0% of the national standard) and 81.0 µg/m<sup>3</sup> (101.3% of the national standard and 202.5% of WHO guidelines value). The background concentrations show that 24-hourly SO<sub>2</sub> concentration is slightly higher than the national standard. The project contribution including baseline concentration shows that the 1-hourly and annual maximum concentration stands at 290.4 µg/m<sup>3</sup> (116.2% of national standard-APCR) and 88.4 µg/m<sup>3</sup> (110.5% of national standard-APCR and 221.0% of WHO guidelines value). It can be concluded that the only project contribution is significant due to the plant operation. Hence, a health impact assessment needs to be carried out before work commences to provide a baseline for monitoring health impacts and confirm no significant impact on human health.

**Figure 7-9: SO<sub>2</sub> Isopleths of Project Contribution**



**1 Hourly SO<sub>2</sub> Isopleths**



24 Hourly SO<sub>2</sub> Isoleths

**Sum of Lead and Chromium and other Heavy Metal (Antimony, Copper, Manganese, Vanadium, Tin, Cobalt, Nickel)**

**Project Contribution (Project Only)**

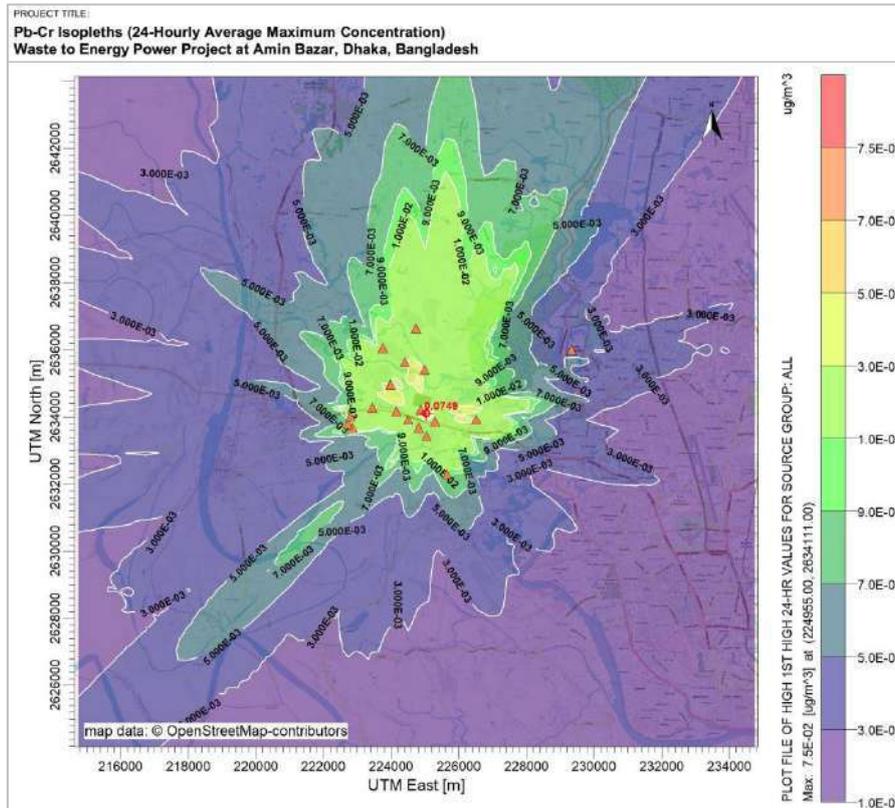
There is no available ambient air quality standard/guideline for the mentioned metal in the national and other internationally. Air Pollution Control Rules of Bangladesh 2022 has only ambient air quality standards for Lead (Pb). Hence, it has been used for comparison with maximum ground-level concentration. **Table 7-22** shows that the 24-hourly predicted maximum sum of Pb and Cr concentration is 0.075 µg /m<sup>3</sup> (15% of national standard) at 76 meters (224955.00 m E 2634111.00 m N) to the west direction from the stack location. The annual predicted maximum sum of Pb and Cr concentration was found as 0.0037 µg /m<sup>3</sup> (1.5% of national standard) at 958 meters (225455.00m E 2634511.00m N) to the north direction of the power plant stack location. It shows that the maximum short-term (24-hr) concentration of Pb & Cr is more than 10% of the national standard. Hence, a health impact assessment needs to be carried out before the start of the commencement of project work. The Sum of Pb and Cr Isoleths of project contribution is shown in **Figure 7-6**.

A total of 19 sensitive receptors have been modeled to find the incremental sum of Pb and Cr concentration. The 24-hourly sum of Pb and Cr concentration varies from 0.004-0.041 µg/m<sup>3</sup> (0.74%-8.1% of the national standard-APCR) at the receptor locations whereas the annual sum of Pb and Cr concentration was found between 0.0004-0.007 µg/m<sup>3</sup> (0.16%-2.64% of the national standard-APCR). **Table 7-23** presents that the 24-hourly maximum sum of Pb and Cr has been found at plant area (AQ1) among 19 receptors point as 0.041 µg/m<sup>3</sup> (8.1% of national standard-APCR) whereas annual concentrations found as 0.007 µg/m<sup>3</sup> (2.64% of national standard-APCR) at AQ5 (Beraid lake city, Banagram, Savar, Dhaka). The project's contribution to the sensitive receptors is well within the national standard.

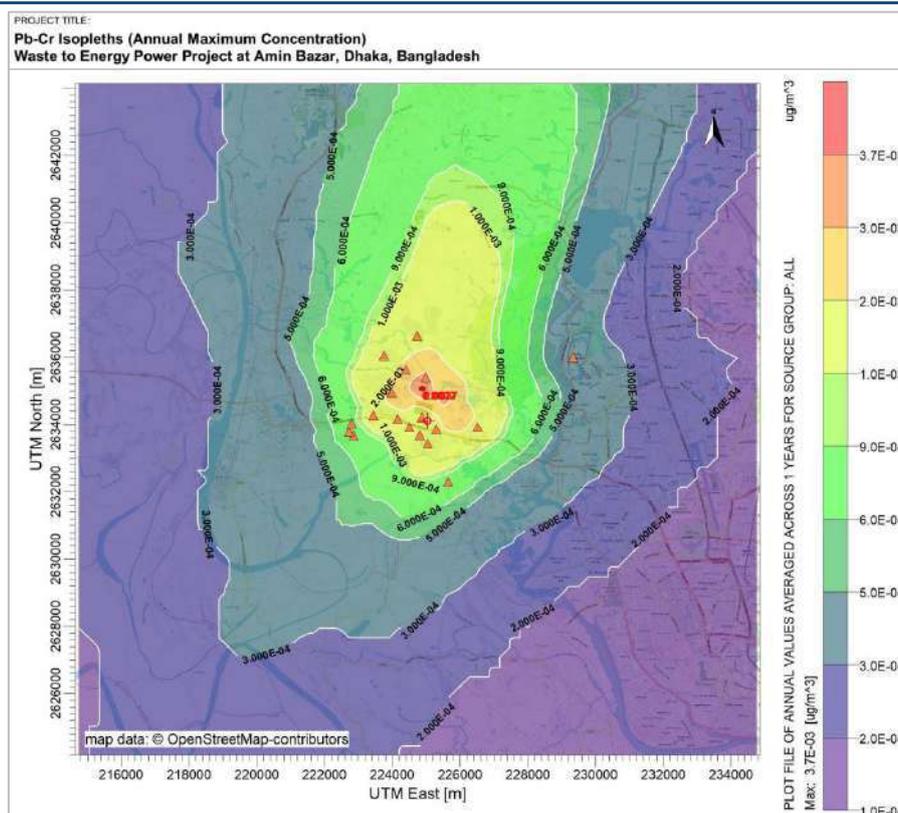
**Project Contribution + Background Concentration**

There is no background concentration of Pb and Cr in the CASE study. Hence, cumulative assessment (project contribution + background concentration) has not been analyzed for lead.

**Figure 7-10: Sum of Pb and Cr Isoleths of Project Contribution**



**24 Hourly Sum of Pb and Cr Isoleths**



**Annual Sum of Pb and Cr Isoleths**

## Hydrogen Chloride (HCL)

### Project Contribution (Project Only)

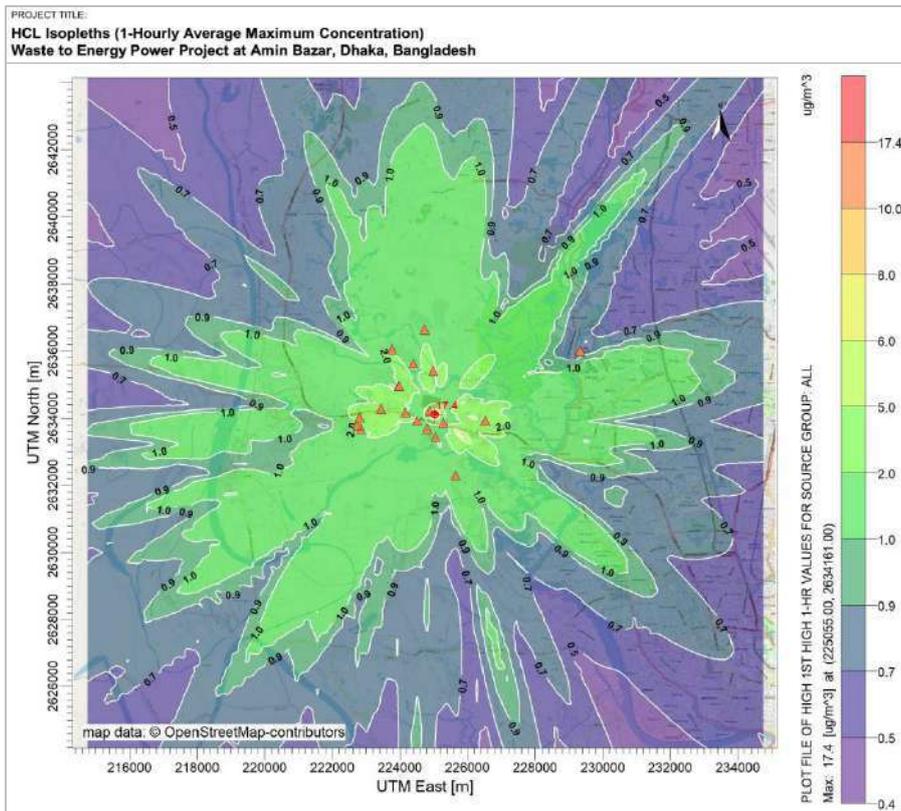
Predicted short-term (1 hour) for controlled hydrogen chloride (HCl) maximum ground level concentrations are 17.4  $\mu\text{g}/\text{m}^3$  located 50.9 m meters N from the Stack location (**Table 7-22**). The 24-hour controlled HCl maximum ground level concentrations are 1.46  $\mu\text{g}/\text{m}^3$  located 76 meters W from the stack location. The annual controlled HCl maximum ground level concentration is 0.071  $\mu\text{g}/\text{m}^3$  located 958 meters N from the stack location. There are no HCl standards in the national air pollution control rules and WHO air quality guideline values. There is only a 1-hourly ambient air quality standard in UK Environmental Agency Environmental Standard which is 750  $\mu\text{g}/\text{m}^3$ . The project will contribute 2.3% of the UK Environmental Agency Environmental Standard. According to the IRIS Reference concentration of annual HCl for inhalation exposure is 20  $\mu\text{g}/\text{m}^3$  whereas the US EPA reference concentration is 2100  $\mu\text{g}/\text{m}^3$  for 24 hours. Therefore, the contribution of HCL due to the plant operation has been considered negligible. HCL Isoleths of project contribution is shown in **Figure 7-11**.

**Table 7-23** shows that the 1-hourly and 24-hourly HCl concentration varies from 0.84-4.2  $\mu\text{g}/\text{m}^3$  and 0.07-0.79  $\mu\text{g}/\text{m}^3$  at the sensitive receptor locations whereas annual HCl concentration was found between 0.007-0.062  $\mu\text{g}/\text{m}^3$ . It can be concluded that the project contribution of HCl to the sensitive receptors is negligible.

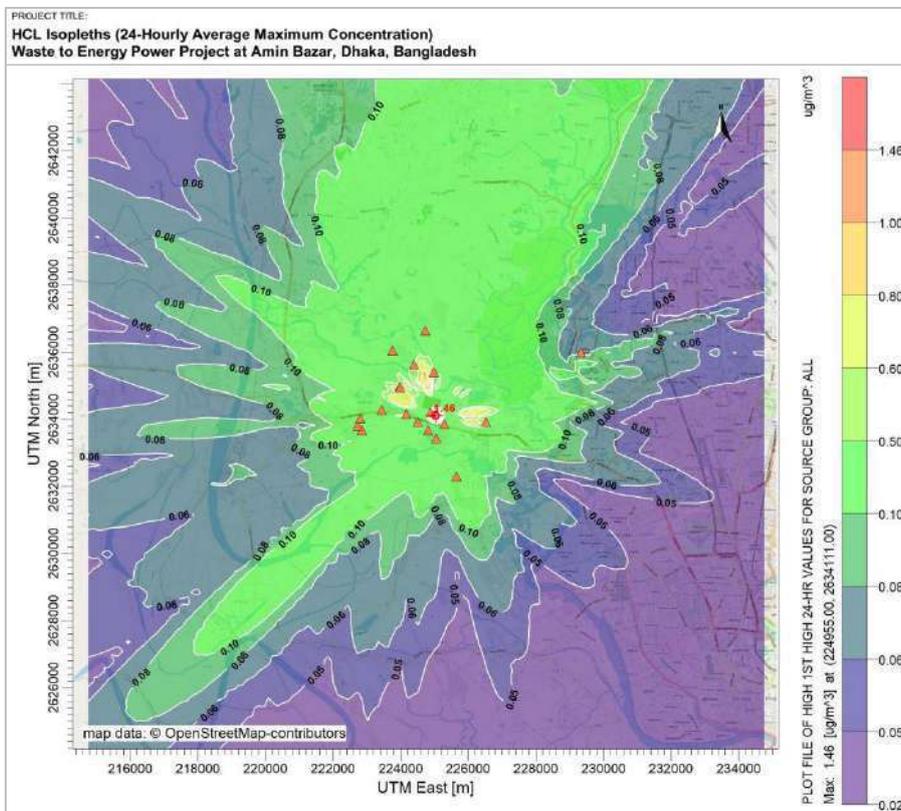
### Project Contribution + Background Concentration

There is no background concentration of HCl in the CASE study. Hence, cumulative assessment (project contribution + background concentration) has not been analyzed for HCl.

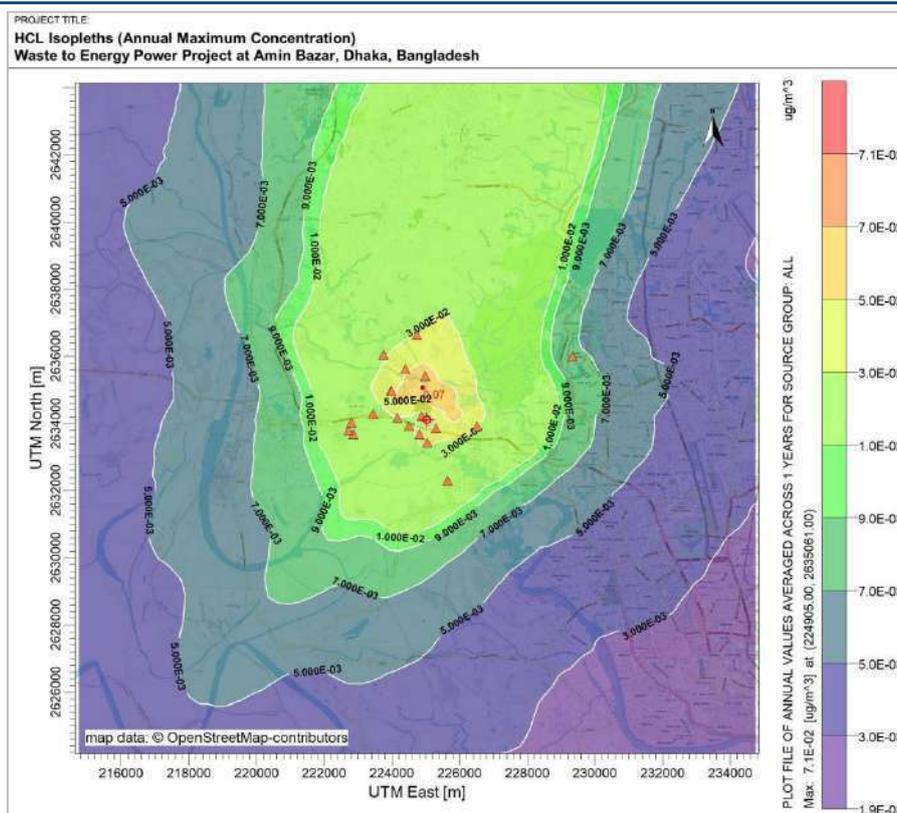
**Figure 7-11: HCl Isoleths of Project Contribution**



**1 Hourly HCl Isoleths**



**24 Hourly HCl Isoleths**



**Annual HCl Isoleths**

## Mercury (Hg)

### Project Contribution (Project Only)

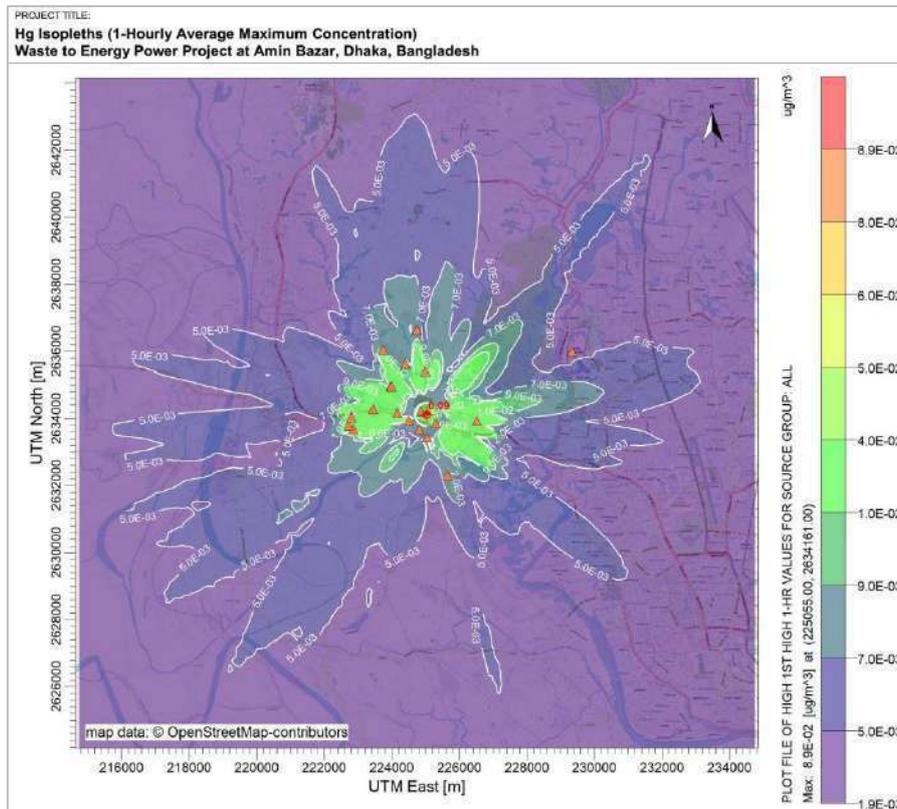
The predicted short-term (1 hour) for controlled mercury (Hg) maximum ground level concentrations are 0.08  $\mu\text{g}/\text{m}^3$  located 50.9 m meters N from the stack location (**Table 7-22**). The 24-hour controlled Hg maximum ground level concentration is 0.0075  $\mu\text{g}/\text{m}^3$  located 76 meters W from the stack location. The annual controlled Hg maximum ground level concentration is 0.00037  $\mu\text{g}/\text{m}^3$  located 958 meters N from the stack location. There are no Hg standards in the national air pollution control rules and WHO air quality guideline values. There are 1-hourly and annual ambient air quality standards in UK Environmental Agency Environmental Standard which are 7.5  $\mu\text{g}/\text{m}^3$  and 0.25  $\mu\text{g}/\text{m}^3$ . The project will contribute 1-hourly and annually 1.07% and 0.15% of the UK Environmental Agency Environmental Standards. Therefore, the contribution of Hg to the local airshed due to the plant operation has been considered negligible. Hg Isoleths of project contribution is shown in **Figure 7-12**.

The 1-hourly Hg concentration varies from 0.004-0.02  $\mu\text{g}/\text{m}^3$  (0.06%-0.3% of the UK environmental agency environmental standard) at the receptor locations whereas annual Hg concentration was found between 0.00004-0.0003  $\mu\text{g}/\text{m}^3$  (0.016%-0.13% of the UK environmental agency environmental standard). The project Hg's contribution to the sensitive receptor can be considered negligible. The pollution concentration on sensitive receptors is presented in **Table 7-23**.

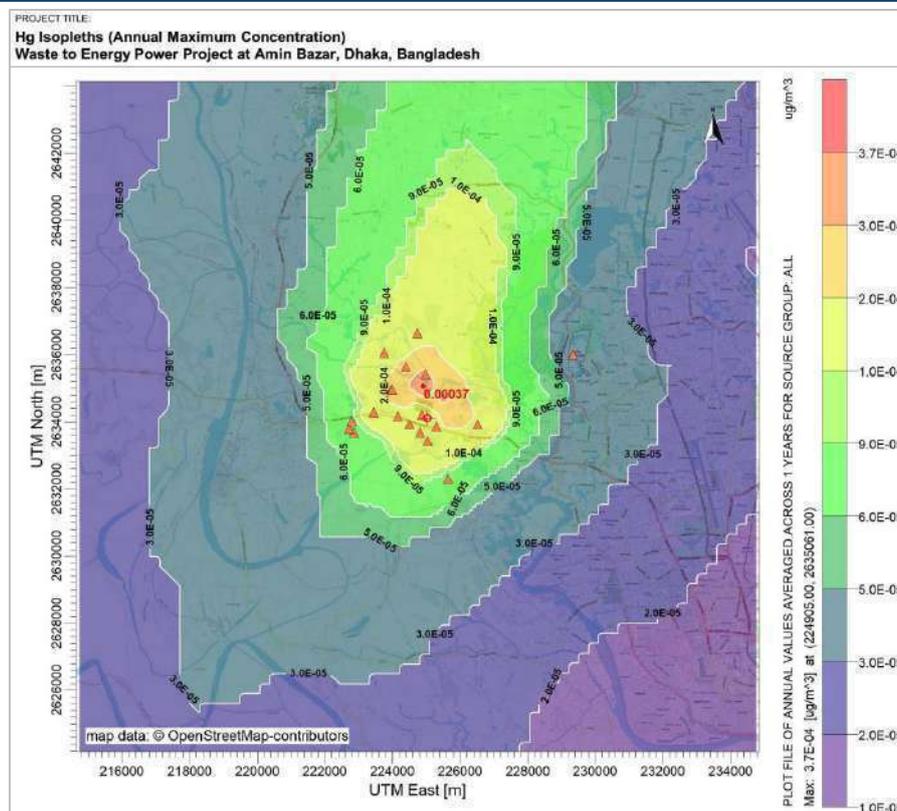
### Project Contribution + Background Concentration

There is no background concentration of Hg in the CASE study. Hence, cumulative assessment (project contribution + background concentration) has not been analyzed for Hg.

**Figure 7-12: Hg Isopleths of Project Contribution**



**1 Hourly Hg Isopleths**



**Annual Hg Isopleths**

### Hydrogen Fluoride (HF)

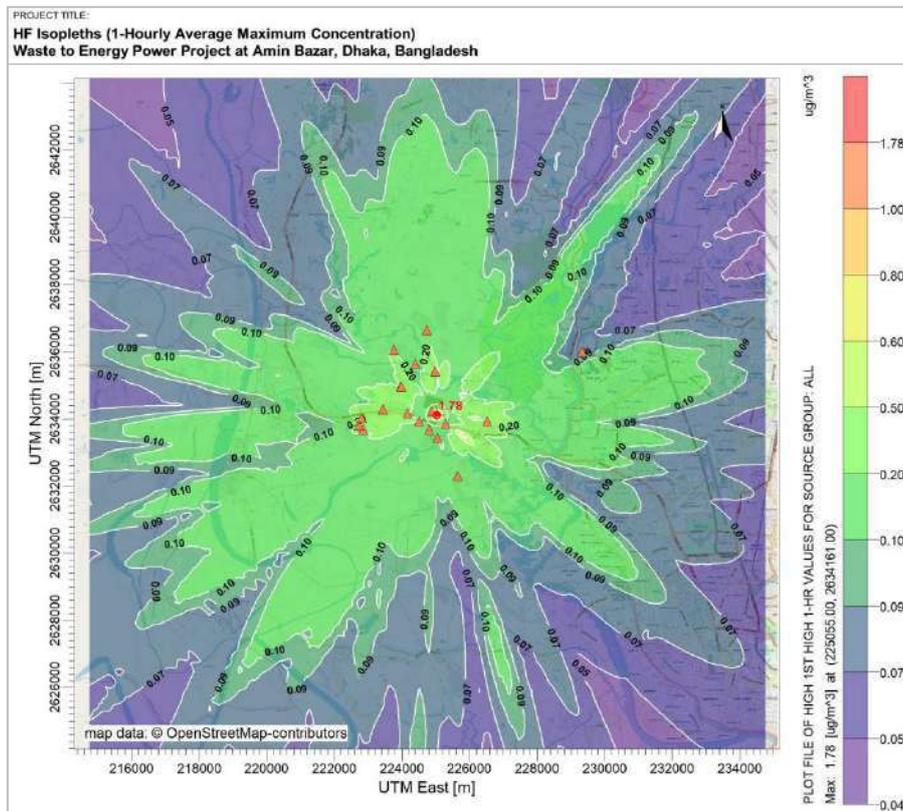
The predicted short-term (1 hour) for controlled hydrogen fluoride (HF) maximum ground level concentrations are  $1.78 \mu\text{g}/\text{m}^3$  located 50.9 m meters N from the stack location (**Table 7-22**). The 24-hour controlled HF maximum ground level concentrations are  $0.15 \mu\text{g}/\text{m}^3$  located 76 meters W from the stack location. The annual controlled HF maximum ground level concentration is  $0.0073 \mu\text{g}/\text{m}^3$  located 958 meters N from the stack location. There are no HF standards in the national air pollution control rules and WHO air quality guideline values. There is only a 1-hourly ambient air quality standard in UK Environmental Agency Environmental Standard which is  $160 \mu\text{g}/\text{m}^3$ . The project will contribute 1-hourly 1.1% of the UK Environmental Agency Environmental Standard. Therefore, the contribution of HF to the local airshed due to the plant operation can be assessed as negligible. HF Isopleths of project contribution is shown in **Figure 7-13**.

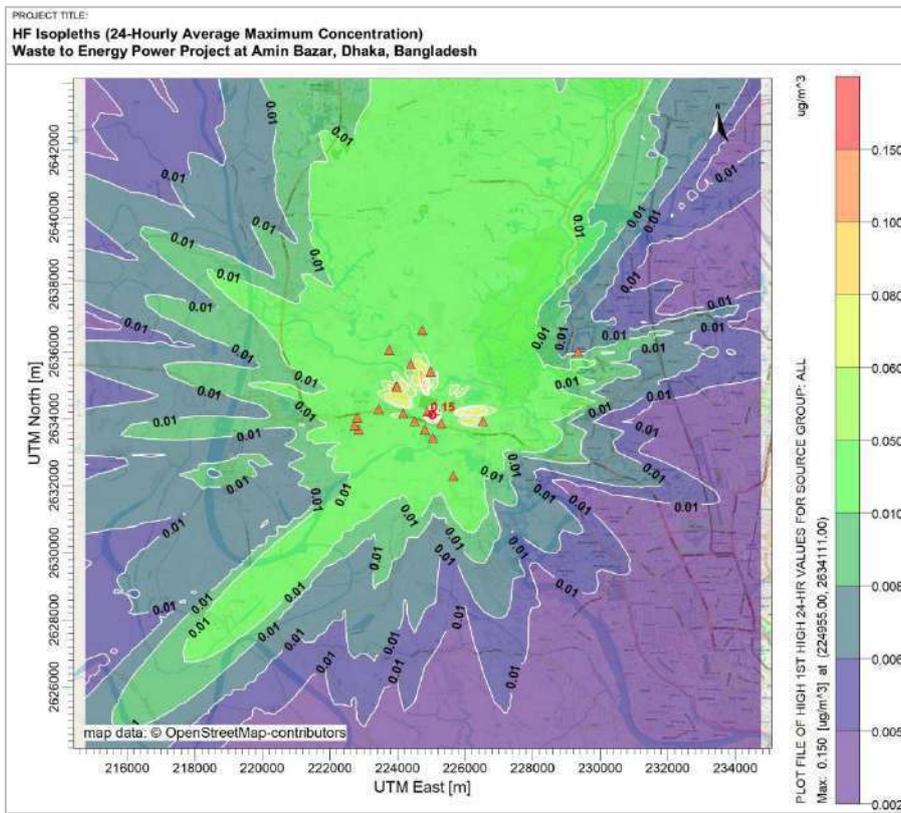
The pollution concentration on sensitive receptors is presented in **Table 7-23**. It shows that the 1-hourly HF concentration varies from  $0.086\text{-}0.43 \mu\text{g}/\text{m}^3$  (0.05%-0.3% of the UK environmental agency environmental standard) at the receptor locations whereas annual HF concentration was found between  $0.0008\text{-}0.006 \mu\text{g}/\text{m}^3$ . Hence, the project HF contribution to the sensitive receptor can be considered negligible.

### Project Contribution + Background Concentration

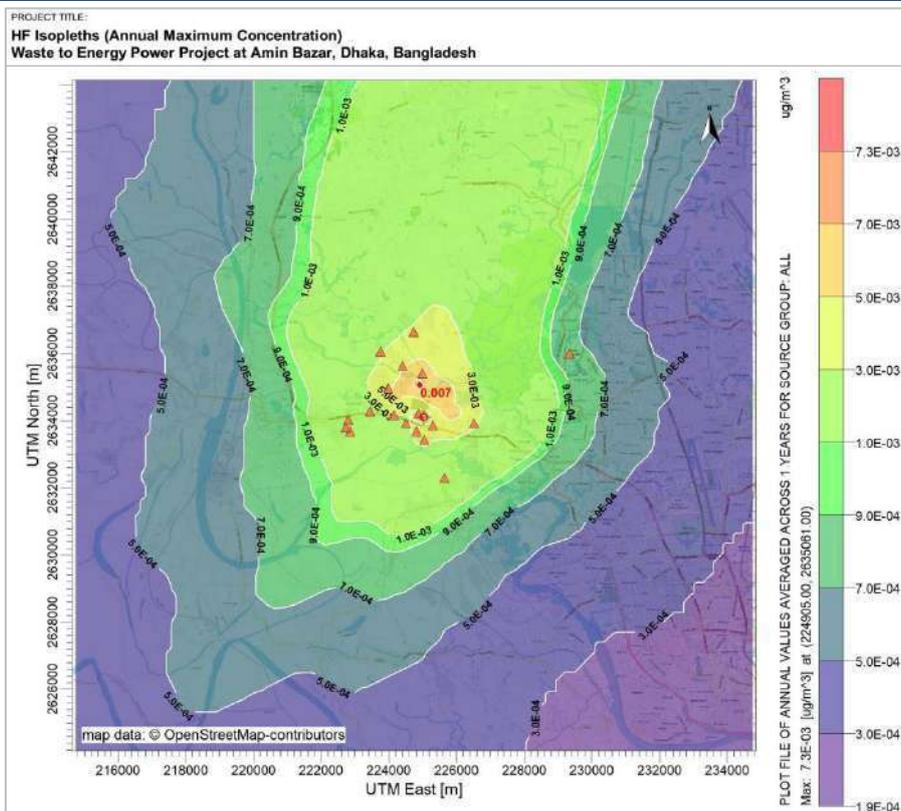
There is no background concentration of Hydrogen Fluoride (HF) in the CASE study. Hence, cumulative assessment (project contribution + background concentration) has not been analyzed for HF.

**Figure 7-13: HF Isopleths of Project Contribution**





**24 Hourly HF Isoleths**



**Annual HF Isoleths**

**Dioxin Furan (DF)**

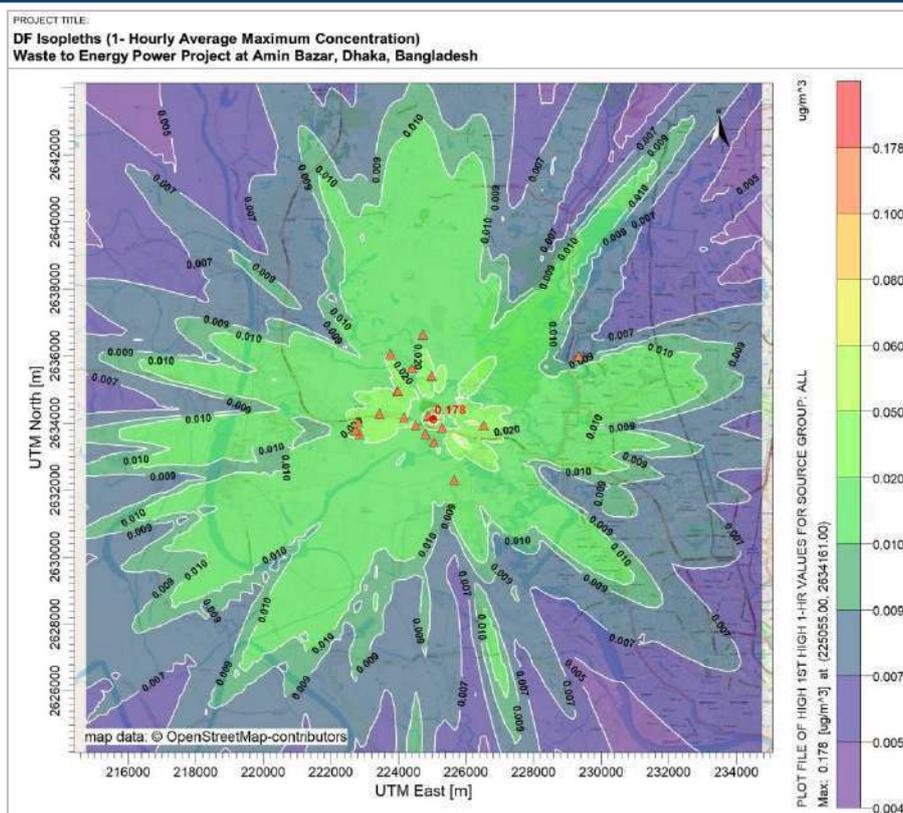
**Table 7-22** shows the model result of different pollutants including Dioxin Furan (DF). It shows that the predicted short-term (1 hour) for controlled Dioxin Furan (DF) maximum ground level concentrations are  $0.178 \mu\text{g}/\text{m}^3$  located 50.9 m meters N from the stack location (**Table 7-22**). The 24-hour controlled DF maximum ground level concentrations are  $0.015 \mu\text{g}/\text{m}^3$  located 76 meters W from the stack location. The annual controlled DF maximum ground level concentration is  $0.00073 \mu\text{g}/\text{m}^3$  located 958 meters N from the stack location. There are no DF standards in the national air pollution control rules and WHO air quality guideline values. The contribution of HF to the local airshed due to the plant operation can be considered negligible. DF Isopleths of project contribution is shown in **Figure 7-13**.

The pollution concentration on sensitive receptors is presented in **Table 7-23**. It shows that the 1-hourly DF concentration varies from  $0.009\text{-}0.043 \mu\text{g}/\text{m}^3$  at the receptor locations whereas annual DF concentration has been found between  $0.00008\text{-}0.0006 \mu\text{g}/\text{m}^3$ . Hence, project DF's contribution to the sensitive receptor can be considered negligible.

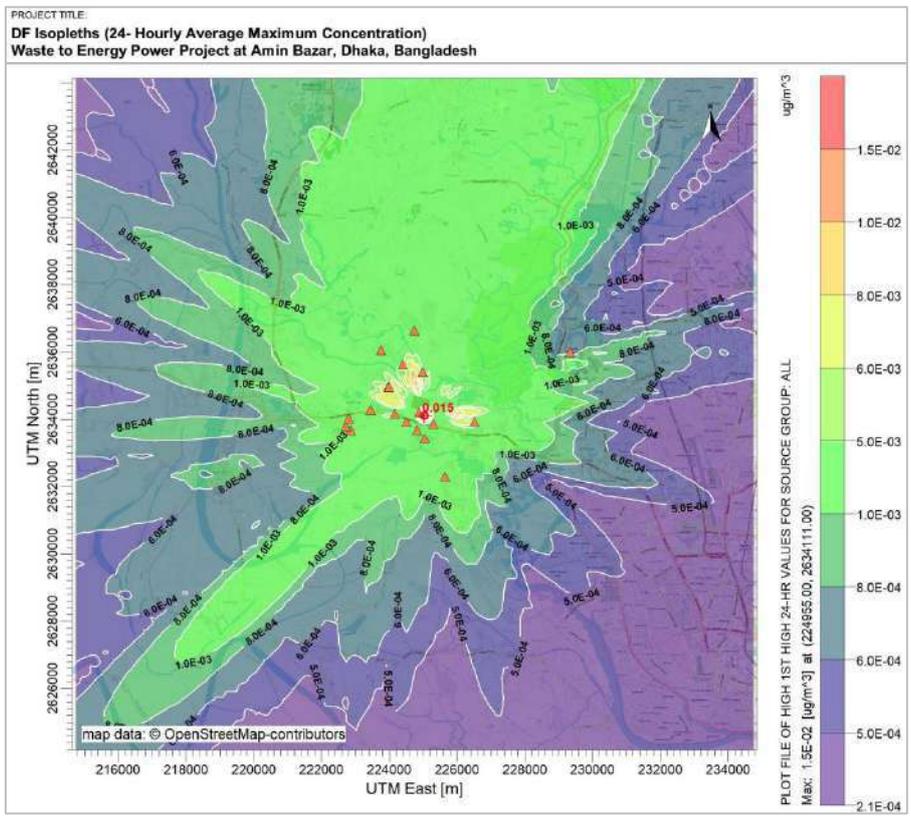
**Project Contribution + Background Concentration**

There is no background concentration of Dioxin Furan (DF) in the CASE study. Hence, cumulative assessment (project contribution + background concentration) has not been analyzed for DF.

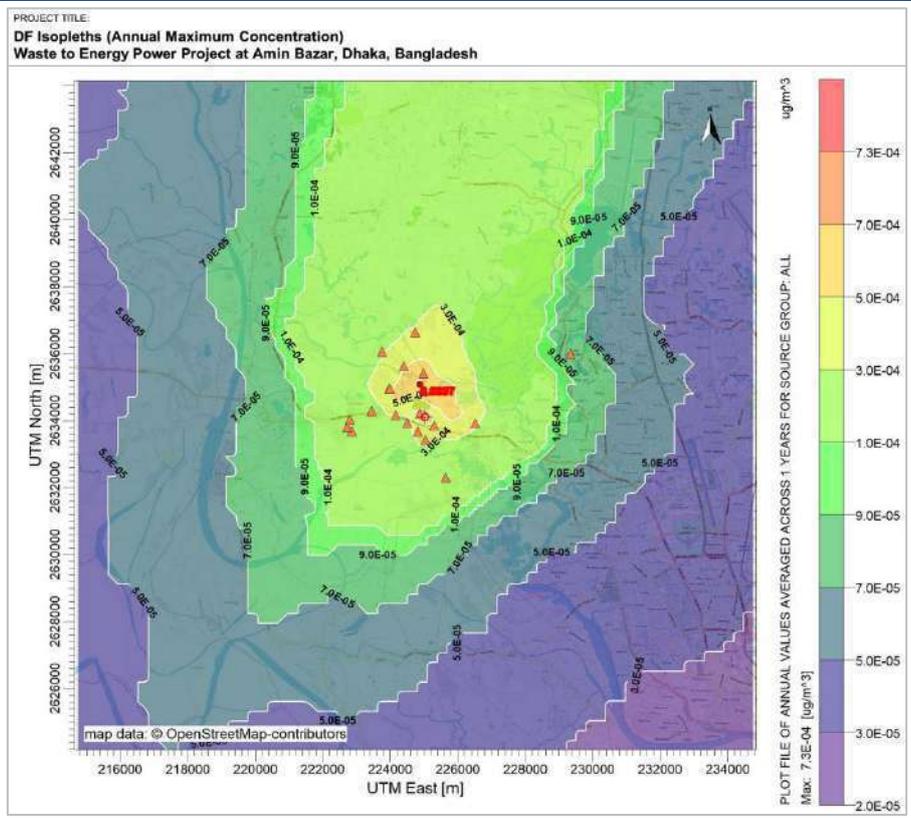
**Figure 7-14: DF Isopleths of Project Contribution**



**1 Hourly DF Isopleths**



**24 Hourly DF Isoleths**



**Annual DF Isoleths**

<b>Impact</b>	<i>Ambient Air Quality</i>					
<b>Impact Nature</b>	Direct		Indirect		Induced	
<b>Impact Scale</b>	The maximum impact zone would be confined to 3km from Project Site					
<b>Frequency</b>	Throughout the project lifecycle					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Magnitude</b>	Insignificant	Low	Medium-low	Medium-high	High	Very High
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		<b>Medium-low</b>			

### Mitigation Measures

The following mitigation measures should be followed.

- The flue gas is to be exhausted at 100m stack height.
- Ensuring the standard of Bangladesh (MoEF) where emissions always should be lower due to nearly presence of any sensitive area.
- The plant equipment must be performance tested during the commissioning phase to ensure the standard has been maintained.
- A continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas.
- Automatic monitoring processes and presentation on real-time Web Pages should be implemented.
- Ambient air quality monitoring stations are to be installed within the project site to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers is to be conducted at other locations.
- Install instruments to record meteorological data such as wind speed, direction, solar radiation, relative humidity, and temperature shall be established so that the operating power plant can record these parameters at regular intervals.
- Regular maintenance and overhauling as per design specification.
- Regular inspection and maintenance of boiler, pressure parts, FD and ID fans bag filter and ash separation and handling system, and other ancillaries.
- Particulate Matter emission concentration will be controlled by a bag filter.
- Selective Non-Catalytic Reduction-SNCR (urea water injection in the furnace) will be adopted for nitrogen oxides control and space for Selective Catalytic Reduction (SCR) will be reserved to

cope with the possible improvement of denitrification standards in the future since the airshed is already degraded.

- Combination mode of "SNCR (urea water injection in the furnace) + semi-dry method (lime pulp solution) + dry method (Ca (OH)<sub>2</sub> dry powder) + activated carbon injection + bag filter + (reserved SCR) will be adopted to control acidic gases (HCl, SO<sub>2</sub>, and HF).
- Control the residence time of flue gas in the furnace above 850°C to ensure adequate decomposition of dioxins.
- Maintain the more stringent emission standard of the European Union Pollutant Emission Standard (European Union 2010/75/EU) since the project location airshed already degraded and
- It is highly recommended to conduct a validation run after 1 to 3 months during the operations stage using actual CEMS, stack testing, and ambient air monitoring results.
- All the parameters of the Air Quality/Emission Standard must have to comply with the Air Pollution Control Rules-2022
- The following air quality monitoring system and air pollution control equipment will be considered for this Waste to Energy Project.

Monitoring	Continuous emission monitoring	Particulate Matter, CO, SO <sub>2</sub> , HF, HCl, NO <sub>x</sub> and other parameters might be added based on clearance certificate condition
	Continuous process parameters monitoring	Furnace Temperature, Flue Gas outlet temperature, pressure, Water vapor or other parameters will be monitored as per clearance certificate condition
	Regular Emission Monitoring (2-4 times in a year)	Heavy Metal, Dioxin and Furan
Air Pollution Control Equipment	Air pollution control device setup	Fabric Filter Dry (Which have Dry Injection Facilities, Packed bed, Venturi or other wet Scrubber, Electrostatic Precipitation (ESP))

### 7.2.3.2 Impacts due to Odor from Waste

The waste requirement is 3,000 t/d whereas the daily wet slag output of this project is estimated at 500 t/d. The maximum wet slag output can reach 600 t/d. DNCC will transport municipal solid waste from the source to the plant. No hazardous waste including medical waste will be accepted as per the agreement with the WTE Power Plant North Dhaka Private Limited. The source of malodor pollution mainly comes from the original waste entering the plant and the produced leachate. The malodorous gas will be emitted by the waste transport vehicle during the unloading process and the waste heap placed in the waste tank, and the malodorous gas may also be emitted by the leachate in the collection facilities and transmission process. Therefore, the main sources of odors during the operation phase will come from the following sources.

- Odorous gas is produced by a waste bunker.
- Odorous gas is produced in the leachate ditch corridor and asphalt collection tank.
- The Discharging Hall produces odor due to the entry and exit of waste trucks.
- Leachate treatment station deodorization.

Malodorous substances in waste (including Stench concentration, Ammonia, Hydrogen sulfide, Methyl thiol, Methyl sulfide, Dimethyl sulfide, Trimethylamine, Acetaldehyde, and Styrene) can possess health

risks to the workers and staff working during the operation phase. Respiratory problems, nausea, headache, and psychological stress could be the main impacts of waste odor. However, the existing landfill system is producing malodor that negatively affects the landfill workers, people of nearby villages, and those walking or traveling along the highway/roads. Malodor generated during the operation phase could pose fewer impacts than the present negative impacts of the existing landfill. Once the project is finished, the existing landfill's harmful effects will be lessened. Thus, the overall impact significance without mitigation measures during the operation phase of the power plant will be medium-low.

<b>Impact</b>	Odor from Waste					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	In and around the project site					
<b>Frequency</b>	During the Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/ Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Medium-low</b>					

### Mitigation Measures

Aiming at the source of malodorous pollution in waste tanks, the following control measures shall be taken.

- The waste loading ramp shall be capped to control the malodorous diffusion caused by the dissipation of leachate from the waste truck.
- An Air curtain shall be set up at the inlet and outlet of the tipping hall to prevent malodor escape.
- Negative pressure shall be maintained inside the waste tank to prevent the spread of malodor inside the waste tank.
- Aiming at the characteristics that malodor can be decomposed at high temperatures, the gas in the pit is extracted from the upper part of the waste tank by a PA fan and fed into the incinerator after preheating, which is used as a secondary air for combustion.
- In the incinerator and maintenance, to ensure the negative pressure in the waste tank, the odor in the waste tank will be pumped out by the deodorizer and fed into the activated carbon adsorption deodorizer. The odor pollutants are adsorbed and filtered by the activated carbon and discharged into the atmosphere after reaching the malodor discharge standard.

- In abnormal operation (when the shutdown state or the negative pressure is not enough), the deodorizing fan of the deodorizing system feeds the odor of the waste tank into the activated carbon deodorizing device located in the deodorizing room for adsorption and filtration and then drains it to the upper air, to ensure the air quality in the incineration power plant area.
- The waste leachate collection chamber is composed of a leachate sump, leachate pump room, and corridor, and these areas will produce a large amount of odor. Therefore, the air supply and exhaust outlets will be set in the space of the leachate collection room, the air supply fan feeds fresh air, and the exhaust fan introduces the odor generated in this space into the waste tank and burns and decomposes in the PA fan inhalation incinerator.

In addition, waste-transporting vehicles shall be covered properly. However, with the proper implementation of suggested mitigation measures, the overall impact will be Very low.

### 7.2.3.3 Impact on Climate due to Green House Gases Emissions

According to the study, based on the project’s annual incineration of 1.09 million tons of domestic waste , calculated according to the industry’s direct emissions (IPCC method, the period is 7 years), the waste incineration mineral carbon emissions are 270,200 tons of CO<sub>2</sub> , methane (CH<sub>4</sub> ) and Dinitrogen monoxide (N<sub>2</sub>O) emission converted into carbon dioxide (CO<sub>2</sub> ) equivalent is 1.36 CO<sub>2</sub> e ; waste incineration technology is used instead of traditional waste landfill process, during the period the average annual carbon emission offset is 418,900 tons CO<sub>2</sub> e; carbon emission offset of waste incineration power generation replacing coal-fired power generation is 226,700 tons of CO<sub>2</sub> (according to the average emission factor of China’s power grid in 2022 is 0.5703t CO<sub>2</sub> /MWh), so this project is relatively waste landfill treatment process, The annual average carbon emission reduction during the period is 361,700 tons of CO<sub>2</sub> , which is equivalent to 0.332 t CO<sub>2</sub> of carbon emission reduction per ton of waste. Details of the Green House Gases Emissions are presented in **Appendix N**:

Considering this fact, the GHG emission impact will be **low**.

Impact	<i>Impact on climate due to greenhouse gas emissions</i>					
Impact Nature	Direct	Indirect			Induced	
Impact Scale	The impact zone will be regional/national					
Frequency	Operation Phase					
Extent and Location	Project Site	Local	Regional	National	Trans Boundary	
Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss of Resources	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

### Mitigation Measures

The following mitigation measures will minimize GHG emissions to ALARP (as low as reasonably practicable) level:

- Monitoring and recording of CO<sub>2</sub> emissions from the stacks
- A continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas.
- Ensure that all equipment and machinery are maintained following the manufacturer's specifications; and
- Improved efficiency of auxiliary drives.

#### **7.2.3.4 Impact on Noise Quality**

##### **Source of Impact**

Significant sources of noise during the operation of the power plant will be:

- Operations of the turbine, blower, cranes, bucket elevator, and conveyor belt.
- Boiler, air compressor, pumps
- Cooling tower

##### **Prediction of Impacts**

##### **Methodology:**

The environmental noise prediction model Sound PLAN 8.2 was used for modeling noise emissions from the plant operation. The major noise sources are machinery in the production and processing unit, Compressors, Turbines, Boiler exhaust, pumps, etc.

Noise escape from the turbine hall is 70 dB(A). Noise generated in pumps is 85 dB(A). The noise from the air compressor is 90 dB(A). Noise generated from primary or secondary ID fans is 85 dB(A). The noise from the cooling tower fan is 85 dB(A). The Boundary brick wall height is 2.2 m. We have assumed cooling tower fan speed is decreased by 20% during nighttime and that noise generation from the fan will be decreased by 5 dB(A). The operation of equipment with a 100% usage scenario was modeled to cover the operation phase of the Project. As a conservative approach to the assessment, atmospheric absorption during sound transmission was not included in the assessment. In addition, to represent a worst-case scenario for the assessment, all equipment was assumed to operate simultaneously. To assess the impact on noise reflection/ barrier due to the structures, buildings within the power plant have been considered. The model has been run to predict the day and nighttime noise levels around the power plant during its operation of the power plant.

##### **Noise contour map**

Based on the noise propagation from the power plant noise contour map has been prepared using the modeling tool. The power plant's day and nighttime noise contour maps are shown in Figure 7-15 and Figure 7-16, respectively. The predicted noise level in the receptors point during the operation of the power plant is shown in Table 7-24.

Figure 7-15: Noise contour map for WTE Power Plant North Dhaka Private Limited Waste to Energy Power Plant during the day (Leq day)

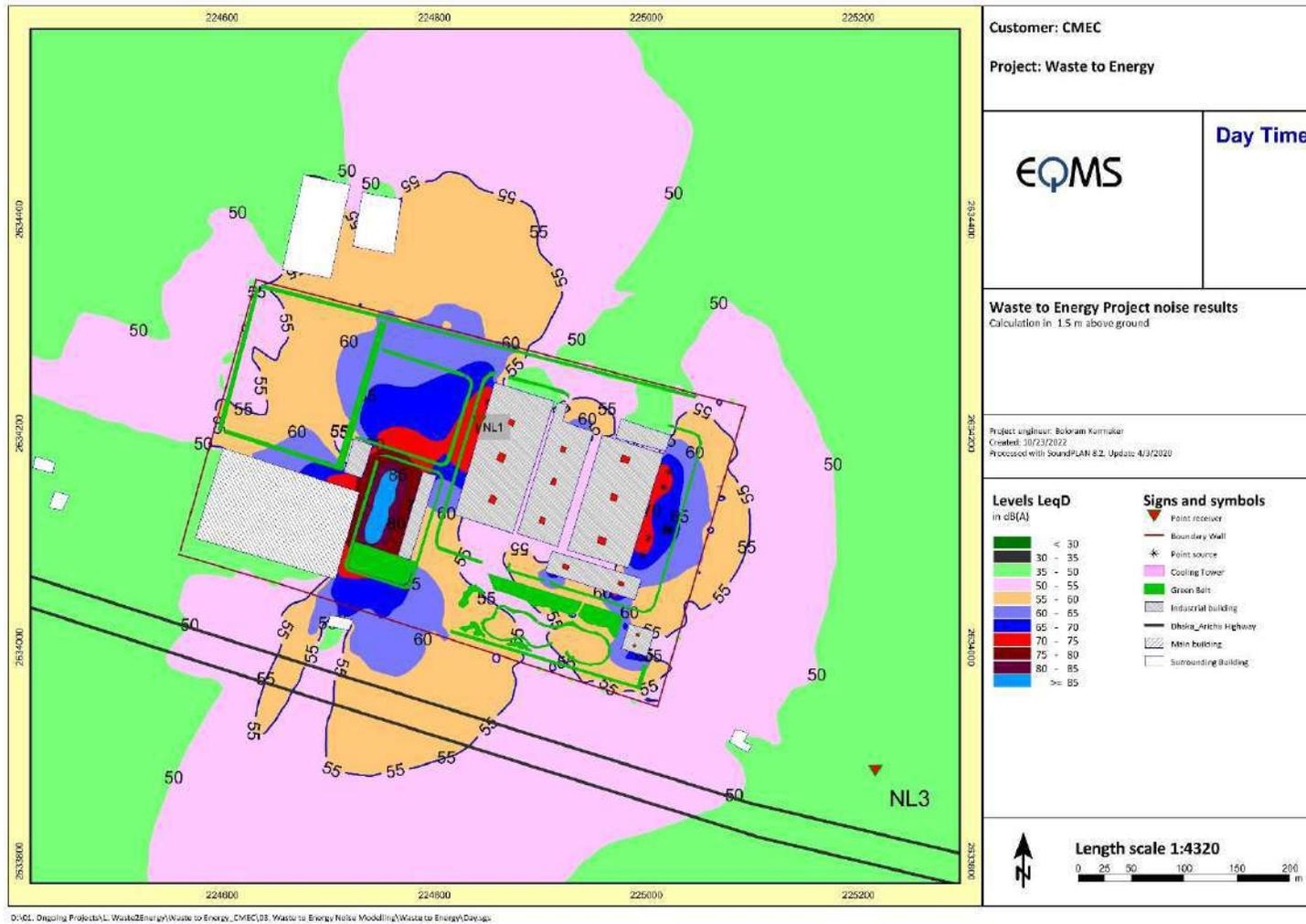
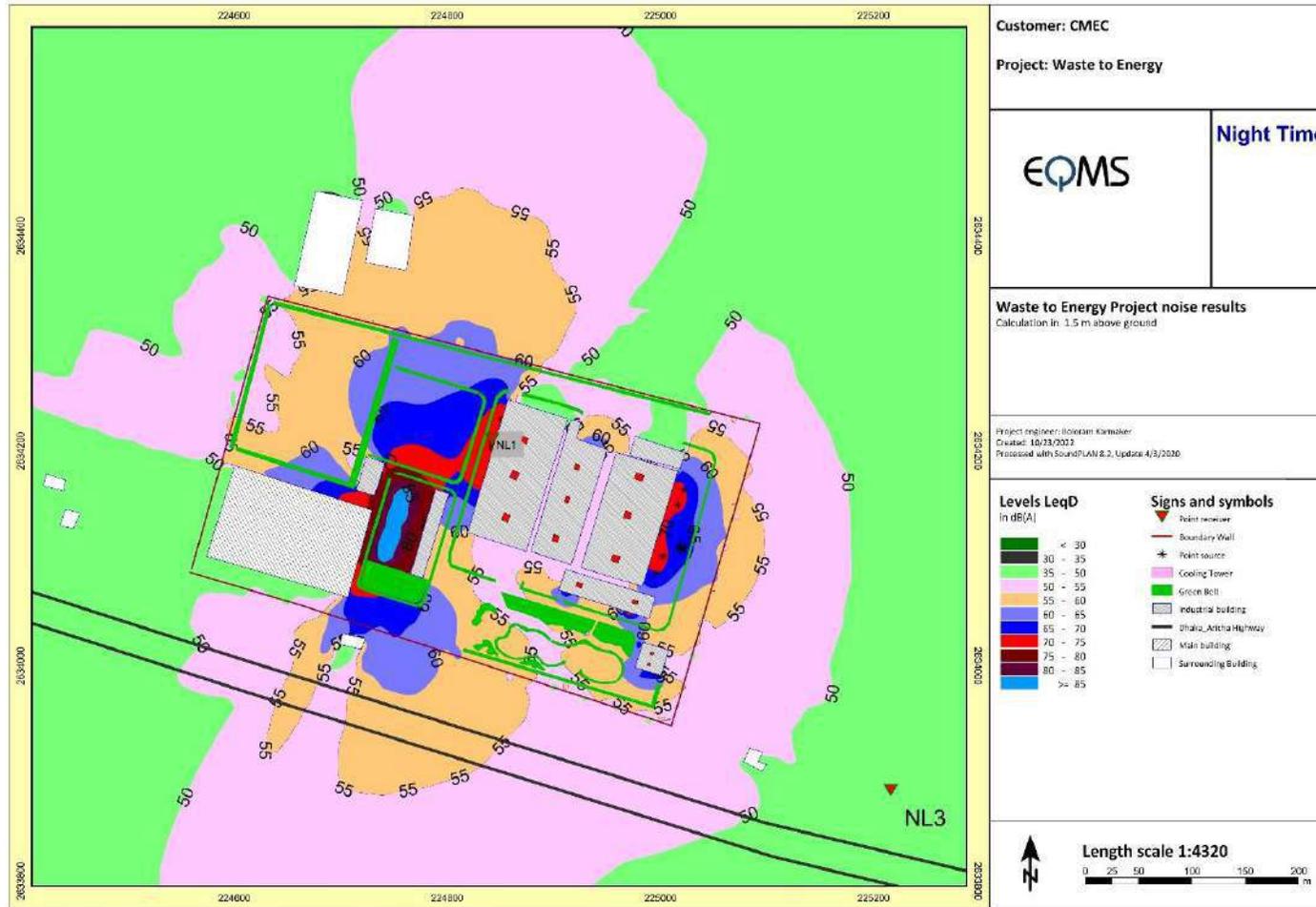


Figure 7-16: Noise contour map for WTE Power Plant North Dhaka Private Limited Waste to Energy Power Plant during the night (Leq Night)



**Table 7-24: Predicted Noise Levels at Receptors during operation of Waste to Energy power plant operation**

Receptor	Category of Area/Receptor	Distance from plant center point	Baseline Sound Pressure Levels at Receptors, Leq (dBA) <sup>1</sup>		Noise Contribution from Power Plant at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable Standard, dB(A) <sup>2</sup> as per Land use		IFC EHS Guideline (2007) <sup>3</sup>	
			Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn
NL1	Project Area	70	66.8	57.5	74.3	73.8	75.0	73.9	75	70	70	70
NL2	Residential	472	54.8	43.1	48.9	43.8	55.8	46.5	55	45	55	45
NL3	Mixed	466	67.3	64.6	47.9	46	67.3	64.7	60	50	70	70
NL4	Mixed	1047	76.9	72.8	43	36.8	76.9	72.8	60	50	70	70
NL5	Residential	988	55.1	43.2	43	37.5	55.4	44.2	55	45	55	45
NL6	Silent	1160	51.5	43.2	40.3	35.2	51.8	43.8	50	40	55	45

1) Ambient noise levels as monitored during the baseline survey.

2) Noise Pollution (Control) Rules, 2006

3) Guidelines values are for noise levels measured outside. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

**Impact Significance**

The predicted noise level at NL1 is 75.0 and 73.9 dB(A) for day and nighttime respectively which exceeded the IFC permissible limit. As the point is very close to the main power plant noise level will be higher. However, the noise level in the boundary of the power plant will vary from 55 to 60 dB(A) which is well below the IFC industrial permissible limit of 70 dB(A).

The predicted noise level at NL2 was found little higher than the residential area’s noise permissible limit as the surrounding environment of the receptors is not considered. However, the incremental noise is below 3 dB(A), which complies with IFC noise level guidelines<sup>32</sup>. NL3 is located beside the Dhaka-Aricha highway, therefore, the baseline noise is exceeded, and the project operation will increase the baseline noise by 0.1 dBA in the nighttime. The model depicts that the baseline noise at NL4 will remain the same for daytime and 0.1 dB(A) increase in nighttime during the operation of the power plant. Baseline noise during daytime at NL5 has already exceeded 0.1 dB(A). Which will be further increased by 0.3 dB(A) during the operation of the power plant. Baseline noise at NL6 has slightly exceeded the permissible limit and during the operation period, it will be increased by 0.3 and 0.6 dB(A) during the day and nighttime, respectively.

The calculated impact significance is **Low**.

<b>Impact</b>	<i>Impact on ambient noise level due to the operation of the power plant</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	In and around the project site					
<b>Frequency</b>	During the operational phase					
<b>Extent and location</b>	Project Site	Local	Regional	National	Transboundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent – Mitigated	Permanent – no mitigation	
<b>Impact Intensity/ severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for irreplaceable loss of resources</b>	Low		Medium		High	
<b>Magnitude</b>	Insignificant	Low	Medium-low	Medium-high	High	Very High
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very low	Low	Medium-Low	Medium-high	High	Very High
	Significance of impact is considered <b>Low</b>					

**Mitigation Measures:**

The noise level in the proposed power plant can be controlled to a tolerable limit by implementing the following mitigation measures:

- Equipment shall be selected with low noise as far as possible.

<sup>32</sup> IFC Environmental, Health and Safety (EHS) General Guidelines (2007)

- The high-noise equipment, such as air compressors, machine repair equipment, and incineration system in the general layout, is centrally arranged in the incineration power plant room.
- For equipment with a higher noise level, such as fan, sound insulation, sound elimination, and vibration reduction under different circumstances shall be adopted.
- Comprehensive control measures shall be adopted such as low noise equipment and sound absorption, for example, PA and SA fan and ID fan set up mufflers and vibration damping devices to make the noise in the workplace and environment reach the standard.
- Where it is still difficult to reach the control standard for the workplace after treatment, such as the place where Turbine Hall and other equipment are continuously operated, the measures for setting sound insulation Control Room shall be taken.
- Flexible connection measures shall be taken for the pipeline that may generate noise, especially the pipeline connected with the pump and fan outlet, to control the vibration noise.
- Noise attenuation provisions such as air intake silencers and acoustic insulation around noisy equipment shall be installed.
- Buildings shall be designed with improved acoustic performance, and sound insulation shall be provided.
- The diesel generator unit shall be arranged in an outdoor box, and attention shall be paid to sound insulation and noise reduction.
- Green belts shall be developed around and inside the power plant.
- The unnecessary use of alarms, horns, and sirens should be avoided.

With proper mitigation measures, noise impact might be low.

### **7.2.3.5 Impact on Water Resources**

During the operation of the project, sources of water pollution include:

- Waste or scattered oil on the roads in the project area of the means of transportation of garbage to the plant.
- Industrial and Domestic Wastewater
- Waste leachate

The surface water body in the study area may be affected by runoff from areas of storage of leachate, blow-down water from the cooling tower & boiler, effluent from the ash quenching area, or flow of untreated sewage.

There is a Karnatali River about 595m north of the proposed plant site, which is a wide river and has a large water volume, with a minimum monthly water supply of 0.48m<sup>3</sup>/s and a minimum water level of 0.86m (which can meet the water demand of the project), which can also be considered as the water source of this project. The water inlet and pump house of this project is placed on the shore. The water consumption of this project is 8,752.8 m<sup>3</sup>/d. It is planned to use river water as the source of industrial water for this project, and groundwater as the standby source of industrial water, and at the same time, it is necessary to set up water intake facilities such as a water inlet and water intake pump room in the river water area. Disinfected river water and groundwater will be used as the domestic water source. This project will adopt 3 Deep tube wells for the abstraction of groundwater as well.

The number of staff in the whole factory is 130 people. Total water needs for domestic purposes is about 44 m<sup>3</sup>/d. The main feedwater objects of circulating cooling water are steam engine condenser, air cooler, oil cooler, and other equipment, and the total circulating cooling water volume is 475440 t/d. Water consumption for reuse is estimated at 527 t/d. The effluent water from the leachate treatment station in the factory is all reused for cooling tower replenishment, and the concentrated solution is used for lime pulp preparation and fly ash solidification. This part of the water volume is 1040 t/d. The daily consumption of chemical water is 870 m<sup>3</sup>/d, using industrial water after treatment. The fire control

system of the whole factory includes an indoor hydrant feed water system and an outdoor hydrant feed water system. For the fire control system, about 792 m<sup>3</sup> of water consumption for one fire extinguisher was considered.

#### 7.2.3.5.1 Water Abstraction

The monthly average flow of the Karnatali River varied from 1.2 to 2.74 m<sup>3</sup>/s. The flow is minimum from February to March (1.2 m<sup>3</sup>/s) and the dry period prevails until May. Then the flow rises rapidly and reaches its peak during August (274.7 m<sup>3</sup>/s). Therefore, water availability could be lower from January to April compared to the rest of the months.

Moreover, due to proposed hard-standing areas (lay down areas, building foundations, compacted gravel roads), and compacted soil (rows between arrays) covering large parts of the site, the recharge to groundwater from rainfall is expected to be reduced on the site.

The depth of the aquifer varies between 6m and 17m in most places. As the Karnatali River flows close to the project site the groundwater recharge rate is quite well in the project study area. As mentioned above, the total amount of water will be needed to uptake from both surface and groundwater will be 364.7 m<sup>3</sup>/hr (8,752.8 tons/day) whereas the domestic water requirement is about 44 m<sup>3</sup>/d. The consumption of surface water mainly comes from the consumption of domestic water, some production experimental water, evaporation loss of cooling towers, windage loss, sewage loss, fly ash solidification, flue gas treatment, demineralized water preparation, etc. This amount of water consumption may have a significant impact on surface water resources and the groundwater table as well. The project authority needs required permission following the Bangladesh Water Rules 2018 to extract the ground/surface water for this proposed project.

Considering the abovementioned fact, the surface and groundwater availability during the operation fact assessed as **medium-low**.

<b>Impact</b>	<i>Surface and Ground Water Abstraction</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Karnatali River and Surrounding area of the Project Location					
<b>Frequency</b>	Throughout the Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Medium-low</b>					

#### Mitigation Measures

The following measure will be implemented to mitigate water consumption:

- Periodical training to workers for best utilization of water.

- If the water flow rate is low compared to the water, use during the operation period proponent should consider the use of groundwater depending on the borehole testing in the project site and surroundings.
- The wastewater emanating from cleaning operations shall be recycled for plantation and greenbelt development around the project. The rest of the wastewater will be deposited in a rainwater harvesting pond.
- A water intake Permission letter from WARPO and local government shall be needed (Appendix B-2:)

The impact due to water abstraction from Karnatali River and groundwater will have medium intensity with local extent for a long duration which will result in an overall medium-low impact without mitigation. However, with the proper implementation of suggested mitigation measures, the overall impact will be low.

### 7.2.3.5.2 Surface and Ground Water Contamination

The sources of liquid effluent generation in the plant include:

- Wastewater from domestic sewage, production sewage, waste leachate, waste truck flushing sewage
- Oily effluents from engine hall, transformer yard, compressor, and Emergency DG set area; fuel loading/ unloading areas.
- Filters (service water filtration plant) backwash.
- Domestic wastewater is generated from offices, canteen, dormitory and guest houses, and driver rest areas.
- Wastewater from the water treatment plant
- Oily water from transformer pits.
- Oily water from buildings/areas like lube oil storage tanks, equipment maintenance area floor drains, etc

The industrial sewage of the whole factory mainly comes from the leachate produced by the waste pit, the vehicle flushing water in the factory, and the ground flushing water in the separate system, with a maximum water volume of 1500 m<sup>3</sup>/d. The production of wastewater of the project mainly includes recirculating water sewage, backwashing water of the water purification station, etc. Approximately 2,793.2m<sup>2</sup>/day will be generated during the plant operation and discharged from the plant to the water body nearby. Discharge of untreated liquid wastes may generate during the operation phase is likely to contaminate/degrade the surface water quality, when discharged into the adjoining channel of Karnatali. Discharges from the proposed project's operation activities are likely to have an impact throughout the project life, and likely to pose a significant impact on the surface water quality, if discharged without adequate treatment and mitigation measures. In addition, surface water and groundwater impacts associated with leaks and spills are reduced during the operation phase since on-site storage of hydrocarbons and site activities will be considerably reduced.

Surface and Groundwater contamination during the operation phase have been assessed as **Medium-Low**.

Impact	<i>Surface and Ground Water Contamination</i>				
Impact Nature	Direct	Indirect		Induced	
Impact Scale	Karnatali River and Surrounding area of the Project Location				
Frequency	Throughout the Operation Phase				
Extent and Location	Project Site	Local	Regional	National	Trans Boundary

Impact Duration	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
Impact Intensity/Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss of Resources	Low		Medium		High	
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Medium-low</b>					

### Mitigation Measures

The following measures shall be taken.

- Monitoring of temperature at the discharge point at a frequency of every 15 days.
- Leak-proof oil transfer mechanism from an oil tanker to an oil storage tank
- Sanitary effluent should be deposited in the septic tank.
- Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas; and
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into the ground.
- Wastewater of similar nature from different units will be treated following GOB Environment Conservation Rule (2023) Schedule 4 (Standards for Waste from Industrial Units or Project Waste).
- All chemicals will be stored in primary containers that have in-built secondary containment of capacity that is at least 110% of primary containment.
- Details of the slag treatment system are described in section 3.14.4
- Details of the leachate treatment process are described in section 3.14.5

The impact on surface and groundwater will have medium intensity with local extent for a medium-term duration which will result in an overall medium-low impact without mitigation. However, with the proper implementation of suggested mitigation measures, the overall impact will be Very low.

#### 7.2.3.6 Impact due to Waste Generation

The potential sources of waste generated during the operation of the Power plant are the following:

- Waste incineration
- The boiler blows down water.
- Cooling water blows down.
- Domestic waste (solid and liquid)
- Effluent treatment plant
- Leachate from the municipal waste
- Powerhouse and workshop area

#### Solid Waste

The operation of waste in an energy power plant will generate both solid and liquid waste. Solid waste includes fly ash, bottom ash, general refuse, scrap, used metals, batteries, empty containers, used paint, engine oils, hydraulic fluids, as well as waste fuel, etc.

As per the feasibility study report, waste will be dumped for 365 days at the plant and incinerated for 333 days where about 3000-ton waste is planned to be burnt daily. The incineration process will produce fly ash and bottom ash as well. The estimated fly ash output from the whole plant is about 74.8 tons/day. The fly ash of this project is mainly composed of the discharge of the reaction tower and the soot collected by the bag filter. The composition of fly ash is complex and has a high leaching concentration of heavy metals such as lead (Pb) and cadmium (Cd) and other toxic substances such as dioxins. If the fly ash is directly landfilled, and by the action of rainwater immersion, the soluble harmful components have the risk of leaching into the groundwater and surface water which can affect groundwater quality and the aquatic ecosystem of Karnatali River. This could also impact air quality and human health due to the size and density that can go airborne with the combustion gases when released into the atmosphere. After solidification/stabilization treatment, the fly ash will be transported to the landfill site for safe disposal if the following conditions are met: (1) Water content is less than 30%; (2) dioxin content is less than 3 µg-TEQ/kg.

Also, during the operation phases, there would be the generation of solid waste and municipal waste including paper, cartons, bags, boxes, office wastes, etc. along with a minor quantity of domestic waste. During the operation phase of the project, around 100 workers would be employed. It is estimated that around 80 kg/day of municipal solid waste would be generated. Solid and municipal waste would be collected, segregated, and disposed of through local waste management bodies.

### Liquid Waste

The liquid waste will generate for this project can be considered to comprise domestic sewage, production sewage, waste leachate, and waste truck flushing sewage.

Wet slag also will be produced due to the waste incineration process. The amount of wet slag to be produced is about 500 tons/day which could reach 600 tons/day. Hazardous constituents of ash and slag can migrate from the dump surface through the air and water action contaminate the atmosphere, soil, groundwater, and surface water. Fly ash landfill and slag comprehensive utilization workshop, considering the occupational health safety and convenience of logistics and transportation, this area is arranged on the northwest side of the plant and is also arranged far from the front area of the plant.

Also, fuel and chemicals like acids/alkalis for water treatment purposes can be generated during the operation phase. Various types of hazardous and non-hazardous wastes would be generated during normal operation of the power plant which has the potential to degrade soil quality and sediment quality if not stored and handled properly.

The land around the Project site is mostly fallow or agricultural. A natural drainage channel is located adjacent to the project site on the north side. Improper storage, handling, and disposal of solid and hazardous waste may lead to contamination of the land and water bodies nearby. In addition, waste can generate odors and cause health hazards to employees and communities nearby. Thus, the overall impact significance without mitigation measures during the operation phase of the power plant will be **Medium-Low**.

<b>Impact</b>	<i>Impact due to Waste Generation</i>				
<b>Impact Nature</b>	Direct	Indirect		Induced	
<b>Impact Scale</b>	In and around the project site				
<b>Frequency</b>	Limited to Operation Phase				
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation

Impact Intensity/ Severity	Insignificant	Low	Medium	High	Very High	
Potential for Irreplaceable Loss of Resources	Low		Medium	High		
Probability of Impact	Unlikely	Low	Medium	High	Definite	
Impact Significance	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Medium-low</b>					

### Mitigation Measures

- The Contractor would ensure that the hazardous waste plan is based on national EHS guidelines for all solid and hazardous waste and implemented adequately.
- Recyclable Waste will be sold to the authorized recycler and the other solid wastes will be disposed of at a locally designated landfill facility.
- Oily waste and chemicals would be stored in tanks/containers that have sufficient secondary containment (~110% more than their capacity).
- All hazardous waste should be properly leveled with information including the Name & type of waste, and the amount of waste. The waste will be removed from the site at regular intervals for safe disposal at the designated site through authorized vendors.
- The Contractor would have a Spill Management plan in place delineating plans and procedures for preventive and corrective actions against any potential spillage of harmful materials and provision of adequate spill kits.
- It would be ensured that activities involving oil handling are carried out on impermeable surfaces and training of workers would be undertaken to manage spill management.
- The wastewater in the plant area after treatment may be used for car washing, ground washing, residue cooling, and greening.
- Prevent the indiscriminate discharge of untreated effluent from the process, equipment/vehicle washing, and chemical/fuel storage areas into the unpaved and open ground.
- A spill response plan and emergency plan will be prepared to address accidental spillages or release of hazardous wastes; and
- Wastewater containing high concentrations of inorganic chlorine salts and heavy metals can only be discharged after treatment.
- Details of Flying ash collection and treatment system are described in section 3.14.2
- Details of the slag treatment system are described in section 3.14.4
- Details of the leachate treatment process are described in section 3.14.5

However, with the proper implementation of suggested mitigation measures, the overall impact will be Very low.

### 7.2.3.7 Impact on Soil Quality

During the operation phase of the project, the soil may get polluted/ contaminated from the littering of various kinds of municipal wastes, leakage of leachates, and due to fly ash or bottom ash.

The following activities will lead to an impact on soil quality:

- Material Handling and Storage
- Hazardous and Non- Hazardous Material during maintenance activity

Compaction of soils from increased leveling and grading of areas within the site will result in lower permeability and therefore, decreased infiltration and increased runoff. Without appropriate measures, compacted areas, and hard-standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

Once the project is commissioned there will be a limited disturbance to the soil, however, repair and maintenance of underground cables and associated utilities will lead to a generation of hazardous wastes such as used transformer oil. The defunct/damaged equipment will also be generated and storage/disposal on the unpaved ground can lead to contamination of soil is hazardous waste. Without proper management, the impact on soil quality has been assessed as Low.

<b>Impact</b>	<i>Soil Contamination from waste and spillage</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Within the project site					
<b>Frequency</b>	Throughout the Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium	High		
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

### Mitigation Measures

Disturbance to the soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken. WTE Power Plant North Dhaka Private Limited shall explore the option of buyback agreements for defunct equipment replacement and disposal of transformer oil by the supplier, otherwise, arrangements shall be made for the disposal of defunct equipment and waste oil by authorized recyclers. Fuel and used oil storage areas will be contained in bunds of 110 capacity of the stored material. Only covered trucks will be allowed to enter the premises for unloading of materials, good housing keeping will help to control contamination of soil. However, with the proper implementation of suggested mitigation measures, the overall impact will be Very low.

### 7.2.3.8 Impact on Ecosystem and Biodiversity

#### 7.2.3.8.1 Impact on Terrestrial Flora

The major sources of impact on terrestrial flora during the operation phase include flue gas and fly ash production due to the incineration of wastes. The production of fly ash is 74.8 t/d or 24,908.4 t/year (considering wastes incinerated for 333 days). Particulate matter of fly ash will be deposited on plant leaves, twigs, and stems which may hamper photosynthesis, respiration, and other physiological processes. As a result, it will affect plant growth and cause diseases. Also, the emission of SO<sub>x</sub>, NO<sub>2</sub>, and other flue gases will impact plant growth. However, the dispersion of Flue gas emission and

deposition of fly ash contents decreases over the distance considering wind speed, topography, and the presence of physical barriers.

During the baseline study, a total of 44 plant species belonging to 23 families were recorded from the project AOI. However, the baseline study represents no threatened terrestrial plant species within the project AOI.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial flora during the operation phase might be less significant. Therefore, it is assessed as **Low**.

<b>Impact</b>	<i>Impact on Terrestrial Flora</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Limited to Project Area of Influence					
<b>Frequency</b>	Limited to Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

The project impact will be long-term to a regional extent within the project AOI of the project site but the probability of impact and potential for irreplaceable loss of resources will be low. Therefore, the potential impact on terrestrial flora can be reduced to Very Low by following proper mitigation measures.

- A plantation plan shall be implemented for greenbelt development with appropriate indigenous species. Extensive plantation of pollutant-resistant trees in and around the project area will serve as a pollution sink and noise barrier
- Plant health monitoring shall be conducted regularly.

#### 7.2.3.8.2 Impact on Terrestrial Fauna

During the baseline study, a total of 40 bird species, 4 amphibian species, 8 reptile species, and 5 mammal species were recorded from the project AOI. None of these species is assessed as conservation significant by the IUCN Red List of Bangladesh (2015). However, two reptiles Bengal Monitor Lizard (*Varanus bengalensis*) and Spectacled Cobra (*Naja naja*) are considered Near Threatened according to the IUCN Red List of Bangladesh (2015).

Flue gas and fly ash production due to the incineration of wastes during the operation phase will impact the health, behavior, and reproduction of terrestrial fauna. Also, heavy metal components will enter the food chain of different terrestrial faunal species which might impact the biogeochemical cycles. However, the dispersion of Flue gas emission and deposition of fly ash contents decreases over the distance considering wind speed, topography, and the presence of physical barriers. In addition, the generation

of noise and light from the plant operation will impact the movement of nocturnal faunal species and degrade their habitat of them.

Considering the project activities and potential biological receptors within the project AOI, the impact on terrestrial fauna during the operation phase might be less significant. Therefore, it is assessed as **Low**.

<b>Impact</b>	<i>Impact on Terrestrial Fauna</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Limited to Project Area of Influence					
<b>Frequency</b>	Limited to Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

The project impact will be long-term to a regional extent within the project AOI of the project site, but the probability of impact will be low. Therefore, the potential impact on terrestrial fauna can be reduced to Very Low by following proper mitigation measures.

- The disturbance of wildlife shall be monitored regularly.
- Rescue, rehabilitation, and relocation shall be done for terrestrial fauna when necessary.
- Comply with the existing rules and regulations of the Department of Environment regarding air and noise.

### 7.2.3.8.3 Impact on Aquatic Flora and Fauna

During the baseline study, a total of forty-seven (47) fish species were recorded from the nearby river, floodplains, beels, and ponds within Project AOI. Among them, five endangered species (*Mastacembelus armatus*, *Clupisoma garua*, *Botia Dario*, *Channa marulius*, *Chitala chitala*) and four vulnerable species (*Monopterus cuchia*, *Sperata aor*, *Gudusia chapra*, *Labeo boggut*) were enlisted according to IUCN Bangladesh (2015). These threatened fish species were recorded mostly from fish market surveys and few of them are rarely found in the adjacent Karnatali River in the monsoon period. In addition, a total of six (6) species of prawns and shrimps under two (2) families were recorded. None of them have threatened species as per the IUCN Red List of Bangladesh, 2015. Also, a total of 10 (Ten) species of aquatic macrophyte were observed in the study area during the field visit.

Fly ash deposition, bottom ash leachate, and sludge disposal into the waterbodies in monsoon will degrade the chemical composition of the surface water. This will result in the degradation of habitats for aquatic resources. Also, the movement, growth, and reproduction of aquatic macroinvertebrates i.e., fisheries resources, etc., and aquatic macrophytes will be hampered. Also, heavy metal pollutants from

flue gas might get into waterbodies by runoff of rainwater, which will enter the food chain of aquatic species and might impact the biogeochemical cycles.

Considering the project activities and potential biological receptors within the project AOI, the impact on aquatic flora and fauna during the operation phase might be less significant. Therefore, it is assessed as **Low**.

<b>Impact</b>	<i>Impact on Aquatic Flora and Fauna</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Limited to Project Area of Influence					
<b>Frequency</b>	Limited to Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

The project impact will be long-term to a regional extent within the project AOI of the project site, but the probability of impact will be low. Therefore, the potential impact on aquatic flora and fauna can be reduced to Very Low by following proper mitigation measures.

- The leaching of hazardous chemicals in adjacent waterbody must be controlled.
- A plan for accidental oil spillage shall be developed and implemented.
- Accidental release of hot water from the boiler in adjacent waterbody shall be checked.
- Regular monitoring of aquatic ecosystem health and fish production in monsoon shall be done.

### 7.2.3.9 Impact on Traffic

The south side of the proposed plant site is the N5 highway, which can be used as the main road for waste transportation. A new connecting road on the east side of the plant is planned to be connected with the N5 highway, which is used as the entry road of the project. A total of 140 trucks will be operational during the operation phase to transport waste to the plant. The existing highway (N5) has connected the capital city Dhaka to the northern part of Bangladesh. This highway remains busy with several kinds of vehicles such as buses, Microbus, Minibus, Jeep, Truck, Covered Van, Ambulance, Motorcycle, etc. Road transportation will be used for waste commuting to and from the project site, there would be added existing traffic due to plying of trucks of DNCC.

An increase in traffic numbers for this project may add extra traffic pressure that can result in obstruction of traffic near the site and around the site. The inflow of waste transporting and carrying workers during operation is likely to generate noise and dust emissions. Therefore, the impact significant on Road Traffic during the operation of the power plant will be **Low**.

<b>Impact</b>	<i>Impact on Traffic</i>					
<b>Impact Nature</b>	Direct	Indirect			Induced	
<b>Impact Scale</b>	Adjacent Road					
<b>Frequency</b>	Limited to Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

### Mitigation measures

The following steps should be taken to minimize the impact due to increasing road traffic.

- The collaboration will be undertaken with local communities and responsible authorities to improve signage (e.g., pedestrian crossings, speed limits, etc.), visibility, and awareness of pedestrian safety.
- The transportation of waste shall be carried out in the covered condition.
- Adoption of Stakeholder measures for avoidance of traffic incidents like display of educational materials and signboards to ensure elderly and children are aware of the increased traffic risk and safety measures.
- Appoint a flagman at the entry point from the highway. Also, engage security guards and flagmen at the main gate of the power plant to manage the flow of traffic.

With the implementation of the precautionary and mitigation measures mentioned above impacts due to increasing traffic would be very low.

#### 7.2.3.10 Occupational Health and Safety

Operation of the WTE plant and its components poses significant occupational health and safety risks. To reduce the risks, contractors will be required to appoint health and safety officers for each site and to ensure regular briefing of the construction workforce on health and safety issues. The contractor shall establish its health and safety plans to be adopted at each site following international best practices and the World Bank EHS guidelines on construction and decommissioning activities.

Machinery and plants require different chemicals and hazardous substances for operation. There is invariably a risk when such chemicals are handled. Although the WTE Plant is located away from residents, there is a considerable safety risk to workers at the plant and the surrounding environment in the event of any leak or spill.

The most significant occupational health and safety impacts typically associated with workers at waste management facilities occur during the operational phase and include accidents and injuries, chemical exposure, and exposure to pathogens and vectors.

Physical hazards encountered at waste management facilities are similar to those at other large industrial projects. Solid waste workers are particularly prone to accidents involving trucks and other moving equipment, so traffic management systems and traffic controllers are recommended. Accidents include fires, explosions, being caught in processing equipment, and being run over by mobile equipment. Other injuries occur from heavy lifting, contact with sharps, chemical burns, and infectious agents. Smoke, dust, and bioaerosols can lead to injuries to the eyes, ears, and respiratory systems.

Chemical hazards encountered at waste management facilities are similar to those at other large industrial facilities, such as toxic and asphyxiating gases, and are addressed in the General EHS Guidelines. However, the full composition of waste and its potential hazards is often unknown. Even municipal solid waste (MSW) often contains hazardous chemicals, such as heavy metals from discarded batteries, lighting fixtures, paints, and inks.

Processing MSW can also generate bioaerosols, suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell, and which can be carried by airborne dust particles.

In summary, the operation and maintenance of the power plant will have risks of industrial accidents and fatalities for workers. Both direct employees and Contractors would be exposed to such risks. Thus, the overall impact significance without mitigation measures during the operation phase of the power plant will be **Medium-low**.

<b>Impact</b>	<i>Occupational Health and Safety</i>					
<b>Impact Nature</b>	Direct		Indirect		Induced	
<b>Impact Scale</b>	The impact zone will be regional/national					
<b>Frequency</b>	Limited to Operation Phase					
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary	
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation	
<b>Impact Intensity/Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium		High	
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider		<b>Medium-low</b>			

**Mitigation Measures**

To minimize the risk of industrial accidents and fatalities to workers during operations, the following mitigation measures are proposed:

- Provide adequate health care facilities and first aid within the project sites.
- Provide OHS training program and information on basic site rules of work, basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures.
- Provide adequate lavatory facilities for the number of people expected to work in the facility.
- Adequate preventive measures against negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labeling of equipment, communication Hazard codes, and electrical.
- Establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction.
- Identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors.
- Proper maintenance of PPE and the instruction of proper use.
- Conduct safety manual classes or orientation regularly.
- Monitor and report safety protocols and incidents.
- Maintain a register for occurring incidents and take measures to prevent them in the future.
- OPs need to be developed for the operation and maintenance of the Plant.

With the implementation of mitigation, the measured impact will be very low.

### 7.2.3.11 Community Health and Safety

During the operation phase of the project, the main sources of impacts on community health and safety are:

- Noise from the power plant
- Vehicular movement
- Gaseous emissions from the power plant
- Accidental leakage of untreated water or leachate
- Unwanted odor
- Water abstraction

Community health and safety may be impacted during the operation phase due to noise generation and gaseous emissions. There might have a chance of being affected by gaseous pollution which could impact human health. Mostly breathing difficulties, particularly for people with asthma and heart disease, headache, and vomiting could be seen during the operation phase. The flue gas treatment system will be implemented to mitigate the impacts due to gaseous emissions. Deterioration of surface water quality due to the discharge of wastewater would also impact the local community. Planned green belts within the plant also reduce the noise and air pollution impact on the surrounding environment significantly. In the case of water quality, WTE Power Plant North Dhaka Private Limited would install ETP and STP for the treatment of wastewater generated in their plant before discharge. Hence impact on community health safety due to plant operation would be **Low**.

<b>Impact</b>	<i>Community Health and Safety</i>				
<b>Impact Nature</b>	Direct	Indirect		Induced	
<b>Impact Scale</b>	Adjacent Communities and project workers				
<b>Frequency</b>	Limited to Operation Phase				
<b>Extent and Location</b>	Project Site	Local	Regional	National	Trans Boundary
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation

<b>Impact Intensity/ Severity</b>	Insignificant	Low	Medium	High	Very High	
<b>Potential for Irreplaceable Loss of Resources</b>	Low		Medium	High		
<b>Probability of Impact</b>	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

### Mitigation Measures

- Developing a Disaster Management Plan (DMP) to charter proper protocol to be followed in the event of a disaster to limit the impact on the local community.
- Disclose potential disasters and potential risks from the plant to the local community as well as the plan of action on the emergency protocol in the event of these accidents.
- Disclose and generate awareness of the DMP as well as the measures and protocols prescribed by the same.
- Train employees and plant personnel in health and safety as well as handling and managing disasters and emergency events.
- Maintain harmonious relations with the community and create a feedback system.
- Maintain sound labor and management relations to avoid conflict and disruption in operation.
- Firefighting systems, such as sprinklers, portable extinguishers (appropriate to the flammable hazard in the area), and automated fire extinguishers will be provided at strategic locations with clear labeling of the extinguisher type. The main hydrant will also be available around the buildings. An automated fire detection system will be in place on all floors.

Implementing proper mitigation measures the impact will be very low.

#### 7.2.3.12 Infectious Diseases, such as HIV/AIDS

The entire operation phase will require only skilled and highly skilled labor. However, it is envisaged that outsourced personnel will comprise mostly skilled laborers and workers. During operation, in general, about 220 people will be involved in the plant operation. Both technical and non-technical sides will require the said number of people for the smooth operation of the plant. Some people might have chances to engage with the community people. Therefore, infectious diseases could spread among the community and plants as well. The overall impact significance due to Infectious diseases such as HIV/AIDS without mitigation measures during the operation phase will be **Low**.

<b>Impact</b>	<i>Infectious Diseases such as HIV/AIDS</i>				
<b>Impact Nature</b>	Direct	Indirect		Induced	
<b>Impact Scale</b>	<i>Within the project area</i>				
<b>Frequency</b>	<i>Limited to the operation phase</i>				
<b>The extent of Affected Stakeholders</b>	Insignificant	Low	Medium	Moderate	High
<b>Impact Duration</b>	Short Term	Medium Term	Long-term	Permanent-mitigated	Permanent-no mitigation
<b>Impact Intensity/ Severity</b>	Insignificant	Low	Medium	High	Very High

<b>Potential for Irreplaceability/ Vulnerability</b>	Low		Medium		High	
	Unlikely	Low	Medium	High	Definite	
<b>Impact Significance</b>	Very Low	Low	Medium-low	Medium-high	High	Very High
	Significance of impact consider <b>Low</b>					

### Mitigation Measure

To minimize the impact of preventive measures against such diseases, the following measures shall be considered and implemented.

- Inform workers of the risk of disease and the need for adhering to all preventative and control measures.
- Recommend a specific medical assessment of workers for histoplasmosis before the start of the project. This may include chest x-rays, serologic (blood) tests, and skin tests. Also consider pulmonary function tests, fitness to wear a respirator, and immunization against tetanus.
- Ensure that hygiene facilities have been installed or are available (for example temporary showers)
- Ensure workers are aware of the symptoms of heat stress conditions and the importance of maintaining adequate fluid and salt intake when working in hot conditions.
- Recommend that arrangements for providing cool drinking fluids, in an uncontaminated area, should be made, especially replenishing fluids and electrolytes like Gatorade.
- Posting of signs warning of potential health risks
- Emergency procedures/key contact person/phone/fax/cell/e-mail

However, with the proper implementation of suggested mitigation measures, the overall impact will be Very low.

# **Chapter 8**

## **Environmental Management Plan**

## **8 ENVIRONMENTAL MANAGEMENT PLAN**

### **8.1 Introduction**

Environmental Management Plan is concerned with implementing the measures necessary to minimize or mitigate adverse impacts and enhance beneficial effects. All mitigation and monitoring measures would be as per Bangladesh's national standards.

The Environmental Management Plan (EMP) is prepared to minimize or mitigate adverse environmental impacts identified in the Environmental Risk and Impact assessment report as specified in Chapter 8 during the pre-construction, construction, and operation stages. The EMP outlines mitigation and monitoring requirements to ensure compliance with the GoB environmental laws and regulations. Unless the mitigation and benefit enhancement measures identified in the EIA are fully implemented, the prime function of EMP cannot be achieved. The key indicator for measuring the success of mitigation measures/action plans in compliance with the Statutory Environmental Quality Standards (EQS) of Bangladesh.

### **8.2 Objectives of the Environmental Management Plan**

The main objective of the Environmental Management Plan (EMP) is to ensure the implementation of the mitigation measures planned to reduce the environmental impact of the performance of the waste-to-energy power plant project and to verify and record the environmental impact. Thus, the objectives of EMP are to formulate Mitigation measures and to minimize or eliminate negative consequences arising from the proposed activities.

The EMP and Monitoring Plan is worked out based on the following:

- To reduce the environmental impact to the permissible level by the mitigation measures during the period of construction and operation so that a hazardous impact would not occur.
- To configure a responsible organization for the implementation of the mitigation measures.
- To implement the EMP and Monitoring Plan adequately during the period of construction and operation.

The Environmental Management Plan (EMP) includes a list of actions to curb adverse environmental impacts and monitor and formulate budgetary costs for implementing the Environmental Management Systems (EMS). In case any non-compliance, change in scope, or unanticipated impact arises during project implementation, corrective action would be taken according to statutory requirements and funding agencies' environmental guidelines and standards.

### **8.3 Mitigation Measures**

For the effective and environment-friendly operation of a project, a set of guiding tools and suggestions are necessary which need to be followed at various stages of plant installation, operation, and maintenance. This plan generally has various components of management depending on the type of project or plant activity and types of discharge and their pollution potential. This Environmental Management Plan (EMP) once prepared, forms the basis of environmental management actions on the part of the project authority and may need modification or upgradation because of changes in the plant operation or accurate pollution load/environmental problems detected afterward. All beneficial and adverse impacts which may likely occur at different phases of the project have been identified.

#### **8.3.1 During Pre-Construction and Construction Phase**

The possible environmental impacts during the pre-construction and construction phases have already been identified and assessed in Chapter 7 of this EIA report. To mitigate the potential environmental impacts, mitigation measures for the pre-construction and construction phases are proposed in Table 8-1.

**Table 8-1: Mitigation Measures during the Pre and Construction Phase**

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Involuntary Resettlement	The significant impacts could be loss of land, loss of structure, and loss of livelihood. About 242 landowners have been affected by the project interventions. Two business entities have been identified there with other associated facilities.	<ul style="list-style-type: none"> <li>Where procuring of private land cannot be avoided and it will be done through a land acquisition process through the enforcement of the Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA), the landowner will be duly compensated as per the provisions mentioned in the Entitlement Matrix of Resettlement Action Plan.</li> <li>Compensation will be provided to the affected as per Cash Compensation Law (CCL) as specified in ARIPA, 2017, or replacement cost, whichever is greater.</li> <li>A stakeholder Engagement Plan and Grievance Redressal Mechanism should be implemented.</li> <li>Compensation for loss of income and other investment-related loss for the affected households will be assessed, determined, and paid based on the entitlements specified in the entitlement matrix of the Resettlement Action Plan (RAP).</li> <li>The Concessionaire has to establish an effective grievance redress mechanism, which should be properly communicated to all the affected persons and stakeholders; this will be a platform to raise their concerns and complaints.</li> </ul>	DNCC	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>In case the affected person is not satisfied with the compensation, he/she has the right to express concern through formal application to the grievance process.</li> <li>It should be ensured that compensation for the income loss is paid to the affected persons before the start of any physical work.</li> </ul>		
Air Quality	Dust from construction activities	<ul style="list-style-type: none"> <li>Implementation of regular watering and sprinkling dust suppression regime during the dry season.</li> <li>The concrete batching plant will be located within the Protected site to protect it from sensitive receptors.</li> <li>Restricting heights from which materials are dropped as far as practicable to minimize the fugitive dust arising from unloading/loading.</li> <li>Stockpiles will be maintained at the site only, which is a fenced area. No stockpiles will be maintained outside, and the maximum possible distance between the stockpiles and receptors will be maintained.</li> <li>Use effective dust suppression techniques, such as on-site watering and street cleaning.</li> <li>Water the material stockpiles, access roads, and bare soils on an as-required basis to minimize the potential for environmental nuisance due to dust.</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Effective water sprays should be used to control potential dust emission sources.</li> <li>• Cover haul vehicles are carrying dusty materials moving outside the construction site.</li> <li>• Establish adequate locations for storage, mixing, and loading of construction materials so that dust dispersion is prevented because of such operations.</li> <li>• Dusty activities should be re-scheduled where possible if high-wind conditions are encountered.</li> <li>• Crushing of rocky and aggregate materials shall be wet-crushed or performed with particle emission control systems.</li> <li>• Waste from construction will not be burned.</li> <li>• The movement of construction vehicles will be minimized, and a 20 km/hr speed limit will be enforced around the construction site,</li> </ul>		
	Exhaust Emissions due to the operation of Construction Machinery	<ul style="list-style-type: none"> <li>• The movement of construction vehicles will be minimized, and a 20 km/hr speed limit will be enforced around the construction site.</li> <li>• All diesel-powered equipment will be regularly maintained, and idling time reduced to minimize emissions.</li> <li>• Low Sulphur diesel (S&lt;O.5%) will be used in diesel-powered equipment in collaboration with best management practices.</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Vehicle/equipment air emissions will be controlled by reasonable practice procedures (such as turning off equipment when not in use); and</li> <li>Vehicle/equipment exhausts observed emitting significant black smoke in their exhausts will be serviced/ replaced.</li> </ul>		
	Offensive odor	<ul style="list-style-type: none"> <li>The sewage sludge generated from stationary toilets in offices, workers' accommodations, and construction yards should be managed with a sanitary pit and should not be released in the open environment.</li> <li>The solid wastes and slurry from batching plant shall not be disposed of in an open place without following the instruction given in the waste management plan.</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited
Noise	Increased ambient noise levels	<ul style="list-style-type: none"> <li>The machinery and vehicles should be equipped with a muffler, silencer, foam, rubber, and other sound soundproofing materials necessary to reduce operation noise; the diesel generators should be covered with a canopy.</li> <li>Only well-maintained equipment will be operated on-site.</li> <li>Regular maintenance of equipment, such as lubricating moving parts, tightening loose parts, and replacing worn-out components, should be conducted.</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Machinery and construction plants in intermittent use (e.g., trucks) shall be shut down or throttled down during non-work periods.</li> <li>• Low-noise equipment shall be used as far as practicable.</li> <li>• The amount of equipment operating simultaneously shall be reduced as far as practicable.</li> <li>• Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby NSRs as practicable.</li> <li>• Noisy plants (such as breakers and rollers) shall be located as far away from receptors as practicable.</li> <li>• The contractor should consider the noise emission characteristics of equipment when selecting equipment for the project and select the least noisy machine available to perform the specific work (this is a requirement of OSHA 2007).</li> <li>• Mobile noise sources such as cranes and earth-moving equipment shall be routed so that there is minimum disturbance to receptors.</li> <li>• Only limited construction activities shall be carried out during night-time.</li> </ul>		

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Restrict the nighttime vehicle movement through the access road.</li> <li>• Adopt the vehicle speed (20 km/hr.) limit on the access road.</li> <li>• Temporary noise barriers shall be provided surrounding the high noise-generating construction equipment.</li> <li>• The personnel involved in high noise-generating activities shall be provided with personal protective devices to minimize exposure to high noise levels.</li> <li>• Construction vehicles and machinery will be well maintained and not kept idling when not in use.</li> </ul>		
Water Resources	Surface water contamination	<ul style="list-style-type: none"> <li>• Phase dust-generating activities such as land clearance, earthworks, and building construction minimize the area of ground exposed and the volume of soil and construction material handled at any time.</li> <li>• Waste management measures shall include provisions to contain and dispose of construction wastes, prohibit waste discharge on the ground or any surface watercourse, and practice recycling as practicable.</li> <li>• Implement a regular maintenance program for all equipment and machinery to prevent</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<p>fuel spillage or leakage during construction activities.</p> <ul style="list-style-type: none"> <li>• Properly store and manage hazardous materials during construction activities. Strategically locate areas for temporarily storing hazardous materials away from surface water resources and preferably down the topographic gradient of watercourses.</li> <li>• Chemicals and fuels shall be properly labeled and stored in a bunded area. Storage of hazardous materials on-site should be limited to minimize spillage or mitigation failure impacts.</li> <li>• Spill kits should be provided, and all personnel managing hazardous materials shall be adequately trained in handling and disposal of Hazardous materials. Such spill kits shall be available where equipment and machinery are temporarily stored and used.</li> <li>• Oil and grease separators shall be used for wastewater generated from cleaning activities.</li> <li>• Refueling, oil changing, and engine maintenance of machinery, equipment, and vehicles shall be undertaken in designated areas with containment to prevent any oil spills from washing away at a distance of at least 100 m from any water course.</li> </ul>		

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Cover temporary stockpiles with tarpaulin when not in use.</li> <li>• Wherever reasonable and practicable, re-vegetate exposed ground as soon as possible to stabilize surfaces.</li> <li>• Discharge of wastewater from excavation to the surface water bodies will be performed through the pipeline to the river due to ecological sensitivities.</li> <li>• Disposal of construction wastes into the waterbodies will be strictly prohibited.</li> <li>• Vehicle maintenance and mechanical repairs are to occur in dedicated, designed locations, bounded to capture, and control oil, grease, and other spills to prevent flow into surface water resources.</li> <li>• Adequate sanitary facilities, i.e., toilets provided for the construction workforce.</li> <li>• Workers are trained in using designated areas/bins for waste disposal and encouraged to use toilets.</li> <li>• Septic tanks will be provided to treat sanitary wastewater and</li> <li>• All sewage and liquid effluent will be treated to meet the standards specified in Schedules 3 and 4 of the ECR, 2023.</li> </ul>		
	Groundwater contamination	<ul style="list-style-type: none"> <li>• Ensure proper spill control and management at the site.</li> </ul>	Appointed Contractor	WTE Power Plant North

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Ensured storage of hazardous material and waste properly and disposed of the waste in a hazardous waste landfill site.</li> <li>The surface runoff or extracted groundwater contaminated by silt and suspended solids will be collected by the on-site drainage system and discharged into storm drains.</li> <li>Monitor groundwater from time to time to detect any contamination.</li> </ul>		Dhaka Private Limited
Soil Quality	Soil compaction and erosion	<ul style="list-style-type: none"> <li>The area to be cleared must be clearly demarcated, and this footprint strictly maintained.</li> <li>Soil conservation measures will be implemented, such as stockpiling topsoil or gravel for the remediation of disturbed areas.</li> <li>Scheduling activities (as far as possible) to avoid extreme weather events such as heavy rainfall and high winds.</li> <li>Work areas will be clearly defined and, where necessary, demarcated to avoid unnecessary disturbance of areas outside the development footprint.</li> <li>Construction vehicles will remain on designated and prepared compacted gravel roads.</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited
	Soil contamination	<ul style="list-style-type: none"> <li>Fuel, lubricating oil, and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.</li> </ul>	Appointed Contractor	WTE Power Plant North

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Spill containment and clean-up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of.</li> <li>Construction vehicles and equipment will be serviced regularly and off-site.</li> <li>The Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel, or chemicals.</li> <li>Surface run-off from bunded areas will pass through oil/water separators before discharge to the stormwater system.</li> <li>Ensure storage areas have impermeable floors and containment.</li> <li>The contractor will restore tower footprints and other areas disturbed by construction as soon as practicable once major construction activity in that area is complete, and while construction is continuing at other sites, and not wait until construction is complete along the entire corridor.</li> <li>The construction contractor will implement a training program to familiarize staff with emergency procedures and practices related to contamination events.</li> </ul>		Dhaka Private Limited
Waste generation	The debris generated from construction activities can be carried along with the river	<ul style="list-style-type: none"> <li>Any construction debris generated at the site will be removed from the site immediately</li> </ul>	Appointed Contractor	WTE Power Plant North

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
	flowing in the proximity of the plant. Construction debris can also contaminate wells, agricultural land, etc. in the proximity of the activity.	<p>after the completion of construction activities and the site will be leveled as the original.</p> <ul style="list-style-type: none"> <li>All storage areas must also be properly demarcated and, if the material is hazardous, there should be adequate labeling and security at the facility.</li> <li>Properly store and manage hazardous materials during construction activities. Chemicals and fuels must be properly labeled and stored in a bunded area. Storage of hazardous materials on-site should be limited to minimize the impacts of any spillage or mitigation failure.</li> <li>Dispose of debris and waste in designated areas. Workers will be strictly instructed about the random disposal of any waste generated from the construction activity. Arrangements will be made to collect and prevent littering by workers on site.</li> <li>Waste will be segregated according to type and stored in a separate bin with a label.</li> </ul>		Dhaka Private Limited
Terrestrial Flora	<ul style="list-style-type: none"> <li>Vegetation clearance Hampering plant growth and causing diseases</li> </ul>	<ul style="list-style-type: none"> <li>Reduce unnecessary clearance of vegetation cover.</li> <li>Dust mitigation measures i.e., water spraying, covering stockpiles during transportation, etc. should be followed.</li> <li>Workers should be aware of the importance of natural resources and should not</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		unnecessarily break branches, twigs, flowers, etc. of adjacent vegetation		
Terrestrial Fauna	<ul style="list-style-type: none"> <li>Habitat degradation</li> <li>Disturbance to the movement of wildlife</li> <li>Death or harm to wildlife</li> </ul>	<ul style="list-style-type: none"> <li>Dust mitigation measures should be followed.</li> <li>Noise mitigation measures should be followed and machinery with lesser noise production should be used.</li> <li>Workers should be aware of the importance of natural resources and should not do any harm or death to wildlife.</li> <li>Nighttime work should be limited and the use of lights at night should not disrupt the movement of nocturnal wildlife species</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited
Aquatic Flora and Fauna	Degradation of habitats for aquatic resources	<ul style="list-style-type: none"> <li>A plan for accidental hazardous chemical spillage should be prepared.</li> <li>Ensure to keep the hazardous chemical in a secure place with secondary containment.</li> <li>Workers should be aware of the importance of natural resources and should not dispose of anything in the waterbodies</li> </ul>	Appointed Contractor	WTE Power Plant North Dhaka Private Limited
Traffic	An increase in traffic volume on a national highway (N5) may cause traffic congestion and accidents.	<ul style="list-style-type: none"> <li>All vehicles would undergo routine repair and maintenance to keep the vehicle in good operating condition.</li> <li>Drivers and operators would be checked for fitness and any driver/operator impaired due to any reason, including but not confined to the influence of drugs and/or alcohol would not be allowed to drive.</li> </ul>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>A speed limit of 20 km/hr. within the site would be followed and the use of mobile phones while driving would be prohibited.</li> <li>Implementation of a safety program (signage, speed restrictions, lights on trucks, truckload restrictions, etc.) within the construction area</li> <li>All drivers shall follow the speed limit, the direction of the signalman, sensitive locations, horn usage restrictions, etc.</li> </ul>		
Cultural heritage and chance finds	The project area does not have any Ancient and Historical Monuments and therefore no measures are warranted.	<ul style="list-style-type: none"> <li>All fossils, coins, articles of the value of antiquity, structures, and other remains or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation.</li> <li>The Contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing.</li> </ul> <p>He will, immediately upon discovery thereof and before removal acquaint the Environmental /Social Specialist of the Contractor of such discovery and carry out the Project Management Unit's instructions for dealing with the same, waiting which all work shall be stopped.</p> <p>The Project Management units will seek direction from GoB through the Department of Archaeology</p>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited/Department of Archeology

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		before instructing the Contractor to recommence the work on the site. <ul style="list-style-type: none"> <li>• Details of the Cultural Heritage Chance Find Procedure are given in <b>Appendix O</b>:</li> </ul>		
Gender	Community-women adjacent to the proposed project site, promote their participation in project planning and activities (if applicable) and ensure safer and healthier living conditions for them.	<ul style="list-style-type: none"> <li>• Announce employment opportunities and recruitment notices widely, targeted at women as well as men.</li> <li>• Technical training can be provided to the local workforce, especially women for inclusion in the operation and maintenance phase.</li> <li>• Ensure basic facilities (separate toilets, clean water, drinking water facilities, resting place) are provided for female as well as male workers at the construction site.</li> <li>• Women are to be trained and empowered to be part of household energy solutions – their understanding and knowledge about their household energy need to be translated into defining the way forward on access to clean, affordable, and sustainable energy.</li> </ul>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited
Child rights	As the labor influx will occur during the construction there might be a chance to appoint child labor	<ul style="list-style-type: none"> <li>• EHS manager will keep close monitoring regarding any appointment of a child as a labor.</li> <li>• Restriction signs should be affixed regarding child labor.</li> <li>• Give proper guidance to say no to recruiting any child as a labor.</li> </ul>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Appoint a traffic man to any crossing of school-going children near the project area.</li> <li>• Conduct a traffic awareness campaign at a nearby school.</li> </ul>		
Infectious Disease	As the labor influx will occur during the construction there might be a chance to spread infectious diseases. During Construction, in general, a lot of migrant workers flow into the sites, who may have the possibility of HIV/AIDS.	<ul style="list-style-type: none"> <li>• To provide surveillance for workers' health.</li> <li>• Prevention of illness among workers by undertaking health awareness and education initiatives and by conducting immunization programs for workers.</li> <li>• To provide treatment through standard case management in on-site and community health care facilities as necessary.</li> <li>• Educating project personnel and area residents on risks, prevention, and available treatment.</li> <li>• Promoting collaboration with local authorities to enhance access of workers' families and the community to public health services and promote immunization as necessary.</li> <li>• Promoting the use of repellents, clothing, netting, and other barriers to prevent insect bites.</li> <li>• Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements.</li> <li>• Elimination of unusable impounded water.</li> <li>• Posting of signs warning of potential health risks.</li> </ul>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Emergency procedures/key contact person/phone/fax/cell/e-mail.</li> <li>• Informing workers, in writing, of the potential risk factors.</li> <li>• Allow for related corrective measures within the specifications for the work prior to tendering.</li> </ul>		
Occupational Health Safety	Health Impacts due to Changes in environmental conditions. Increased prevalence of the disease.	<ul style="list-style-type: none"> <li>• All persons working on site will be provided information about risks on site and arrangements will be made for workers to discuss health and safety with the Contractor.</li> <li>• All workers will be properly informed, consulted, and trained on health and safety issues.</li> <li>• Personal Protective Equipment (PPE) shall be worn at all times on the Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips.</li> <li>• Before starting work all the appropriate safety equipment and the first-aid kit will be assembled and checked as being in working order. The breathing apparatus will be tested at regular intervals in the manner specified by the makers.</li> <li>• All lifting equipment and cranes will be tested and inspected regularly.</li> <li>• Where sound levels cannot be reduced at the source, suitable hearing protection will be</li> </ul>	Appointed Contractor	EPC Contractor and EHS manager

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<p>provided when noise levels indicate a Leq of more than 90 dB(A).</p> <ul style="list-style-type: none"> <li>The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations when the work is in progress.</li> <li>Regular awareness and group meetings need to conduct t before work</li> </ul>		
Community Health and Safety	Possible sources of impacts on community health and safety during the construction phase are Changes in environmental quality due to construction activities. Increased prevalence of disease arising from the influx of construction workers; and additional traffic movement.	<ul style="list-style-type: none"> <li>Barriers will be provided to prevent the ingress of persons into the construction site and also to protect the public from exposure to hazards associated with construction activities.</li> <li>Avoiding the formation of stagnant water pools in and around the site.</li> <li>Implementation of a vector control program in labor camps and surrounding areas; and</li> <li>Emphasizing safety aspects among drivers, particularly about the speed limit of 20 km/hr that will be enforced.</li> <li>Ensuring that the Project employs only licensed drivers.</li> <li>Avoiding peak hours for heavy vehicle movement where possible.</li> <li>Collaboration with local communities and responsible authorities to improve signage (e.g., pedestrian crossings, speed limits, etc.), visibility, and awareness of traffic and pedestrian safety.</li> </ul>	Appointed Contractor	A designated person from WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Screening, surveillance, and treatment of workers, through the provision of medical facilities and, where required, immunization programs.</li> </ul>		

### 8.3.2 During Operation Phase

The possible environmental impacts during the operation phase have already been identified and assessed in Chapter 7 of this EIA report. For mitigating the possible environmental impacts, mitigation measures for the operational phase are proposed in Table 8-2.

**Table 8-2: Mitigation Measures during Operation Phase**

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Air Quality	High air emissions of air pollutants such as sulfur dioxide, nitrogen dioxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide.	<ul style="list-style-type: none"> <li>The flue gas is to be exhausted at 100m stack height.</li> <li>Ensuring the standard of Bangladesh (MoEF) where emissions always should be lower due to nearly presence of any sensitive area.</li> <li>The plant equipment must be performance tested during the commissioning phase to ensure the standard has been maintained.</li> <li>A continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas.</li> <li>Automatic monitoring processes and presentation on the real-time Web Pages should be implemented.</li> <li>Ambient air quality monitoring stations are to be installed within the project site to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers is to be conducted at other locations.</li> <li>Install instruments to record meteorological data such as wind speed, direction, solar radiation, relative humidity, and</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<p>temperature shall be established so that the operating power plant can record these parameters in a regular intervals;</p> <ul style="list-style-type: none"> <li>• Regular maintenance and overhauling as per design specification.</li> <li>• Regular inspection and maintenance of boiler, pressure parts, FD and ID fans bag filter and ash separation and handling system, and other ancillaries.</li> <li>• Particulate Matter emission concentration will be controlled by a bag filter.</li> <li>• Selective Non-Catalytic Reduction-SNCR (urea water injection in the furnace) will be adopted for nitrogen dioxides control and space for Selective Catalytic Reduction (SCR) will be reserved to cope with the possible improvement of denitrification standards in the future since the airshed is already degraded.</li> <li>• Combination mode of "SNCR (urea water injection in the furnace) + semi-dry method (lime pulp solution) + dry method (Ca (OH)<sub>2</sub> dry powder) + activated carbon injection + bag filter + (reserved SCR) will be adopted to control acidic gases (HCl, SO<sub>2</sub>, and HF);</li> <li>• Control the residence time of flue gas in the furnace above 850°C to ensure adequate decomposition of dioxins.</li> <li>• Maintain the more stringent emission standard of the European Union Pollutant Emission Standard (European Union 2010/75/EU) since the project location airshed already degraded and</li> <li>• It is highly recommended to conduct a validation run after 1 to 3 months during the operations stage using actual CEMS, stack testing, and ambient air monitoring results.</li> </ul>		

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Odor	The source of malodor pollution mainly comes from the original waste entering the plant and the produced leachate. Respiratory problems, nausea, headache, and psychological stress could be the main impacts of waste odor.	<ul style="list-style-type: none"> <li>The waste loading ramp shall be capped to control the malodorous diffusion caused by the dissipation of leachate from the waste truck.</li> <li>An Air curtain shall be set up at the inlet and outlet of the tipping hall to prevent malodor escape.</li> <li>Negative pressure shall be maintained inside the waste tank to prevent the spread of malodor inside the waste tank.</li> <li>Aiming at the characteristics that malodor can be decomposed at high temperatures, the gas in the pit is extracted from the upper part of the waste tank by a PA fan and fed into the incinerator after preheating, which is used as a secondary air for combustion.</li> <li>In the incinerator and maintenance, to ensure the negative pressure in the waste tank, the odor in the waste tank will be pumped out by the deodorizer and fed into the activated carbon adsorption deodorizer. The odor pollutants are adsorbed and filtered by the activated carbon and discharged into the atmosphere after reaching the malodor discharge standard.</li> <li>In abnormal operation (when the shutdown state or the negative pressure is not enough), the deodorizing fan of the deodorizing system feeds the odor of the waste tank into the activated carbon deodorizing device located in the deodorizing room for adsorption and filtration and then drains it to the upper air, to ensure the air quality in the incineration power plant area.</li> <li>The waste leachate collection chamber is composed of a leachate sump, leachate pump room, and corridor, and these areas will produce a large amount of odor. Therefore, the air supply and exhaust outlets will be set in the space of the</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		leachate collection room, the air supply fan feeds fresh air, and the exhaust fan introduces the odor generated in this space into the waste tank and burns and decomposes in the PA fan inhalation incinerator.		
GHG emission	GHG emission from the diesel fuel consumed for each start and shutdown will be 1023 (tCO <sub>2e</sub> /year).	<ul style="list-style-type: none"> <li>Monitoring and recording of CO<sub>2</sub> emissions from the stacks</li> <li>Ensure that all equipment and machinery are maintained following the manufacturer's specifications; and</li> <li>Improved efficiency of auxiliary drives</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Noise	Noise pollution from the boiler, Turbine generator set, Fan, Air blower, Air compressor, Mechanical ventilation cooling tower, and circulating water pump is continuous. Garbage transport vehicles are also another source of noise pollution.	<ul style="list-style-type: none"> <li>Equipment shall be selected with low noise as far as possible.</li> <li>The high-noise equipment, such as air compressors, machine repair equipment, and incineration system in the general layout, is centrally arranged in the incineration power plant room.</li> <li>For equipment with a higher noise level, such as fan, sound insulation, sound elimination, and vibration reduction under different circumstances shall be adopted.</li> <li>Comprehensive control measures shall be adopted such as low noise equipment and sound absorption, for example, PA and SA fan and ID fan set up mufflers and vibration damping devices to make the noise in the workplace and environment reach the standard.</li> </ul>	WTE Power Plant North Dhaka Private Limited  A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE/ WARPO

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>• Where it is still difficult to reach the control standard for the workplace after treatment, such as the place where Turbine Hall and other equipment are continuously operated, the measures for setting sound insulation Control Room shall be taken.</li> <li>• Flexible connection measures shall be taken for the pipeline that may generate noise, especially the pipeline connected with the pump and fan outlet, to control the vibration noise.</li> <li>• Noise attenuation provisions such as air intake silencers and acoustic insulation around noisy equipment should be installed.</li> <li>• Buildings shall be designed with improved acoustic performance, and sound insulation shall be provided.</li> <li>• The diesel generator unit shall be arranged in an outdoor box, and attention shall be paid to sound insulation and noise reduction.</li> <li>• Green belts shall be developed around and inside the power plant.</li> <li>• Unnecessary use of alarms, horns, and sirens shall be avoided</li> </ul>		

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Water Resources	Water abstraction	<ul style="list-style-type: none"> <li>Periodical training to workers for best utilization of water.</li> <li>If the water flow rate is low compared to the water, use during the operation period proponent should consider the use of groundwater depending on the borehole testing in the project site and surroundings.</li> <li>The wastewater emanating from cleaning operations shall be recycled for plantation and greenbelt development around the project. The rest of the wastewater will be deposited in a rainwater harvesting pond.</li> <li>A water intake Permission letter from WARPO and local government shall be needed <b>Appendix B-2:</b></li> </ul>	WTE Power Plant North Dhaka Private Limited  A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE/ WARPO
	Surface and groundwater contamination	<ul style="list-style-type: none"> <li>Monitoring of temperature at the discharge point at a frequency of every 15 days.</li> <li>Discharge system shutdown in event that the discharge temperature of effluent exceeds the standard.</li> <li>Leak-proof oil transfer mechanism from an oil tanker to an oil storage tank</li> <li>Sanitary effluent should be deposited in the septic tank.</li> <li>Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas; and</li> <li>All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into the ground.</li> <li>Wastewater of similar nature from different units will be treated following GOB Environment Conservation Rule (2023) Schedule 4 (Standards for Waste from Industrial Units or Project Waste)</li> </ul>	WTE Power Plant North Dhaka Private Limited  A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE/ WARPO

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>All chemicals will be stored in primary containers that have in-built secondary containment of capacity that is at least 110% of primary containment.</li> <li>Details of the slag treatment system are described in section 3.14.4</li> <li>Details of the leachate treatment process are described in section 3.14.5</li> </ul>		
Waste generation	Improper storage, handling, and disposal of solid and hazardous waste may lead to contamination of the land and water bodies nearby. In addition, waste can generate odor and cause health hazards to employees and communities nearby.	<ul style="list-style-type: none"> <li>The Contractor would ensure that the hazardous waste plan is based on national guidelines for all solid and hazardous waste and implemented adequately.</li> <li>Recyclable Waste shall be sold to the authorized recycler and the other solid wastes shall be disposed of to a locally designated landfill facility.</li> <li>Oily waste and chemicals would be stored in tanks/containers that have sufficient secondary containment (~110% more than their capacity).</li> <li>All hazardous waste shall be properly leveled with information including the Name &amp; type of waste, and the amount of waste. The waste will be removed from the site at regular intervals for safe disposal at the designated site through authorized vendors.</li> <li>The Contractor would have a Spill Management plan in place delineating plans and procedures for preventive and corrective actions against any potential spillage of harmful materials and provision of adequate spill kits.</li> <li>It would be ensured that activities involving oil handling are carried out on impermeable surfaces and training of workers would be undertaken to manage spill management.</li> <li>The wastewater in the plant area after treatment may be used for car washing, ground washing, residue cooling, and greening.</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Prevent the indiscriminate discharge of untreated effluent from the process, equipment/vehicle washing, and chemical/fuel storage areas into the unpaved and open ground.</li> <li>A spill response plan and emergency plan shall be prepared to address accidental spillages or release of hazardous wastes; and</li> <li>Wastewater containing high concentrations of inorganic chlorine salts and heavy metals shall only be discharged after treatment.</li> <li>Details of Flying ash collection and treatment system are described in section 3.14.2</li> <li>Details of the leachate treatment process are described in section 3.14.5</li> <li>Details of the slag treatment system are described in section 3.14.4</li> </ul>		
Soil Quality	Soil contamination	<ul style="list-style-type: none"> <li>Disturbance to the soil from repair and maintenance activity shall be limited and will ensure proper restoration of soil wherever excavation is undertaken.</li> <li>WTE Power Plant North Dhaka Private Limited shall explore the option of buyback agreements for defunct equipment replacement and disposal of transformer oil by the supplier, otherwise, arrangements shall be made for the disposal of defunct equipment and waste oil by authorized recyclers.</li> <li>Fuel and used oil storage areas shall be contained in bunds of 110 capacity of the stored material. Only covered trucks shall be allowed to enter the premises for unloading of materials, good housing keeping will help to control contamination of soil shall be ensured by the DNCC.</li> </ul>	<p>WTE Power Plant North Dhaka Private Limited</p> <p>A study by 3rd Party agency /experts.</p>	<p>Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE</p>

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
Terrestrial Flora	Hampering plant growth and causing diseases	<ul style="list-style-type: none"> <li>A plantation plan should be implemented for greenbelt development with appropriate indigenous species. Extensive plantation of pollutant-resistant trees in and around the project area will serve as a pollution sink and noise barrier.</li> <li>Plant health monitoring shall be conducted regularly.</li> </ul>	WTE Power Plant North Dhaka Private Limited  A study by 3 <sup>rd</sup> party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Terrestrial Fauna	<ul style="list-style-type: none"> <li>Impact on health, behavior, and reproduction of terrestrial fauna</li> <li>Impact on the biogeochemical cycles</li> </ul>	<ul style="list-style-type: none"> <li>Disturbance to wildlife should be monitored regularly.</li> <li>Rescue, rehabilitation, and relocation should be done for terrestrial fauna when necessary.</li> <li>Comply with the existing rules and regulations of the Department of Environment for air and noise.</li> </ul>	WTE Power Plant North Dhaka Private Limited  A study by 3 <sup>rd</sup> party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Aquatic Flora and Fauna	<ul style="list-style-type: none"> <li>Degradation of habitats for aquatic resources</li> <li>Impact on movement, growth, and reproduction of aquatic flora and fauna.</li> </ul>	<ul style="list-style-type: none"> <li>Leaching of hazardous chemicals in adjacent waterbody shall be controlled.</li> <li>A plan for accidental oil spillage shall be developed and implemented.</li> <li>Accidental release of hot water from the boiler in adjacent waterbody shall be checked.</li> </ul>	Plant EHS Team and operations/ Study by 3 <sup>rd</sup> party agency/experts	Designated Team comprising of representation from EHS and Operations of WTE Power

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		<ul style="list-style-type: none"> <li>Regular monitoring of aquatic ecosystem health and fish production in monsoon shall be done</li> </ul>		Plant North Dhaka Private Limited
Traffic	An increase in traffic numbers for this project may add extra traffic pressure that can result in obstruction of traffic near the site and around the site. The inflow of waste transporting and carrying workers during operation is likely to generate noise and dust emissions.	<ul style="list-style-type: none"> <li>Collaboration shall be undertaken with local communities and responsible authorities to improve signage (e.g., pedestrian crossings, speed limits, etc.), visibility, and awareness of pedestrian safety.</li> <li>The transportation of waste shall be carried out in the covered condition.</li> <li>Adoption of Stakeholder measures for avoidance of traffic incidents like display of educational materials and signboards to ensure elderly and children are aware of the increased traffic risk and safety measures.</li> <li>Appoint a flagman at the entry point from the highway. Also, engage security guards and flagmen at the main gate of the power plant to manage the flow of traffic.</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Occupational Health and safety	<ul style="list-style-type: none"> <li>Accidents or incidents are more likely to increase.</li> <li>Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases,</li> </ul>	<ul style="list-style-type: none"> <li>Provide adequate health care facilities and first aid within the project sites.</li> <li>Provide OHS training program and information on basic site rules of work, basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures.</li> <li>Provide adequate lavatory facilities for the number of people expected to work in the facility.</li> <li>Adequate preventive measures against negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labeling of equipment, communication Hazard codes, and electrical.</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
	dust, fumes, vapors, and liquids are the major hazards that are harmful to worker's health. Road Accidents	<ul style="list-style-type: none"> <li>Establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction.</li> <li>Identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors.</li> <li>Proper maintenance of PPE and the instruction of proper use.</li> <li>Conduct safety manual classes or orientation regularly.</li> <li>Monitor and report safety protocols and incidents.</li> <li>Maintain a register for occurred incidents and take measures to prevent them in future</li> </ul>		
Community Health Safety	This is a possibility to increase the risks of infectious diseases due to the influx of workers from the industries and the semi-urbanization of the project area and its surrounding area.	<ul style="list-style-type: none"> <li>Potential disasters and potential risks from the plant to the local community as well as the plan of action on the emergency protocol in the event of these accidents shall be disclosed.</li> <li>Disclose and generate Awareness of the Disaster Management Plan as well as the measures and protocols prescribed by the same.</li> <li>Employees and plant personnel shall be trained in health and safety as well as handling and managing disasters and emergency events.</li> <li>Harmonious relations with the community and creating a feedback system shall be maintained.</li> <li>Sound labor and management relations shall be maintained to avoid conflict and disruption in operation.</li> <li>Firefighting systems, such as sprinklers, portable extinguishers (appropriate to the flammable hazard in the area), and automated fire extinguishers shall be provided at strategic locations with clear labeling of the extinguisher type. The main</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Aspect	Key Potential Impacts	Proposed Mitigation/Enhancement Measures	Responsibility	
			Implementation	Supervision
		hydrant shall also be available around the buildings. An automated fire detection system will be in place on all floors.		
Infectious Diseases such as HIV/AIDS	During operation, in general, about 220 people will be involved in the plant operation. Infectious diseases could spread among the community and plants as well.	<ul style="list-style-type: none"> <li>• Inform workers of the risk of disease and the need for adhering to all preventative and control measures.</li> <li>• Recommend a specific medical assessment of workers for histoplasmosis before the start of the project. This may include chest x-rays, serologic (blood) tests, and skin tests. Also consider pulmonary function tests, fitness to wear a respirator, and immunization against tetanus.</li> <li>• Ensure that hygiene facilities have been installed or are available (for example temporary showers)</li> <li>• Ensure workers are aware of the symptoms of heat stress conditions and the importance of maintaining adequate fluid and salt intake when working in hot conditions.</li> <li>• Recommend that arrangements for providing cool drinking fluids, in an uncontaminated area, should be made, especially replenishing fluids and electrolytes like Gatorade.</li> <li>• Posting of signs warning of potential health risks</li> <li>• Emergency procedures/key contact person/phone/fax/cell/e-mail</li> </ul>	Plant EHS Team and operations	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

### 8.3.3 Budget plan for Environmental Management Plan (EMP)

WTE Power Plant North Dhaka Private Limited will allocate a separate budget for environmental management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring, and capacity building.

Cost estimates are prepared for all the mitigation measures proposed in the EMP. The environmental management budget estimation for the construction and operation phase of the Project is provided in, Table 8-3, and Table 8-4. The cost estimates for mitigation measures are given yearly. The cost estimates include the budget for environmental enhancement and compensation measures, but do not include the budget for consultants for EMP implementation, institutional strengthening, and capacity building of the plant staff.

The preconstruction and construction stage environmental management budget is 2.4 million (BDT) and the operation stage environmental management budget is 46.70 million (BDT). This budget does not include the decommissioning stage since the minimum operation period is 20 years and the rate will vary largely from the present cost.

**Table 8-3: Environmental Management Cost (A) for Pre-construction/Construction Stage**

No.	Description of Item	Unit	EMP Cost (BDT million)
<b>Pre-construction/Construction Stage/year</b>			
1.	Dust pollution control (sprinkling)	LS	0.4
2.	EMP for air pollution control	LS	0.2
3.	EMP for controlling noise pollution	LS	0.2
4.	EMP for controlling surface water resources	LS	0.2
5.	EMP for controlling groundwater resources	LS	0.2
6.	EMP for controlling impacts on Soil	LS	0.2
7.	EMP for controlling waste generation and mitigating impacts	LS	0.3
8.	EMP for Occupational health and safety	LS	0.5
9.	EMP for Community health and safety	LS	0.2
<b>Total Environmental Management Cost (A)</b>			<b>2.4</b>

**Table 8-4: Environmental Management Cost (B) for Operation Stage**

No.	Description of Item	Unit	EMP Cost (BDT million)
<b>Operation Stage (Yearly)</b>			
1.	EMP for air pollution control	LS	12.0
2.	EMP for controlling noise pollution	LS	2.0
3.	EMP for controlling surface water resources	LS	3.0
4.	EMP for controlling groundwater resources	LS	2.0
5.	EMP for produced fly ash and slag from the power plant	LS	4.0
6.	EMP for controlling the impact of wastewater generation	LS	11.0
7.	EMP for controlling impacts on Soil	LS	3.0
8.	EMP for Occupational Health and Safety	LS	6.0

No.	Description of Item	Unit	EMP Cost (BDT million)
9.	EMP for Community health and safety	LS	3.0
10.	Tree plantation and green area development plan	LS	0.5
11.	EMP for enhancing the better socioeconomic condition	LS	0.2
<b>Total Environmental Management Cost (B)</b>			<b>46.70</b>

Note: These mentioned costs are tentative at the time of this study and might be changed during the detailed design of the project.

# **Chapter 9**

## **Environmental Monitoring Plan**

## 9 ENVIRONMENTAL MONITORING PLAN

The monitoring plan is one of the important tools for implementing the mitigation plan for the proposed waste-to-energy power plant project. The Monitoring plan guides environmental issues/parameters, location, frequency, and means of monitoring.

The aim of environmental monitoring during the pre-construction, construction, and operation phases of the project is to compare the monitored data against the baseline condition collected during the study period (particularly during the detailed design stage) to assess the effectiveness of the mitigation measures and the protection of environmental components (e.g., air, water, soil, sediment noise, etc.) based on the national environmental standards (e.g., ECR 2023, Air Pollution (Control) Rule, 2022 and Noise Pollution (Control) Rule, 2006). Since the project is likely to impact various components of the environment, a comprehensive monitoring plan covering soil quality, air quality, water quality, noise, ecology, workers and community health, and safety must be developed.

An Environmental Monitoring Plan (EMoP) has been prepared along with this EIA for execution to mitigate or minimize the adverse impacts of the project's construction and operational activities on the natural environment.

### 9.1.1 Objectives

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national and international standards. The main objectives of the preconstruction, construction, and operation phase monitoring plans will be to:

- Monitor the actual impact of the works on physical and biological receptors within the project area to indicate the adequacy of the EIA.
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds anticipated in the EIA.
- Ensure compliance with legal and community obligations, including safety on the project site.
- Ensure the safe disposal of excess construction materials and other wastes.
- Appraise the adequacy of the EIA concerning the project's predicted long-term impacts on the physical, biological, and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements when necessary.

### 9.1.2 Performance Indicators

Physical, biological, and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented in below Table 9-1 and Table 9-2. This includes parameters to be measured, methods to be used, sampling locations, frequency of measurements, and responsibilities for implementation and supervision.

### **9.1.3 Indicator and Monitoring Schedule**

Environmental and Social Monitoring would form an integral part of the Environmental Management Plan implementation procedure. During the construction phase, the Contractor (and their sub-contractor) shall be entrusted with carrying out the environmental monitoring, while in the operation phase, WTE Power Plant North Dhaka Private Limited or its Contracting Operating agency would hire third-party agencies for environmental monitoring at a periodic interval. The monitoring also aims to ascertain whether activities are in progress as per the schedule and the timelines are being met and evaluate whether project-affected entities (households and local community) have been compensated and that PAPs have at least the standard of living are no worse off than it was before the project.

WTE Power Plant North Dhaka Private Limited Management would allocate a dedicated budget for environmental and social management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring, and capacity building.

### 9.1.4 During Construction Phase

The proposed environmental monitoring program during the project's construction phase is given in Table 9-1.

**Table 9-1: Monitoring Plan during Construction Phase**

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
Land acquisition	Loss of land, income, livelihoods, etc. as per the RAP report	Land acquisition area	According to the RAP report	Monitoring and record keeping	Regular RAP implementation	DNCC	Assigned Consultant
General	Inspection of mitigation compliance	Construction site and surroundings	Visual inspection of all active work area	Monitoring	Daily	Appointed Contractor	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Ambient Air Quality	Dust	Project activity areas	Visual inspection of all active work areas	Monitoring	Daily	Appointed Contractor	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	PM2.5, PM10, CO, NO <sub>2</sub> , SO <sub>2</sub> , Odor	Project site and nearest receptors (5 Locations) as per baseline monitoring points	Onsite measurement and analysis	Air quality standards as per Air pollution (Control) Rules 2022 and WHO standard	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Noise	Noise levels in Leq, Leq day, Leq night	The project site, adjacent sensitive receptors (6 locations) as per baseline monitoring points	Onsite measurement and analysis	Noise Pollution Control Rules (2006), Bangladesh	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Water Quality	DO, BOD, Temperature, Electric Conductivity (EC), Turbidity, pH, TDS, Salinity, Iron, Arsenic, Phosphate, Zinc, Chromium, Nitrate, Magnesium,	2 samples (upstream and downstream of Karnatali River)	Surface water sampling and laboratory analysis	National Water Quality Standard (Schedule-2: Standards for Water, ECR, 2023)	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE/

Affected components	Parameters/Units	Monitoring Locations	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	Aluminum, Copper, COD, Hardness (as CaCO <sub>3</sub> ), Ammonia, Ammonium, Color, TSS, Oil, and Grease.						WARPO
	Temperature, Electric, Conductivity (EC), Turbidity, Ph, TDS, DO, Salinity, Iron, Fluoride, Arsenic, Total Coliform, Fecal Coliform, Chloride, Total Alkalinity, Total Hardness	2 Locations Project site, Adjacent village.	Groundwater sampling and laboratory analysis	National Water Quality Standard (Schedule-2: Standards for Water, ECR, 2023) and WHO guideline	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE/ WARPO
Soil Quality	Texture, Particle Size Distribution (Sand, Silt, Clay), Salinity, pH, Cation Exchange Capacity, Nitrogen (Total),	2 samples (Project Site and adjacent agriculture land)	Soil sampling and laboratory analysis	Standard analytical methods	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	Potassium, Magnesium, Sodium, Phosphorus, Iron, Chromium Cadmium						Private Limited /DOE
Sediment Quality	pH, Nitrogen (Total), Potassium, Calcium, Magnesium, Sodium, Phosphorus, Iron Zinc (Zn), Cadmium	2 samples (upstream and downstream of Karnatali River)	Sediment sampling and laboratory analysis	Standard Analytical methods	Quarterly	Appointed Contractor  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Waste (Solid and liquid waste)	Solid waste: Quantity, volume, and waste management Liquid waste: Waste management	Construction site	Visual inspection of all active work areas, Audits, photographic documentation	Monitoring and record keeping	Daily	Appointed Contractor	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Terrestrial Flora	Plant Health Monitoring (Plant Growth, Canopy)	5 sample plots within a 2 km Buffer Area	Sample Plot Survey, Visual inspection	Monitoring and Reporting	Once	Appointed Contractor or	Designated Team comprising of representation

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	Coverage, Disease, etc.)					A study by 3 <sup>rd</sup> party agencies/experts	from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Terrestrial Fauna	Death/disturbance of wildlife	Construction Sites and adjacent areas	Visual observation	Monitoring and Reporting	Monthly	Appointed Contractor or  A study by 3 <sup>rd</sup> party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Aquatic Flora and Fauna	Fisheries Resources-diversity, abundance, habitat suitability, etc.	2km upstream and 2km downstream from the adjacent project Area in the Karnatali River	Boat to boat Survey, Stakeholder consultation	Monitoring and Reporting	Once in the Construction Phase (End of monsoon)	Appointed Contractor or  A study by 3 <sup>rd</sup> party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Traffic	Traffic safety	Project adjacent road (Dhaka-Aricha highway (N5),	Visual inspection	Monitoring and record keeping	Daily	Appointed Contractor	Designated Team comprising of representation from EHS and

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
		approach road					Operations of WTE Power Plant North Dhaka Private Limited
Occupational Health and Safety	Accidents, incidents, diseases, and community complains	Construction site	Visual inspection	Monitoring and record-keeping	Based on occurrence	Appointed Contractor	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Community Health and Safety	Number of accidents, first aid, PPE	Construction site and surroundings	Visual inspection	Monitoring and record-keeping	Based on occurrence	Appointed Contractor	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

### 9.1.5 During Operation Phase

The proposed environmental monitoring program during the operation phase of the project is given in Table 9-2.

**Table 9-2: Monitoring Plan during Operation Phase**

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
Compliance monitoring	EIA, mitigation measures, condition of environmental approval	All areas	-	Environmental and Social Management and Monitoring Plan	Monthly	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Meteorology	Wind speed, wind direction, temperature, humidity, rainfall, solar radiation, cloud cover	Project site	Establishment of a weather station	-	Continuous	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Air Quality	PM <sub>2.5</sub> , PM <sub>10</sub> , CO, SO <sub>2</sub> , NO <sub>2</sub> , O <sub>3</sub>	Project site and nearest receptors (8 Locations) as per baseline monitoring points	Onsite measurement and analysis	Air Pollution Control (Rules), 2022	Once a month	O & M Unit  A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
							Operations of WTE Power Plant North Dhaka Private Limited /DOE
Emission monitoring	SO <sub>x</sub> , NO <sub>2</sub> , CO, CO <sub>2</sub> , O <sub>2</sub> , Temperature	Stack	Continuous Emissions Monitoring System (CEMS)	Air Pollution Control Rules-2022	Quarterly	A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
	Particulate Matter, CO, SO <sub>2</sub> , HF, HCl, NO <sub>x</sub> and other parameters might be added based on clearance certificate condition	Stack	Continuous emission monitoring	Solid waste management rules-2021	Continuous	A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	Furnace Temperature, Flue Gas outlet temperature, pressure, Water vapor or other parameters will be monitored as per clearance certificate condition	-	Continuous process parameters monitoring	Solid waste management rules-2021	Continuous	A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
	Heavy Metal, Dioxin and Furan	Stack	Regular Emission Monitoring	Solid waste management rules-2021	2-4 times in a year	A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Air Pollution Control Equipment	Fabric Filter Dry (Which have Dry Injection Facilities, Packed bed, Venturi or other wet Scrubber, Electrostatic Precipitation (ESP))	Air pollution control device setup	Onsite measurement and analysis	Solid waste management rules-2021	Continuous	A study by 3rd Party agency /experts.	Designated Team comprising of representation from EHS and Operations of WTE Power

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
							Plant North Dhaka Private Limited /DOE
Noise	Leq values in dB(A)	The project site, adjacent sensitive receptors (6 locations) as per baseline monitoring points	Onsite measurement and analysis	Noise Pollution Control Rules (2006)	Quarterly	O & M Unit  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Surface Water Quality	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	2 sampling sites (Water from the outlet and downstream of Karnatali river close to the project area)	Surface water sampling and laboratory analysis	National Water Quality Standard (Schedule-2: Standards for Water, ECR, 2023)	Quarterly	O & M Unit  A study by 3rd Party agency /experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Groundwater Quality	Temperature, Electric, Conductivity (EC), Turbidity, Ph, TDS, DO, Salinity, Iron, Fluoride, Arsenic, Total Coliform,	2 Locations (Project residential deep tube well and adjacent village)	Groundwater sampling and laboratory analysis	Drinking water quality standards as	Quarterly	O & M Unit	Designated Team comprising of representation

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
	Fecal Coliform, Chloride, Total Alkalinity, Total Hardness			per Schedule 2 of ECR 2023		A study by 3rd Party agency /experts	from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Wastewater	Temperature, pH, Chlorine, BOD5, COD, oil & grease, heavy metals, FC, TC, TDS, EC	The outlet of the discharge channel	Sampling and laboratory analysis of effluent	National Standards for Waste (Schedule-4: Standard for waste from Industrial units or Projects waste)	Monthly	O & M Unit  A study by 3rd Party agency /experts	Designated Team  comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Soil Quality (Contamination of Soil)	Texture, Particle Size Distribution (Sand, Silt, Clay), Salinity, pH, Cation Exchange Capacity, Nitrogen (Total), Potassium, Magnesium, Sodium, Phosphorus, Iron, Chromium Cadmium	2 samples (Project Site and nearest agricultural land)	Soil sampling and laboratory analysis	Standard analytical methods	Annually	O & M Unit  A study by 3rd Party agencies/experts	Designated Team  comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
Solid waste (domestic and office waste)	Quality, quantity, collection system and disposal locations	Disposal site on project premises	Visual checks to assess the situation	Monitoring and record keeping	Daily	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Solid waste (Fly ash, bottom ash)	Types, quantity, storage, associated hazards, disposal method	Fly ash, bottom ash generating sources, and disposal points	Visual checks to assess the situation	Monitoring and record keeping	Monthly	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Liquid Waste	Types, quantity, storage, associated hazards, disposal method	Storage and discharge point	Visual checks to assess the situation	Monitoring and record keeping	Monthly	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
							Plant North Dhaka Private Limited
Sediment Quality	pH, Nitrogen (Total), Potassium, Calcium, Magnesium, Sodium, Phosphorus, Iron Zinc (Zn), Cadmium	2 samples (upstream and downstream of Karnatali River)	Sediment sampling and Laboratory analysis	Standard Analytical methods	Annually	O & M Unit  A study by 3rd Party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Terrestrial Flora	Plant Health Monitoring (Plant Growth, Canopy Coverage, Disease, etc.)	5 sample plots within a 2 km Buffer Area	Sample Plot Survey, Visual inspection	Monitoring and Reporting	Yearly	O & M Unit  A study by 3rd Party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Terrestrial Fauna	Diversity and abundance of birds	Project site and adjacent areas	Visual observation	Monitoring and Reporting	Quarterly	O & M Unit	Designated Team comprising of representation

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
						A study by 3rd Party agencies/experts	from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Aquatic Flora and Fauna	Fisheries Resources- diversity, abundance, habitat suitability, etc.	2km upstream and 2km downstream from the adjacent project Area in the Karnatali River	Boat to boat Survey, Stakeholder consultation	Monitoring and Reporting	Yearly (End of monsoon) for 2 years	O & M Unit  A study by 3rd Party agencies/experts	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited /DOE
Traffic	Traffic management plan in the project area and disturbance in the approach road	Entry and exit routes of the plant and approach road	Visual inspection	Traffic Management Plan	Daily	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

Affected components	Parameters/Units	Monitoring Location	Means of Monitoring	Applicable Standards	Frequency	Responsibility	
						Implementation	Supervision
Green belt development	The number of trees is planted	Project premises and surrounding area	Plantation of trees and record keeping	Monitoring	Periodic and need based	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited
Community health and safety	Respirable disorders, Heart diseases, Child health, etc.	Surrounding villages around the project	Health check-up	-	Yearly	WTE Power Plant North Dhaka Private Limited	WTE Power Plant North Dhaka Private Limited
Occupational health and safety	Accidents, PPEs, Diseases (respirable disorders, heart diseases, diabetes, reproductive and Child health, ENT problems, etc.)	Operational areas (all places where there is the presence of workers all the time)	-	Health and Safety Policy of WTE Power Plant North Dhaka Private Limited	Weekly	O & M Unit	Designated Team comprising of representation from EHS and Operations of WTE Power Plant North Dhaka Private Limited

## **9.2 Budget Plan for Environmental Mitigation Measures and Monitoring**

WTE Power Plant North Dhaka Private Limited will allocate a separate budget for environmental monitoring, analysis and reporting, verification monitoring, and capacity building. It should be noted that costs for many in-built mitigation measures, such as acoustic enclosures for noise control, water, and wastewater treatment, must be included in the contract cost estimation and operating cost estimation. The estimated budget for environmental monitoring for the construction and operation phase is 3.136 million (BDT) per year. This budget does not include the decommissioning stage since the minimum operation period is 20 years, and the rate will vary largely from the present cost.

The environmental monitoring budget estimation for the construction and operation phase of the Project is provided in Table 9-3.

**Table 9-3: Environmental Monitoring Cost (C) during construction and operation stage/year**

Component	Stage	Item	Location	Unit	Quantity	Rate (BDT)	Total Costs (BDT)
Ambient Air Quality	During Construction	PM <sub>2.5</sub> , PM <sub>10</sub> , CO, SO <sub>2</sub> , NO <sub>2</sub> , Odor	8	No.	32	20,000	0.640
	During Operation	PM <sub>2.5</sub> , PM <sub>10</sub> , CO, SO <sub>2</sub> , NO <sub>2</sub> , Odor	8	No.	32	20,000	0.640
Stack Emission	Operation Stage	SO <sub>x</sub> , NO <sub>2</sub> , CO, CO <sub>2</sub> , O <sub>2</sub> , Temperature	1	No.	4	20,000	0.08
Water Quality (Surface & Ground Water)	During Construction	<b>Surface Water</b> DO, BOD, Temperature, Electric Conductivity (EC), Turbidity, pH, TDS, Salinity, Iron, Arsenic, Phosphate, Zinc, Chromium, Nitrate, Magnesium, Aluminum, Copper, COD, Hardness (as CaCO <sub>3</sub> ), Ammonia, Ammonium, Color, TSS, Oil, and Grease.	2	No.	8	18,000	0.144
		<b>Ground Water</b> Temperature, Electric, Conductivity (EC), Turbidity, Ph, TDS, DO, Salinity, Iron, Fluoride, Arsenic, Total Coliform, Fecal Coliform, Chloride, Total Alkalinity, Total Hardness	2	No.	8	15,000	0.12

Component	Stage	Item	Location	Unit	Quantity	Rate (BDT)	Total Costs (BDT)
	During Operation	<b>Surface Water</b> DO, BOD, Temperature, Electric Conductivity (EC), Turbidity, pH, TDS, Salinity, Iron, Arsenic, Phosphate, Zinc, Chromium, Nitrate, Magnesium, Aluminum, Copper, COD, Hardness (as CaCO <sub>3</sub> ), Ammonia, Ammonium, Color, TSS, Oil, and Grease.	2	No.	8	18,000	0.144
		<b>Ground Water</b> Temperature, Electric, Conductivity (EC), Turbidity, Ph, TDS, DO, Salinity, Iron, Fluoride, Arsenic, Total Coliform, Fecal Coliform, Chloride, Total Alkalinity, Total Hardness	2	No.	8	15,000	0.12
Wastewater	During Operation	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	1	No.	4	15,000	0.06
Noise	During Construction	Noise levels in Leq, Leq day, Leq night	6	No.	24	6000	0.144
	During Operation		6	No.	24	6000	0.144

Component	Stage	Item	Location	Unit	Quantity	Rate (BDT)	Total Costs (BDT)
Soil	During Construction	Texture, Particle Size Distribution (Sand, Silt, Clay), Salinity, pH, Cation Exchange Capacity, Nitrogen (Total), Potassium, Magnesium, Sodium, Phosphorus, Iron, Chromium Cadmium	2	No.	8	20,000	0.16
	During Operation		2	No.	8	20,000	0.16
Sediment	During Construction	pH, Nitrogen (Total), Potassium, Calcium, Magnesium, Sodium, Phosphorus, Iron Zinc (Zn), Cadmium	2	No.	8	30,000	0.24
	During Operation		2	No.	8	30,000	0.24
<b>Total Environmental Monitoring Cost (C)</b>							<b>3.036</b>
Environmental Training	During Operation	Orientation Workshop and follow-up training program for capacity building/ institutional development program	-	Lump sum	LS	100,000	0.1
<b>Environmental Training Costs (D)</b>							<b>0.1</b>
<b>Grand Total (C+D)</b>							<b>3.136</b>

### 9.3 Institutional Setting and Implementation Arrangement

The EMP (mitigation plan) will be included in the construction contract and the contractor will be responsible for the implementation of the measures associated with design and construction. The overall management and coordination of the Project will be the responsibility of the Project General Manager of WTE Power Plant North Dhaka Private Limited. The project-level activities will be managed by the Deputy Project Manager and Chief Engineer. At the project level, the implementation of management plans and corrective actions are the responsibilities of the EHS Department in coordination with other departments. In the construction and operational phase, EHS Manager will supervise the Contractor's environmental and health safety performance to implement the management action plans. The roles and responsibilities of the Project Developer (WTE Power Plant North Dhaka Private Limited) and EPC Contractor for implementation and monitoring have been outlined in Table 9-4. The flow diagram depicting the institutional arrangement for the implementation of the ESMP is presented in Figure 9-1.

**Table 9-4: Roles and Responsibilities of Project Developer and EPC Contractor**

<b>Project Developer (WTE Power Plant North Dhaka Private Limited)</b>	<b>EPC Contractor</b>
Obtaining statutory clearances required during the pre-construction stage of the Project	Obtaining permits required during the construction stage
Overall project coordination and management through EPC and supported by the third-party environmental consultant/s	Joint verification with Project Developer and Third-Party Environmental Consultant for review of EMP implementation
Interaction and reporting to the respective department of GOB	Interaction with Project Developer and appointed supervision consultant if any
Effective implementation of EMP and monitoring of EMP implementation	Environmental monitoring through the Third-Party Environmental Laboratory
Carryout verification/ supervision exercises during the construction phase of the Project for the implementation of EMP	Preparation of various plans for effective implementation of EMP as detailed in the "Specification Manual" by the Project Developer
Keeping records of all permits obtained by EPC Contractor	Identification of site for labor camp, batch mix plant, and laydown areas
Overall supervision of EMP implementation	Management of labor camp and providing drinking water, sanitation facility
Approval of plans prepared by EPC Contractor	
Addressing grievances of the local community and information dissemination	
Environmental monitoring through laboratory	

While the contractor or a particular party is responsible for the physical implementation of the mitigating measures, the whole implementation process requires supervision, checking, documentation, and verification to identify and adequately address problems before they get out of hand.

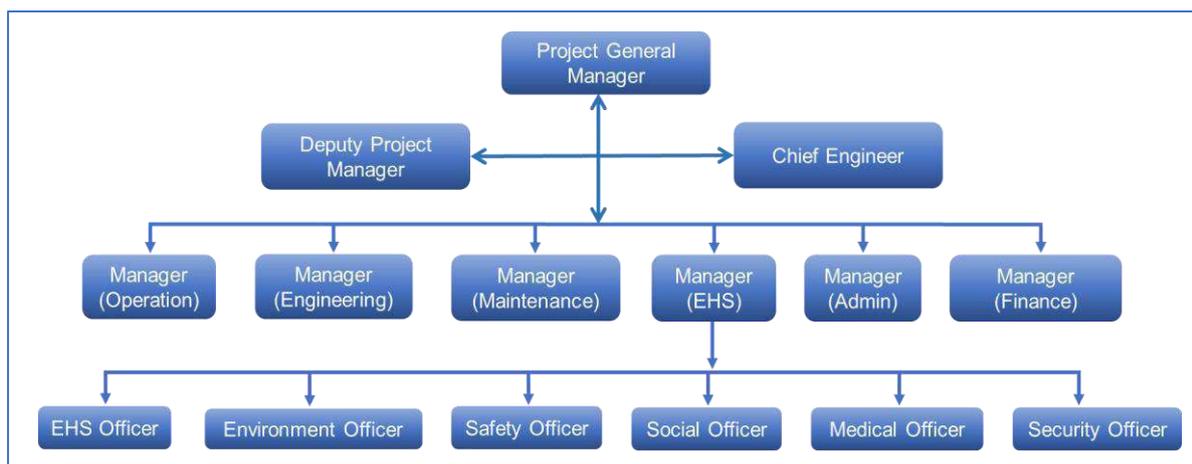
To ensure proper execution of the EMP, implementation reviews will be conducted by the project engineer, such as the weekly construction meetings, construction logbook, monthly and other construction reports, etc.

Records of these weekly meeting minutes, monthly reports, and special reports on implementing the mitigating measures will also be maintained and available for review by the Project management. It is

suggested to identify documents and records that require templates. Accordingly, suitable templates shall be developed, including but not limited to policies, procedures, work instructions, meeting minutes, monitoring results, training attendance records, emergency contact lists, action plans, etc. Further, all these templates shall be communicated to all potential users. All these records will be archived at the Project office and maintained by the EHS officer. All documents and records shall be archived with a unique identifier to be distinguished from any other material and easily retrieved. WTE Power Plant North Dhaka Private Limited will document the process for creating, allocating, and approving unique identifiers and will communicate this to relevant staff.

The Contractor shall ensure that the EMP (for the project) is implemented, the performance of which will be evaluated by WTE Power Plant North Dhaka Private Limited from time to time. The Contractor shall also be responsible for provisioning adequate arrangements and resources for implementing the corrective action developed as part of the internal and external audit reports developed from time to time. The implementation shall be time and responsibility bound in the contractor project organogram. As the project is also being developed on some private land, it is envisaged that the Developer needs to appoint an onsite Admin officer to manage social (including labor and community) issues. The name and contact number of the appointed person should be displayed at the site office. The environment management organogram of WTE Power Plant North Dhaka Private Limited is shown in Figure 9-1 below.

**Figure 9-1: Organization Chart for Environmental Management**



### 9.3.1 Roles and Responsibilities

This section describes the roles and responsibilities of the key persons responsible for the management of environmental and social activities for the proposed project:

#### Project General Manager

The Project Manager of WTE Power Plant North Dhaka Private Limited is responsible for the overall management of the project and ESMP implementation during the construction and operation phase. The following tasks will fall within his/her responsibilities:

- To consider and react to issues and solutions proposed by the HSE Department of WTE Power Plant North Dhaka Private Limited.
- To cooperate and consult the relevant environmental agency to perform better.
- To evaluate the progress of the development and implementation of ESMP; and
- To approve any change in decision-making and authorities in consultation with Manager EHS, if appropriate

### **EHS Manager**

The success of EMP depends on proper and effective management provided by the EHS manager. The roles and responsibilities assigned to the Manager EHS are given below:

- To ensure that the points of view of staff, contractors, and EHS officers are considered and placed likewise in the EMP.
- To identify issues and propose solutions for inclusion in the EMP review process.
- To improve coordination and exchange of information between top management, employees, and contractors.
- To contribute to actions required to deliver the management plan and ensure its continued development.
- To review EMP every year, tracking issues and changing EMP in accord with the solutions and suggestions; and
- To monitor the progress of the development and implementation of the EMP.

### **EHS Officer**

The role of the EHS officer will be authorized by the EHS manager. The responsibilities of an HSE officer will include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan.
- To maintain a balanced, comprehensive approach to the solution of concerning issues in accordance with and compliance with legislative requirements.
- To provide professional guidance on questions relating to the environment management and issues raised by contractors/relevant personnel; and
- To develop the EMP process through its implementation

### **Environmental Officer**

The role of the Environmental Officer will include.

- Advising on environmental legal requirements regarding issues that may arise during the project.
- To identify environmental issues and implement environmental management with the help of the HSE department.
- Regular auditing with the view of ensuring that all activities on the site are undertaken in accordance with the ESMP.

### **Social Officer**

The Assistant Manager (Social) will be responsible for the following scope of work:

- Acting as a point of contact for residents and community members.
- To meet the labor requirements during the construction phase of the Project.
- To involve in Grievance Redressed Committee and will actively participate in addressing issues raised by workers and the community.
- To conduct independent social audits.
- To Address training needs for social and community issues.
- Conduct periodic meetings with the local community to understand their grievances.
- To involve in CSR activities with the community people.

### **Safety Officer**

The major responsibilities of the Safety Officer will include.

- To stay at ground levels daily and will coordinate with the Contractor's representatives for all construction activities.
- To provide toolbox training to labor and will also issue relevant PPEs to them.
- To develop formats for the work permit system and will ensure its implementation.

- Submit audit reports to the EHS Manager of respective Modules.

# **Chapter 10**

## **Consultation with Stakeholder**

## 10 CONSULTATION WITH STAKEHOLDERS

### 10.1 Introduction

Stakeholder engagement is the continuing and iterative process by which the Borrower identifies, communicates, and facilitates a two-way dialogue with the people affected by its decisions and activities, as well as others with an interest in the implementation and outcomes of its decisions and the project. It considers the different access and communication needs of various groups and individuals, especially those more disadvantaged or vulnerable, including consideration of both communication and physical accessibility challenges. Engagement begins as early as possible in project preparation because early identification of and consultation with affected and interested parties allows stakeholders' views and concerns to be considered in the project design, implementation, and operation.

To make the consultation and disclosure process effective and fruitful, comprehensive planning is required to assure that local government, host population, and project staff interacts regularly and purposefully, throughout all stages of the project and contribute toward a common goal.

#### 10.1.1 The objective of stakeholder engagement

The objectives of the stakeholder engagement are as follows.

- Identify all the interested and affected people (IAPs) of the project.
- Identify the methods, timing, and structures through which to share project information and ensure regular, accessible, transparent, and appropriate consultation with IAPs.
- Identify the interests, concerns, and needs of IAPs.
- Manage IAPs expectations through negotiation.
- Fulfill requirements for consultation.

### 10.2 Applicability

This Stakeholder Engagement Plan is developed for the current Project design and capacity and is designed to facilitate information disclosure, consultation, and participation, grievance redress mechanism including indigenous peoples located within the project area. The plan outlines the project provisions about engaging with the community and also receiving feedback during the project operation.

#### 10.2.1 Information disclosure

Disclosure of relevant project information helps stakeholders understand the risks, impacts, and opportunities of the project. If communities may be affected by adverse environmental or social impacts from the project, the client will disclose to them the following information (“the Information”):

- the purpose, nature, and scale of the project.
- the duration of proposed project activities.
- any risks to and potential impacts with regard to the environment, worker health and safety, public health and safety, and other social impacts on communities, and proposed mitigation plans.
- the envisaged consultation process, if any, and opportunities and ways in which the public can participate.
- the proposed stakeholder engagement process highlighting how stakeholders can participate.
- Time/venue of any envisaged public meetings and the process by which meetings are notified and reported.

The information will be disclosed in the local languages and in a manner that is accessible and culturally appropriate, considering any vulnerable people. Meaningful stakeholder engagement depends on timely, accurate, accessible, and comprehensible information. Information may include presentation printouts, nontechnical summaries, project leaflets, and pamphlets. Documents used in stakeholder

consultation should be made available to stakeholders, for example on community public notice boards, and where possible, on the borrower's website. Additional information may need to be disclosed on an ongoing basis, such as the project or its impacts, or if material new risks and impacts arise.

## 10.2.2 Consultation

Consultation involves information exchanges among the government, the Implementing Agency, the project executing agencies, and other stakeholders. Although decision-making authority rests with the government, the Implementing Agencies, and the project executing agencies, periodic consultations throughout the project cycle help managers make informed choices about project activities. More importantly, it provides opportunities for communities and local groups to contribute to project design, implementation, and evaluation. A list of identified stakeholders is given in Table 10-1.

**Table 10-1: List of Identified Stakeholders**

Disclosure	Office/Group	Frequency	Time
KII	<ul style="list-style-type: none"> <li>• DNCC</li> <li>• Local Union</li> <li>• Upazila Agriculture</li> <li>• SWM official at Ward</li> <li>• Local School Teacher</li> </ul>	Once	During ESIA
FGD	<ul style="list-style-type: none"> <li>• Local Community</li> <li>• Women group</li> <li>• Local Youth</li> <li>• Landowners</li> <li>• Waste Vendors/Buyers</li> <li>• Waste management group</li> </ul>	Once	During ESIA
PCM	<ul style="list-style-type: none"> <li>• Local Community</li> <li>• Landowners</li> <li>• Civil Society Member</li> <li>• Community Influential</li> </ul>	Once	During ESIA

## 10.3 Approach and Methodology for Stakeholder Mapping and Analysis

The approach adopted for mapping and analyzing involves mapping the key stakeholders (affected and interested) and assessing their significance, influence, and impact on the project. The methodology adopted for stakeholder mapping and analysis is described below:

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale, frequency) or degree of influence (power, proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed by taking the power/responsibility of the stakeholder group and is categorized as negligible, small, medium, and large. The Urgency or likelihood of the impact on/influence by the stakeholder is assessed on a scale of low, medium, and high. The overall significance of the stakeholder group is assessed below: Stakeholder Assessment.

**Table 10-2: Stakeholder Mapping Matrix**

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	Medium	High
Magnitude of Impacts	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Urgent
	Large	Moderate	Urgent	Urgent

The following section provides brief profiles of the various stakeholders in the project as discussed above along with their degree of influence. The details are provided in below Table 10-3

**Table 10-3: List of Identified Key Project Stakeholders Basis on Influence**

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
<b>Project Management</b>				
Project Owner	Primary	Waste to Energy Power Project North Dhaka Private Limited is the primary project proponent who owns a controlling stake of 100% in the project	Urgent	<ul style="list-style-type: none"> <li>• Primary project proponents.</li> <li>• Primary financial beneficiaries.</li> <li>• Responsible for all the project risks and impact liabilities.</li> <li>• Responsible for the establishment and operation of this project.</li> </ul>
Project Financiers	Primary	May include local and regional banks, national and international banks as well as a development partner organization.	Urgent	<ul style="list-style-type: none"> <li>• Engagement is limited to the corporate management level.</li> <li>• Key participants in the decision-making process.</li> <li>• Compliance with funding agencies' safeguards/operation policies and other policies.</li> </ul>
EPC contractor	Primary	Construct to deliver a functioning facility or asset to their clients	Moderate	<ul style="list-style-type: none"> <li>• Carry out the detailed engineering design of the project.</li> <li>• Procure all the equipment and materials necessary.</li> <li>• Carry out the works following the agreed scope of works and following the Contract</li> </ul>
Migrant Worker and Labor	Primary	Labors and workers inside, and outside of Savar Upazila for participating in construction and production activities	Moderate	<ul style="list-style-type: none"> <li>• Responsible for undertaking mostly skill and unskilled-based work during the construction phase.</li> <li>• Skilled-based work during the operation/production period.</li> </ul>

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
<b>Community</b>				
Local Community	Primary	Primarily includes communities residing adjacent to the project site including women and vulnerable households.	Moderate	<ul style="list-style-type: none"> <li>The receptor of potential air, water pollution, and other environmental risks.</li> <li>Potential beneficiaries of the infrastructural and other development activities.</li> <li>Potential beneficiaries of business and job opportunities.</li> </ul>
Landowners	Primary	Primarily includes landowners whose land was acquired.	Moderate	<ul style="list-style-type: none"> <li>Land Buying Status</li> </ul>
Women	Primary	Includes women residing in villages around the project site	Moderate	<ul style="list-style-type: none"> <li>No major direct impacts on women's communities except the potential air, water, and other environmental impacts.</li> <li>Mostly, no major stake in households' income and decision-making.</li> <li>Expected to be the beneficiaries of work opportunities.</li> </ul>
<b>Regulatory/Administrative Authorities &amp; Agencies</b>				
Department of Agriculture	Secondary	The local governmental agency is responsible for the implementation of governmental agricultural activities.	Moderate	<ul style="list-style-type: none"> <li>Expert input in the design phase</li> </ul>
<b>Local Administration</b>				
Elected Representatives (Chairman, Member)	Secondary	Elected representatives of local Union Parishad	Moderate	<ul style="list-style-type: none"> <li>Plays an important role in providing public opinion and sentiment on the project.</li> </ul>

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
				<ul style="list-style-type: none"> <li>Empowered to provide consent and authorization for the establishment of the project on behalf of the community</li> </ul>
<b>Waste Supply Chain</b>				
Chief Waste Management Officer, DNCC	Secondary	DNCC official of waste management	Urgent	<ul style="list-style-type: none"> <li>Plays an important role in providing opinions and discussion on the project.</li> <li>Plays an important role in the operation phase.</li> </ul>
Waste Supervisor/Manager	Secondary	SWM official at WARD level	Urgent	<ul style="list-style-type: none"> <li>Plays important role in providing information regarding the waste supply chain</li> </ul>
Waste Buyer/Vendor	Secondary	Different locations at waste dumping points	Moderate	<ul style="list-style-type: none"> <li>Plays a moderate role in providing information on the waste supply chain.</li> </ul>

### **10.3.1 Information Disclosure**

Disclosure of relevant project information helps stakeholders understand the risks, impacts, and opportunities of the project. If communities may be affected by adverse environmental or social impacts from the project, the client will disclose to them the following information (“the Information”):

- the purpose, nature, and scale of the project.
- the duration of proposed project activities.
- any risks to and potential impacts regarding the environment, worker health and safety, public health and safety, and other social impacts on communities, and proposed mitigation plans.
- the envisaged consultation process, if any, and opportunities and ways in which the public can participate.
- the proposed stakeholder engagement process highlighting how stakeholders can participate.
- Time/venue of any envisaged public meetings and the process by which meetings are notified and reported.

The information will be disclosed in the local languages and in a manner that is accessible and culturally appropriate, considering any vulnerable people. Meaningful stakeholder engagement depends on timely, accurate, accessible, and comprehensible information. Information may include presentation printouts, nontechnical summaries, project leaflets, and pamphlets. Documents used in stakeholder consultation should be made available to stakeholders, for example on community public notice boards, and where possible, on the borrower’s website. Additional information may need to be disclosed on an ongoing basis, such as the project or its impacts, or if material new risks and impacts arise.

### **10.3.2 Key Informant Interview**

During the site visit conducted by EQMS, the following key informant interviews with the different stakeholders took place to disseminate and disclose information on the proposed activities. A summary of the KII and photographs are given in the Figure.

**Table 10-4: Summary of Key Informant Interview**

Key Stakeholder	Office/Department	Date	Key Points Discussion	Responses
<b>Community Influential</b>				
Md Saiful Islam	Chairman, Bongaon Union	30-08-22	<ul style="list-style-type: none"> <li>• Area Name correction</li> <li>• Proper maintenance of waste</li> <li>• Employment for the qualified locals</li> <li>• NOC, Trade License, and Tax payment</li> </ul>	<ul style="list-style-type: none"> <li>• Chairman raised his voice to correct the area name to “Baliarpur” instead of Amin Bazar. People used to call the place Amin Bazar though it falls under the Bangoan Union, and the area's name is Baliarpur.</li> <li>• His other concern was regarding the management of waste at the project. Currently, the amount of waste and the condition of landfill is worse than ever. If proper waste handling has not occurred, it will be devastating.</li> <li>• Collect NoC from Union Parishad along with the trade license for the company if they sell electricity and pay tax accordingly.</li> <li>• Give priority to the qualified local people for employment at the project.</li> <li>• Union Parishad will always cooperate with the company when needed.</li> </ul>
Mss. Shema Akter	UP Member (Ward-7,8,9)	30-08-22	<ul style="list-style-type: none"> <li>• Health safety issues for women and children. She requests to consider health and safety issues first.</li> <li>• Employment opportunities for locals.</li> <li>• Traffic and transportation control during construction</li> </ul>	<ul style="list-style-type: none"> <li>• During the construction and Operation phase of the plant, health safety issues should be considered a prior for women and children.</li> <li>• Employment opportunities for the local people should be on priority lists based on their qualifications.</li> <li>• Deeply monitor and control the traffic and transport of material.</li> </ul>

Key Stakeholder	Office/Department	Date	Key Points Discussion	Responses
Md Firoz Hossen	UP Member (ward 8) & Committee Member of Mosque	30-08-22	<ul style="list-style-type: none"> <li>Concern about agricultural land.</li> <li>Air, Noise, Water, and Soil quality.</li> <li>Impact on the health of the local people.</li> </ul>	<ul style="list-style-type: none"> <li>Near-by agricultural land should not be damaged due to the proposed project and other relevant work of the project.</li> <li>Monitor and control the pollution of air noise and water as well as soil of nearby lands.</li> <li>Consider the health and safety issues of local people during the operation phase.</li> </ul>
Kanai Lal Rajbongshi	Advisor of Local Temple (Hindu)	28/8/22	<ul style="list-style-type: none"> <li>Request to consider safety for local and odor management.</li> <li>A small grant for the development of the Temple is requested.</li> </ul>	<ul style="list-style-type: none"> <li>Odor management should be a top priority during the construction and operation phases of the project.</li> <li>From the CSR activity of the project, a small grant is requested for the development of the temple.</li> </ul>
<b>Administrative</b>				
MSS Naziat Ahmed	Upazila Agriculture Officer, Savar	24/8/22	<ul style="list-style-type: none"> <li>Safety precautions for agricultural land</li> <li>Waste control from spreading out.</li> <li>Wastewater leakage from the plant</li> <li>Skill-based training and other plans for poor farmers of the area</li> </ul>	<ul style="list-style-type: none"> <li>Make sure that proper safety protocol is maintained so that agricultural land remains unharmed.</li> <li>Control the waste from spreading outside the boundary.</li> <li>Make sure no wastewater comes out and falls into the land and damages crops and soil quality.</li> <li>If possible, arrange skill-based training and workshop for poor farmers in that area from the CSR perspective.</li> </ul>
<b>Waste Management &amp; Supply Chain</b>				
Shafikur Rahman	Project Director, Waste to Energy Power Plant, DNCC	3/10/22	<ul style="list-style-type: none"> <li>Waste Generation</li> <li>Waste management</li> <li>The supply chain of waste</li> <li>Project Benefit</li> </ul>	<ul style="list-style-type: none"> <li>Currently, DNCC collects 3400 tons of waste per day.</li> <li>DNCC manages its waste by itself for 28 WARD and 26 WARD by a private company. Overall liaison and reporting have been maintained with the waste management department of DNCC.</li> </ul>

Key Stakeholder	Office/Department	Date	Key Points Discussion	Responses
			<ul style="list-style-type: none"> <li>Challenges</li> <li>Outcome</li> </ul>	<ul style="list-style-type: none"> <li>Four private companies engaged in waste management systems independently.</li> <li>147 vehicles and 3914 cleaners working for waste management.</li> <li>52 STS for waste dumping at the zone level.</li> <li>Medical waste and ternary waste are not dumped in landfills.</li> <li>Mainly waste supply chain follows 3 stages, these are <b>Primary</b> level or household-level collection by the waste collector, <b>secondarily</b> it comes to STS from where it goes to different buyers or vendors through waste pickers and finally resin has been created as a material of plastic product from the waste.</li> <li>Currently, the inner part of the landfill is full of and cannot be operational. Once the project runs this landfill will produce power from waste and the tension of waste handling will be resolved.</li> <li>The landfill operated through five major activities <b>One-</b> Vehicle Management. <b>Two-</b> Disposal management. <b>Three-</b> Landfill facility management. <b>Four-</b> Safety Management. <b>Five-</b> Environmental Management.</li> <li>Waste segregation at the household level is the biggest challenge for us. If people cooperate in this matter waste segregation challenge will not be an issue to resolve.</li> <li>This project will help tremendously to control our waste and produce energy which will contribute to the national grid.</li> </ul>
Farid Ahmed	Manager, Multi Waste Management	3/10/22	<ul style="list-style-type: none"> <li>Waste management</li> <li>Future plan</li> <li>Waste supply chain</li> </ul>	<ul style="list-style-type: none"> <li>The company is responsible for 13 wards of DNCC to manage waste.</li> </ul>

Key Stakeholder	Office/Department	Date	Key Points Discussion	Responses
	and Engineering Ltd.			<ul style="list-style-type: none"> <li>In the future, we will introduce more technical instruments for waste handling and management.</li> <li>Some newly introduced vehicles for waste collection have already been started and they will increase in the near future.</li> <li>Waste is generated from a different source and designated collectors collect the waste and it goes to STS after some segregation the ultimate destination of waste is the landfill of Amin Bazar.</li> </ul>
Kazi Ahmed Kabir	General Manager, Clean Tech, Waste Management, DNCC	22/09/22	<ul style="list-style-type: none"> <li>Waste segregation</li> <li>Proper waste collection</li> <li>Target-based amount of waste</li> <li>Proper monitoring at the local level</li> <li>Train up waste collectors</li> <li>Maintain liaison with ward waste committee</li> </ul>	<ul style="list-style-type: none"> <li>The most challenging part of waste management is the segregation part.</li> <li>Make a proper target that needs to be achieved for burning.</li> <li>Need to monitor waste collection and dumping properly to get burnable waste from the local level to the plant.</li> <li>Arrange training for the collectors on waste handling and reaching out to the destination.</li> <li>Maintain liaison with the ward-level waste committee for proper waste collection.</li> </ul>
Md Siraj Mia	Supervisor, Sector waste management	22/09/22	<ul style="list-style-type: none"> <li>Waste collection Chain</li> <li>Waste collection system</li> </ul>	<ul style="list-style-type: none"> <li>Mainly the waste is collected from the household level by the locally recruited waste collector, and they carry the waste to the secondary transfer station, after some segregation the waste is taken by DNCC waste picking vehicle to the landfill.</li> <li>Each ward of DNCC has a box type of non-motorized van and pickup for carrying waste from the household level. Based on the area and population waste collectors may vary from ward to ward.</li> </ul>

Key Stakeholder	Office/Department	Date	Key Points Discussion	Responses
Rasel Mia	Waste Buyer/Vendor	22/09/22	<ul style="list-style-type: none"> <li>• Supply chain</li> <li>• Process of waste buying</li> <li>• The ultimate destination of waste</li> <li>• Manpower involvement</li> </ul>	<ul style="list-style-type: none"> <li>• Mainly waste was collected from the household level by van, and it comes to the STS. During the transfer from the household level to STS some sorting of waste has been done by the pickers and it comes to the vendor or buyer.</li> <li>• The vendor/buyer buys the waste of weight, and the price was determined by the type of waste.</li> <li>• Mainly general plastic is sold for 30–35 taka kg based on the quality, poly bags, and rubber materials are sold for 40–45 taka kg, and aluminum or silver, or metal items are sold at a higher price up to 60–70 taka kg.</li> <li>• Some buyers from the old town and Savar buy the collected and segregated waste from the vendor and they make chips from that plastic in a small factory which was bought by the plastic company after cleaning and drying.</li> <li>• Each secondary transfer station (STS) has more or less 100-120 people involved in the entire waste buy sell and carrying process.</li> </ul>
Md Kalam	Waste Vendor/Buyer	22/09/22	<ul style="list-style-type: none"> <li>• Employment status</li> <li>• Business condition</li> <li>• Future of waste business</li> <li>• Opinion</li> </ul>	<ul style="list-style-type: none"> <li>• He has 16 employees working with his shop for waste segregation and other purposes regarding waste. More than 100 people are even involved from different perspectives.</li> <li>• This business is good if govt. gives them loans and training, it could be better, and the country can earn revenue from waste.</li> <li>• Proper management and guidance are required to grow this business. There is a huge opportunity in the waste business.</li> </ul>

Source: EQMS, August 2022

### **10.3.3 Focus Group Discussion**

During the preliminary site visit, the following focus group discussion was conducted to disseminate and disclose the information proposing the waste-to-energy project and to know their opinions about the project. Focus Group Discussion was conducted near the proposed project site with the participants where the consultant team discusses the proposed project details and noted their perceptions. following groups were consulted:

- Landowners
- women group
- local youth group

#### **10.3.3.1 Summary of FGD with Landowners**

The key findings of the focus group discussion with landowners are as follows:

- Landowners and community people know about the project from the consultant's visit. They welcome the proposed project and agree to support the project.
- The major livelihood activity of the community is business and agriculture. They generally practice mixed farming on their land.
- The major crops in the area are rice, vegetables, etc. They sell their products in the local market.
- The major livestock reared by the community are cattle, sheep, and goats. Poultry rearing is also seen in families. Some of the participants raised issues of grazing and farming land.
- Land compensation is preferred in cash. They also believe that employment opportunities will be created according to their skills and experiences.
- People are happy with the determined piece for their land.
- Some of them claim additional compensation for the loss of their crop production due to waste.
- Mainly the ownership is inherited, and some are from buying through deeds and cash payments.
- People are aware of the project and are concerned about any further pollution of their land.
- Lands are sold based on oral conversation and deeds with a cash payment at a time or through installment with or without any involvement of any third party or broker.
- People have an issue with odor management and any further pollution by the waste.

#### **10.3.3.2 Summary of Consultation with Women Group**

Women in the Baliarpur area are mostly engaged in household chores such as cooking, child-rearing, animal care, etc. Daily activities of women start between 6.00 AM to 7.00 AM and involve cooking and cleaning, taking care of children, feeding cattle and other livestock, etc. Besides household work, some of the women reported they are involved in business and private jobs. 80% of the females have completed the primary level of education. Girls dropping out in the area is very common. The major reason for girls' dropout is majorly poor family economic conditions and the high cost of education. Girls drop out mostly after completing secondary education, post which they got married. The most common age of marriage for girls is between 19 to 20 yrs. As per consultation, there are no cases of domestic violence and rape reported in the project area. Women in the area are not involved in a community-level decision-making activity. Most of the participants opined that gender-wise employment opportunities for males and family members would benefit the local community from jobs created by the project. The women also expressed interest in receiving vocational training in tailoring, boutique, animal husbandry, etc. The women's groups also requested to control the odor generated from the waste.

#### **10.3.3.3 Summary of Consultation with Local youth**

The youth group of the adjacent area of the project is mainly involved in the study, mostly they are higher secondary and undergraduate level students. There is one high school in the village and most

of them are studying at that school. 1/2 of students report that they go to study at Mirpur which is 6-8 km from their village. During the consultation, it was stated that some of the youths are involved in small-scale businesses (mainly online-based clothing) and private jobs in the RMG sector. This youth group is one of the largest groups in consideration of the age-based grouping of the population in that area. The youth also expressed interest in receiving vocational training like digital marketing, entrepreneurship, mechanical or electrical training, etc. The youth group also requested to consider them for employment in the project.

## **10.4 Public Consultation Meeting (PCM)**

### **10.4.1 Introduction**

The objective of the meeting was to inform and obtain opinions of the public from the proposed project area about the proposed Waste to Energy Power project, its potential environmental and social impacts, and mitigation measures. A public consultation meeting was held on 30<sup>th</sup> August 2022 at Jamuna Natural Park, Baliarpur, Savar, Dhaka.

The proceedings commenced at 10:30 am and were presided over by Md Saiful Islam, Chairman Bangoan Union of Savar Upazila. The meeting was attended by a total of 65 people (Attendance sheet have been attached in **Appendix D-2**), which represent the elected representatives of Bongaon Union, non-government organization, land-affected people, local people including women and senior citizen, local businessman, employees, and shopkeepers of the project area.

Mr. Najmul Hossen, Senior Consultant, EQMS Consulting Limited welcomed the participants to the consultation meeting. Mr. Najmul gave a presentation about the proposed Waste Energy Power Project. After a concise presentation about the project, the floor was opened to opinions and suggestions from the participants.

DNCC representatives answer the queries and questions raised by local people. Also, the consultant gives feedback on behalf of WTE Power Plant North Dhaka Private Limited regarding some queries about the project. Mr. Lucas also gives thanks to the participants for their spontaneous participation.

After the completion of the opinions and suggestions session, Mr. Modin Mia UP, a member of the Bangoan Union, concluded the meeting by thanking everyone for their participation and concluded the public consultation meeting.

### **10.4.2 Methodology**

#### **10.4.2.1 Consultation**

Prior to the notice, EQMS Consulting Limited consulted with the union chairman about the date and time. The consultant requested to conduct the consultation/meeting at a convenient place, where there is enough space for more than 100 people under the shadow with sufficient electricity facilities. The venue was selected in terms of easy accessibility from villages near the project area, and invitees as well.

#### **10.4.2.2 Invitation**

After the confirmation of the date, time, and venue, EQMS's team visited the project area and invited the nearly residing persons to present in the consultation meeting. They also invited project-interested persons from the Baliarpur, and Kunda Villages, and businessmen from the project's adjacent area.

#### **10.4.2.3 Announcement**

After the finalization of the date and venue, UP members of the respected Wards informed local people to attend PCM.

### 10.4.3 Meeting Outcome

The key points raised by the stakeholders with responses provided by the project sponsor and consultant are summarized in the following Table 10-5 presents the outcome of the public consultation meeting.

**Table 10-5 Public Consultation Meeting Outcome**

Name	Occupation	Views/Responses
Md. Saiful Islam	Chairman, Bongaon UP, Savar, Dhaka	<ul style="list-style-type: none"> <li>• Mr. Chairman mentioned that the place name should be used as “Baliarpur” instead of Amin Bazar in any project-related document and Signboard. As the project area comes under Baliarpur of Savar, Dhaka.</li> <li>• He expresses his cooperation with the project and expects the same from the project authority.</li> <li>• Mr. Chairman suggests maintaining a proper waste management system and taking all relevant NOC from respective departments and trade licenses as well.</li> <li>• He also expects employment opportunities for qualified locals.</li> <li>• Mr. Chairman asks for cooperation and open discussion from all and he concludes his speech by thanking the arranging committee and WTE Power Plant North Dhaka Private Limited.</li> <li>• Local people should get the opportunity to work during the construction and operation of the power plant based on their skills.</li> <li>• As an elected representative I will be available at your service any time if required for the development of this area.</li> </ul>
Chandan Ghosh.	Director, Shyamoli Food & Beverage	<ul style="list-style-type: none"> <li>• How long they can stay in the project area?</li> <li>• The company asks for 3-4 months for evacuating the place.</li> <li>• Removing and displacing heavy machinery is time-consuming and critical and the employment of so many peoples are depending on the factory, what will be the steps to minimize such kind of impacts?</li> <li>• For displacing the factory and other equipment, they need electricity connection, shed, and land preparation, which is time-consuming and costly, so they need that time from both DNCC and WTE Power Plant North Dhaka Private Limited for smooth removal of machinery.</li> <li>• Interim period of relocation, the company can't produce any product, and without that how they can provide salaries for employees? What will be the steps to mitigate such loss for the company?</li> </ul>

Name	Occupation	Views/Responses
Jogodish Gosh	Businessman and landowner	<ul style="list-style-type: none"> <li>Plot no 3324 (BS) has half of it under acquisition if the authority buys the entire plot or leaves the acquired half will be better for the owner.</li> <li>Plot no 3323 (BS) has been impacted due to waste from the landfill, and no agricultural activity is performed due to waste materials. What will be the steps from the authorities to compensate for that damage?</li> </ul>
Mohiuddin Mia	Shopkeeper	<ul style="list-style-type: none"> <li>4 Shops (tea stall, mobile recharge, mobile banking, restaurant) are going to be impacted due to the project and those shops are very small tin and wood made. All the shop owners are poor, and the families run through the money that came from selling the shop.</li> <li>The owners ask for relocation assistance in their shop so that minimum damage will happen, and they can bear that amount of loss.</li> </ul>
Nitesh Gosh	Landowner	<ul style="list-style-type: none"> <li>Some of my land have been damaged by waste from the landfill and I could not grow any crops on that land.</li> <li>He proposes compensation for the loss of his productive land.</li> </ul>
Tofayel Ahmed	Plant Engineer Shyamoli Water	<ul style="list-style-type: none"> <li>The water plant is a big industry with heavy machinery that is automated and cannot relocate without proper precaution and place.</li> <li>The company needs time for proper relocation.</li> <li>Any compensation will be better to minimize the loss of production during the shifting time.</li> </ul>

**Responses against the question from DNCC, WTE Power Plant North Dhaka Private Limited, and Consultants**

DNCC's response	<ul style="list-style-type: none"> <li>The company will take necessary steps to avoid and control any kind of odor that can be created from the waste during the project life cycle.</li> <li>Govt. give a satisfactory amount of money for the procured land and there will be no more compensation regarding land or any other facilities.</li> <li>All the landowners have been notified to collect their compensated amount from the DC office, if any complexity arises DNCC will cooperate.</li> <li>Those who are doing business in the project area are requested to remove all the facilities on time as they are already notified several times to evacuate the place.</li> <li>Due to the project timeline, no additional time will be given to the persons for staying within the project boundary.</li> </ul>
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Name	Occupation	Views/Responses
WTE Power Plant North Dhaka Private Limited response		<ul style="list-style-type: none"> <li>• The company will take the necessary steps to manage the odor.</li> <li>• The company will ensure no waste will go outside the boundary, and no more damage will occur to any land.</li> <li>• A proper safety protocol will be taken to control any kind of hazard to the environment and the people as well.</li> <li>• The company has no provision to give any money to anyone regarding their claimed issue, DNCC or the DC office may look after this.</li> </ul>
Consultant response		<ul style="list-style-type: none"> <li>• Adequate time is given to the landowners and other associated facilities to remove and vacate the place. Due to the time and project deadline, no additional time will be given to staying within the project boundary.</li> <li>• Waste and wastewater will be treated as per the DoE's guidelines and safeguard policy of landers and national policy. No harm or issue will arise from the project.</li> <li>• This project will use very advanced technology so that no environmental pollution will occur and no fly ash or any harmful material will affect the community.</li> <li>• Cooperation is requested from the people of the community for a smooth run of the project.</li> </ul>
Concluding the meeting		<ul style="list-style-type: none"> <li>• Union Parishad Member Mr. Madin Mia, who helped in every aspect to arrange the meeting and invite local people to attend, has given thanks to all the participants and the arrangement committee. He concludes the meeting by thanking DNCC, WTE Power Plant North Dhaka Private Limited, and Consultants for their valuable time and response to all the raised issues.</li> <li>• The meeting was concluded with food and water for all the participants</li> </ul>

# **Chapter 11**

## **Conclusion and Recommendations**

## **11 CONCLUSION AND RECOMMENDATIONS**

### **11.1 Conclusion**

Waste of energy plays a vital role in fulfilling the world's future electricity demands. This provides Bangladesh with a newly opened, huge opportunity to deploy a viable yet sustainable alternative to reduce waste generation and provide power supply to the national grid.

As per the Environmental Conservation Act, 1995, and the Department of Environment (DoE) of Bangladesh, the project falls under the "Red category" and requires the preparation of an EIA. This report is prepared following the GoB environmental requirements.

The proposed project's construction complies with the relevant plans and national industrial policies. Both the online and cumulative emission of pollutants can meet the requirements of applicable regulations and will have a minimal impact on the outside environment by utilizing internationally advanced technology and essential equipment as well as conducting efficient pollution control methods.

Essentially primary data was used to assess the environmental impacts in a comprehensive manner. Site surveys for environmental data collection, public consultation, and specific studies (flora, fauna, land use,) were carried out to complete the environmental impact assessments and recommend suitable mitigation measures.

The project entails various impacts on the study area, some negative and some positive. Impacts will be more during the operation phase. The main impact is associated with the generation of NO<sub>2</sub>, CO, Hydrocarbons, and Volatile Organic Carbon (VOCs) and their impact on the nearby areas.

Strict risk prevention strategies must be taken for the primary risk factors, and a thorough emergency plan must be established to guarantee that environmental risks are kept within reasonable limits. Additional human and financial resources will be required to improve environmental capability and to progress and achieve necessary statutory compliance and environmental clearance certification for the project or associated activities that also require an environmental assessment and environmental permits under the environmental laws of Bangladesh.

With the effective implementation of the Environment Management Plan (EMP) during the construction and operation activities, the proposed project can proceed without any significant negative impact on the environment.

### **11.2 Recommendations**

The EMP, its mitigation and monitoring programs, contained herewith shall be included within the Bidding documents for project works. The bid documents state that the contractor shall be responsible for the implementation of the requirements of the EMP through his own Site-Specific Environmental Management Plan, which will adopt all the conditions of the EMP. This ensures that all potential bidders are aware of the environmental requirements of the project and its associated environmental costs.

The EMP and its requirements shall be added to the contractor's contract, thereby implementing the EMP as a legal requirement according to the contract. To ensure compliance with the EMP, a professional, qualified HSE team from the contractor will be responsible to monitor and reporting project activities throughout the construction phase.

# APPENDICES

## Appendix A: Approved TOR for the Study

শেখ হাসিনার বাংলাদেশ  
পরিচ্ছন্ন পরিবেশ

Government of the People's Republic of Bangladesh  
Department of Environment  
Head Office, Paribesh Bhaban  
E-16 Agargaon, Sher-e-Bangla Nagar, Dhaka-1207  
www.doe.gov.bd

শেখ হাসিনার বাংলাদেশ  
পরিচ্ছন্ন পরিবেশ

Memo No: 22.02.2600.137.72.18.22. ৫৪

Date: ২৪.০৪.২০২২

**Subject: Exemption from IEE and Approval of Terms of Reference (ToR) for Environmental Impact Assessment (EIA) for Waste to Energy Power Plant Project in North Dhaka.**

Ref: Your Application dated 08/02/2022.

With reference to your application dated 08/02/2022 for the subject mentioned above, the Department of Environment hereby accords Exemption from IEE and approval of the Terms of Reference (ToR) for Environmental Impact Assessment (EIA) for Waste to Energy Power Plant Project in North Dhaka as per as under subject to fulfilling the following terms and conditions:

- I. The project authority shall carryout a comprehensive EIA study considering the overall activity of the said project in accordance with the ToR and time schedule submitted to the Department of Environment (DoE) and additional suggestions provided herein.
- II. The EIA report should be prepared in accordance with following indicative outlines:
  1. Executive summary.
  2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references).
  3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared).
  4. **Project description**
    - 4.1 Location of the project site with coordinates of all four corners of the site.
    - 4.2 Justification for selecting the site with details of alternative sites examined
    - 4.3 Geographical information of the project sites well as study area around 5km radius of the project site. It includes location map, cadastral map showing land plots, geographical map showing natural features.
    - 4.4 Land requirement for the facility including its breakup for various purposes.
    - 4.5 Details on requirement of raw materials, its source and storage at the plant.
    - 4.6 Layout plan indicating Waste storage rooms, waste treatment equipment rooms/areas, treated waste storage room, ash storage/disposal area, vehicle washing areas and others such as admin area, worker room, health centers, greenbelt etc.
    - 4.7 Details on collection and transportation of Bio Medical Waste from health care establishments. Number of vehicles and feature of vehicles etc.
    - 4.8 Details of the treatment equipment's capacity and make.
    - 4.9 Details on fuel requirement for incineration, flue gas emission through stack and proposed pollution control technologies.
    - 4.10 Details on residual/ ash generation and management.
    - 4.11 Details of waste heat utilization, if any and wastewater management, safety and health protection measures.
    - 4.12 Maps at appropriate scales with proper labels and legends to illustrate the general setting of project-related development sites as well as surrounding areas likely to be environmentally affected.
    - 4.13 Details on support infrastructure for the project.

- 4.14 Complete process flow diagram describing each unit, its processes and operations along with material and energy inputs and outputs (material, water and energy balance).
- 4.15 Details of cooling towers installation.
- 4.16 Details of effluent treatment plant, inlet and treated water quality with specific efficiency of each treatment unit in reduction in respect of all concerned/regulated environmental parameters.
- 4.17 Examine the feasibility of zero discharge. In case of any proposed discharge, its quantity, quality and point of discharge, users downstream, etc.
- 4.18 Details of disposal of sludge.
- 4.19 Details of proposed source-specific pollution control schemes and equipments to meet the national standards.
- 4.20 Management plan for solid/hazardous waste generation, storage, utilization and disposal.
- 4.21 Map and survey information: Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geographic map showing natural features.

**5. Analysis of alternative resources and technologies**

- 5.1 Comparison of alternate sites considered and the reasons for selecting the proposed site.
- 5.2 Details of alternative sources of energy such as photovoltaic cells use in the plant for various applications.
- 5.3 Details on improved technologies.

**6. Socio-economic environment should include, inter alia, following:**

- 6.1 Population: Demographic profile and ethnic composition
- 6.2 Settlement and housing
- 6.3 Traffic and transport
- 6.4 Public utilities: water supply, sanitation and solid waste
- 6.5 Economy and employment: employment structure and cultural issues in employment

**7. Description of the Environment**

- 7.1 Baseline data including different components of environment viz., air, noise, water and biology of the study area.
- 7.2 Details on climate, meteorology including relative humidity wind patterns (wind speed & direction), temperature and rainfall in the study area.
- 7.3 Details on establishment of baseline on the air quality of the areas immediately affected by the activities in the various phases of the project. To this end AQ data at 8 locations for PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, CO and other parameters relevant to the project shall be collected.
- 7.4 Details on establishment of baseline on the water resources of the area affected or potentially impacted the activities on the various phases of the project. This baseline should include water quality assessment of available water sources of the project site and zone of influence including water quality of nearby river/khal at 8 locations (100 m upstream and downstream of the discharge point).
- 7.5 Details of the basic physical environment of the study area.
- 7.6 Studies on flora and fauna including the main habitat types with list of species of flora and fauna and their conservation value.

**8. Potential Environmental Impacts and Mitigation Measures**

### **8.1 Environmental Impacts**

- 8.1.1 Anticipated generic environmental impacts due to incineration are indicated, evaluated for significance and based on corresponding likely impacts Valued Environmental Components (VECs) may be identified. Baseline studies may be conducted for all the concerned VECs and likely impacts will have to be assessed for their magnitude in order to identify mitigation measures.
- 8.1.2 Impacts due to waste carrying trucks movement, impacts due to noise, and impacts due to fugitive emissions.
- 8.1.3 Impacts on health of workers due to proposed hazardous waste processing and disposal activities.
- 8.1.4 Impacts due to spills, leaks on soil and surface/ ground water bodies  
Impacts due to fire/explosion.
- 8.1.5 Impacts due to power shut downs.
- 8.1.6 Impacts due to puffs / injection of high vapour pressure material into the kiln such as solvents.
- 8.1.7 Impacts due to failure of each of the unit in an incineration system.
- 8.1.8 Impacts due to ash disposal, etc.

### **8.2. Mitigation Measures**

- 8.2.1 Identify the preferred options for mitigation measures, management/disposal method base on environmental grounds, including necessary infrastructure, specify any residual impacts of waste management, their significance and mitigation measures to be undertaken.
- 8.2.2 Identify the mitigation measures to reduce the impact on the surrounding environment and zone of influence (human and wildlife)
- 8.2.3 Details on occupational health and safety of employees and workers.
- 8.2.4 Recommend precise mitigation measures based on the specific option selected, for the proper management of all types of traffic close to and within the project area. These mitigation measures must include recommendations for protection features against erosion and other potential pollution to environment as well as social and human impacts.

## **9. Environmental Management Plan (EMP)**

- 8.1 For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not capable of mitigation, will be identified as residual impacts. Both technical and financial plans shall be incorporated for proposed mitigation measures..
- 8.2 An outline of the Environmental Management Plan shall be developed for the project.
- 8.3 In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipment and expertise).

## **10. Environmental Monitoring Programme**

- 9.1 Technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules).
- 9.2 Monitoring programs during construction and operation with particular emphasis on air (ambient air quality), noise and water.

9.3 Develop and implement an emission monitoring programme to monitor the following parameters especially PM, NOx, HCl and VOC in order to ensure compliance with Medical Waste (Management & Treatment) Rules, 2008.

**11. Consultation with Stakeholders/Public Consultation** (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project). Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)

**12. Conclusion and Recommendations**

- III. The project authority shall submit the EIA along with an application for Environmental Clearance in prescribed form, the applicable fee in a treasury Chalan, the No Objection Certificates (NOCs) from the local authority and NOCs from other relevant agencies for operational activity etc. to the Dhaka District Office of DoE.
- IV. Without approval of EIA report by the Dept. of Environment, the project proponent shall not undertake land and infrastructural development and open L/C for importable machineries.
- V. Without obtaining Environmental Clearance, the project authority shall not start operation of the project.

  
28.04.2022  
**(Masud Iqbal Md. Shameem)**  
Director (Environment Clearance)  
Phone # 02-8181673

**Managing Director (Local Representative)**  
WTE Power Plant North Dhaka Private Ltd & China Machinery Engineering Corporation (CMEC)  
F11, Anamika Concord, 583 Rokeya Sarani, Dhaka.

**Copy Forwarded to:**

1. Director, Department of Environment, Dhaka Regional Office, Dhaka.
2. Deputy Director, Department of Environment, Dhaka District Office, Dhaka.
3. Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

**Appendix B: No Objection Certificate (NOC)**

**Appendix B-1: No Objection Certificate (NOC) from the Local Authority**

বিসমিল্লাহির রাহমানির রাহিম  
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

**বনগাঁও ইউনিয়ন পরিষদ কার্যালয়**  
**BANGAON UNION PARISHAD OFFICE**

P.O. Nagar Konda, Upazila-Savar  
District- Dhaka  
ডাকঘর- নগর কোন্ডা, উপজেলা- সাভার  
জেলা- ঢাকা-১২১৬।

স্মারক নং/Memo No. \_\_\_\_\_ তারিখ / Date : ২৭/০৯/২০২২

অবস্থানগত/পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র

১। প্রকল্পের নাম : "ওয়েস্ট-টু-এনার্জি পাওয়ার প্রোজেক্ট"  
২। আবেদনকারীর নাম : ডব্লিউ টি ই পাওয়ার প্রান্ট নর্থ ঢাকা প্রাইভেট লিমিটেড  
৩। আবেদনকারীর ঠিকানা : এফ-১১, অনামিকা কনকর্ড ৫৮৩ রোকেয়া অরগানাইজেশন, ঢাকা-১২১৬, বাংলাদেশ  
৪। প্রকল্পের অবস্থানগত ঠিকানা : বলিয়ারপুর, সাভার, ঢাকা  
৫। প্রকল্পের তফসিল :

জেলা নাম	থানার নাম	মৌজার নাম	খতিয়ান নং**	দাগ নং	জমির ধরন	মোট জমির পরিমাণ
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	৩৪১৫	নাশ				
	৩৪১৬	নাশ				
	৩৪১৭	নাশ				
	৩৪১৮	নাশ				
	৩৪১৯	নাশ				
	৩৪২০	নাশ				
	৩৪২১	নাশ				
	৩৪২২	নাশ				

সময়মতো ইউনিয়ন পরিষদের ট্যাক্স পরিশোধ এবং জন্ম নিবন্ধন করুন।

বিসমিল্লাহির রাহমানির রাহিম  
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

**বনগাঁও ইউনিয়ন পরিষদ কার্যালয়**  
**BANGAON UNION PARISHAD OFFICE**

P.O. Nagar Konda, Upazila-Savar  
District- Dhaka  
ডাকঘর- নগর কোন্ডা, উপজেলা- সাতার  
জেলা- ঢাকা-১২১৬।

স্মারক নং/Memo No. \_\_\_\_\_ তারিখ / Date : ২৭/০১/২০২২

জেলায় নাম	থানার নাম	মৌজার নাম	খতিয়ান নং**	দাগ নং	জমির ধরন	মোট জমির পরিমাণ
				৩৩৫২	নাল	
				৩৩৫৯	রাঙা	
				৩৩৫০	রাঙা	
				৩৩৫১	নাল	
				৩৩২০	নাল	
				৩৩১১	নাল	
				৫০০১	বাড়ী	
				৫০০২	নাল	
				৫০০৩	নাল	
				৫০০৪	জিটা, নাল	
				৩০২৪	নাল	
				৩০২৫	নাল	
				৩০২৬	জিটা	
				৩০২৭	নাল	
				৩০২৮	নাল	
				৩০২৯	নাল	
				৩০৩০	জিটা, নাল	
				৩০২১	নাল	
				৩০২২	নাল	
				৩০২৩	নাল	
				৩০২৪	নাল	
				৩০২৫	নাল	
				৩০২৬	নাল	
				৩০২৭	নাল	
				৩০২৮	নাল	
				৩০২৯	নাল	
				৩০৩০	নাল	
				৩০৩১	নাল	
				৩০৩২	নাল	
				৩০৩৩	নাল	
				৩০৩৪	নাল	
				৩০৩৫	নাল	
				৩০৩৬	নাল	
				৩০৩৭	নাল	
				৩০৩৮	নাল	
				৩০৩৯	নাল	
				৩০৪০	নাল	
				৩০৪১	নাল	
				৩০৪২	নাল	
				৩০৪৩	নাল	
				৩০৪৪	নাল	
				৩০৪৫	নাল	
				৩০৪৬	নাল	
				৩০৪৭	নাল	
				৩০৪৮	নাল	
				৩০৪৯	নাল	
				৩০৫০	নাল	
				৩০৫১	নাল	
				৩০৫২	নাল	
				৩০৫৩	নাল	
				৩০৫৪	নাল	
				৩০৫৫	নাল	
				৩০৫৬	নাল	
				৩০৫৭	নাল	
				৩০৫৮	নাল	
				৩০৫৯	নাল	
				৩০৬০	নাল	

সময়মতো ইউনিয়ন পরিষদের ট্যাক্স পরিশোধ এবং জন্ম নিবন্ধন করুন।

বিশ্বমিহ্মাহির রাহমানির রাহিম  
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

**বনগাঁও ইউনিয়ন পরিষদ কার্যালয়**  
**BANGAON UNION PARISHAD OFFICE**

P.O. Nagar Konda, Upazila-Savar  
District- Dhaka  
ডাকঘর- নগর কোন্ডা, উপজেলা- সাভার  
জেলা- ঢাকা-১২১৬।

স্মারক নং/Memo No. তারিখ / Date : ২৯/১২/২০২২

জেলা নাম	থানার নাম	বৌজার নাম	খতিয়ান নং**	দাগ নং	জমির ধরন	মোট জমির পরিমাণ
				৩০৩৬	নাল	
				৩০১৯	নাল	
				৩০১৩	পুকুর	
				৩০১৪	পতিত	

\*\* খতিয়ান নং ডিএনসি/ডিএনসি/ডিএনসি/ডিএনসি এর এক এ শাখা থেকে সংগ্রহ করিতে হইবে।

৬। কারখানা/ প্রকল্পের উৎপাদিত পণ্যের নাম : বিদ্যুৎ

উপরোক্ত তথ্যাদির আলোকে 'ওয়েস্ট-টু-এনার্জি পাওয়ার প্রোজেক্ট' প্রকল্পকে নিম্নবর্ণিত শর্তসাপেক্ষে অনুমতিপত্র প্রদান করা হলো।

- প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষণ আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
- পরিবেশ অধিদপ্তর হতে বিধি দ্বারা নির্ধারিত পদ্ধতিতে ছাড়পত্র গ্রহণ করতে হবে।
- কর্মরত শ্রমিকদের পেশাগত ঝুঁকি ও নিরাপত্তা নিশ্চিত করতে হবে।
- উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নিকাণ্ড কিংবা অন্য কোন দুর্ঘটনার সময় জরুরি নির্গমন ব্যবস্থা থাকতে হবে।
- বায়ু ও শব্দ দূষণ করা যাবে না।
- প্রকল্প সৃষ্টি তরল বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উল্লিখিত যে কোন শর্ত লঙ্ঘন করলে যথাযথ কঠোর কার্যকর প্রকল্পের বিরুদ্ধে আইনমুখা ব্যবস্থা নেওয়া যাবে।

তারিখ- ২৯/১২/২০২২

হানীম কর্তৃপক্ষের স্বাক্ষর ও সীল  
মোঃ সাইফুল ইসলাম  
চেয়ারম্যান  
বনগাঁও ইউনিয়ন পরিষদ  
সাভার, ঢাকা।

সময়মতো ইউনিয়ন পরিষদের ট্যাক্স পরিশোধ এবং জন্ম নিবন্ধন করুন।

বিস্মিল্লাহির রাহমানির রাহিম  
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

**বনগাঁও ইউনিয়ন পরিষদ কার্যালয়**  
**BANGAON UNION PARISHAD OFFICE**

P.O. Nagar Konda, Upazila-Savar  
District- Dhaka  
ডাকঘর- নগর কোন্ডা, উপজেলা- সাভার  
জেলা- ঢাকা-১২১৬।

স্মারক নং/Memo No. \_\_\_\_\_ তারিখ / Date : ২৭/০১/২০২২

স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্র

১। প্রকল্পের নাম : "ওয়েস্ট- টু- এনার্জি পাওয়ার প্রজেক্ট"  
২। আবেদনকারীর নাম : ডব্লিউ টি ই পাওয়ার প্লান্ট নর্থ ঢাকা প্রাইভেট লিমিটেড  
৩। আবেদনকারীর ঠিকানা : এফ-১১, আনামিকা কনকর্ড, ৫৮৩ বোকেরা আবাদী, ঢাকা-১২১৬, বাংলাদেশ  
৪। প্রকল্পের অবস্থানগত ঠিকানা : বলিয়ানপুর, সাভার, ঢাকা  
৫। প্রকল্পের ডাকসিল : ৫

কেলার নাম	ধানার নাম	সেক্টর নাম	ভূ-গর্ভস্থ পানি উত্তোলনের অধ্বনন	ভূপৃষ্ঠস্থ পানি উত্তোলনের অধ্বনন	পানি উত্তোলনের পরিমাণ
ঢাকা	সাভার	বলিয়ানপুর	১. আ্যপেনডিক্স-১ এ নির্দেশিত ২. আ্যপেনডিক্স-১ এ নির্দেশিত ৩. আ্যপেনডিক্স-১ এ নির্দেশিত	আ্যপেনডিক্স-১ এ নির্দেশিত	৭৮৯৮ টন/দিন

উপরোক্ত তথ্যাদির আলোকে "ওয়েস্ট- টু- এনার্জি পাওয়ার প্রজেক্ট" প্রকল্পকে নিম্নবর্ণিত শর্তসাপেক্ষে অনাপত্তিপত্র প্রদান করা হলো।

- প্রকল্প স্থাপন ও পরিচালনার ক্ষেত্রে জাতীয় পানি নীতিমালা - ১৯৯৯ যথাযথভাবে অনুসরণ করতে হবে।
- ভূ-গর্ভস্থ পানির স্তর সঠিক ভাবে পর্যবেক্ষণ করতে হবে এবং প্রয়োজনের অধিক ভূ-গর্ভস্থ পানি উত্তোলন করা যাবে না।
- প্রকল্প স্ট্রাকচার বর্জ্য অপরিশোধিত অবস্থায় বাইরে নিঃসরণ করা যাবে না।
- ভূ-গর্ভস্থ ও ভূপৃষ্ঠস্থ পানি ন্যূন হয় এমন কোন কার্য সম্পাদন করা যাবে না।
- উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নিকাণ্ড কিংবা অন্য কোন দুর্ঘটনার সময় জরুরী নিয়মিত ব্যবস্থা থাকতে হবে।
- কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তা নিশ্চিত করতে হবে।

উল্লিখিত যে কোন শর্ত লঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক প্রকল্পের বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

তারিখ: ২৭/০১/২০২২

স্থানীয় কর্তৃপক্ষের সাক্ষর ও মীল  
মোঃ সাইফুল ইসলাম  
চেয়ারম্যান  
বনগাঁও ইউনিয়ন পরিষদ  
সাভার, ঢাকা।

সময়মতো ইউনিয়ন পরিষদের ট্যাক্স পরিশোধ এবং জন্ম নিবন্ধন করুন।

## Appendix B-2: No Objection Certificate from the WARPO

(Substitute to the same date and memo)  
Government of the People's Republic of Bangladesh  
Ministry of Water Resources  
Water Resources Planning Organization  
www.warpo.gov.bd



Memo.No: 42.02.0000.010.36.017.22-445

Date: 08/01/2023

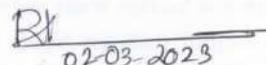
Sub: No Objection Certificate (NOC) for abstraction of groundwater by WTE Powe Plant, North Dhaka Private Limited, Dhaka-1216

In reference to your application to grant permission for abstraction of Groundwater by your Company as per Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018; Water Resources Planning Organization (WARPO) has reviewed your application, data and information regarding water resources availability (groundwater & surface water) on the surrounding areas of the proposed project and agreed to allow using both groundwater water and surface water on certain conditions.

The 'No Objection Clearance (NOC)' hereby issued subject to the following conditions.

1. Permission is given to WTE Power Plant, North Dhaka Private Limited for extract the surface water in a way suitable to the site's hydro-geology conditions.
2. Permit for abstraction of Ground Water of maximum amount 8753 m<sup>3</sup>/day for Company's Mfg. uses, drinking purposes and daily domestic uses in dry season-when insufficiency of Surface Water.
3. The permit would be valid for 2 (two) years from the date of issue and will require renewal before 30 days of the end period.
4. The Water will not be used in other purposes except the approved case i.e. Company's manufacturing, daily uses for the employees etc.
5. To reduce the pressure on ground water, it is strongly encouraged to identify the alternative source of Surface Water and to use it in different purposes.
6. A detailed study on "water resources availability and impact due to abstraction, use and discharge to the project area and surroundings considering the shallow and deep aquifer, EIA, SIA and model simulation" has to be submitted to WARPO within next six months." has to be submitted to WARPO within next six months.
7. Monitoring well has to be installed on project side to measure the groundwater level.
8. The daily measured or collected groundwater level data of the monitoring well, volume of abstracted Water have to be provided to WARPO on quarterly basis.
9. The Depth of Deep Tube well, Diameter of Pipe, Horse power (HP) of Pump cannot be changed without permission of WARPO Authority.
10. The Distance between the two Deep Tube wells will have to be followed as per condition no 5 of Topsil-1 of "Groundwater Management Rules for Agricultural Purposes 2019".
11. The project will not pollute the nearby water body and will not deteriorate bio-diversity and freshwater ecosystems dependent upon the water body concerned and will not hamper water security and water right of nearby community.
12. The project will not change the natural flow of water as per Bangladesh Water Act, 2013, article 34.

13. The treated discharge water might be reserved in a pond within the boundary of the Project area and the temperature of the discharge water should be tolerable for the ecosystem and will not do any harm to the aquatic bionetwork. It is strongly discouraged to discharge treated waste water in the natural Channel or River. However, There should have a mechanism of "3Rs" (reduce, reuse and recycle) policy for management of waste water.
14. There should have a rainwater harvesting system and the harvested water can be used for different purposes.
15. In case of any adverse impact on the nearby community due to groundwater abstraction by company, immediate mitigation measures and compensation must be ensured and be reported to WARPO.
16. There should have adequate green space with vegetation around the plant area. It is recommended to build a water reservoir for recharge to Groundwater. However, it is strictly prohibited to inject the contaminated water or wastewater to the underground aquifer.
17. The Company will arrange the Training Programme regarding 'Water Governance and Compliance Monitoring' time to time to their employees.
18. Extensive awareness need to be built regarding water use and impact to the employees of the company and the nearby community of project area.
19. The NOC is not transferable/exchangeable without the prior approval.
20. Within the validity period of the NoC, any decision (imposition of water charges, issuance/renewal fee or service charge for NoC/ Clearing Certificate, levy of penalty for violation of enforcement or protection order, etc.) taken by the Government under the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018 shall be applicable.
21. WARPO authority can change the existing conditions or add new conditions if necessary within the clearance time period. Moreover, the Authority reserve the power to cancel the 'NOC' if any condition of 'NOC' or Provision of Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018 is violated.
22. Environmental 'Clearance Certificate' will have to be taken from 'Department of Environment (DoE).

  
02-03-2023  
(Md. Rezaul Maksud Jahedi)  
Director General, WARPO  
Phone: 44819006  
E-mail: dg@warpo.gov.bd

Managing Director  
WTE Powe Plant, North Dhaka Private Limited  
F11, Anmika Concord, 583 Rokeya sarani,  
Dhaka-1216, Bangladesh

Copy for kind information:

1. Director General, Department of Environment (DoE), Agargaon, Dhaka
2. Deputy Commissioner & Chairman, District Integrated Water Resources Management Committee, Dhaka.
3. PS to Secretary (for kind information to Secretary), Ministry of Water Resources.
4. PS to DG, WARPO ( For kind information of DG, WARPO)
5. Office Copy.





Resettlement Action Plan (RAP) Survey

**B. Household Details**

Sl. No	Full Name (Starting with Household Head)*	Relation with HCH	Sex	Age	Marital Status	Educational Qualification	Disability Type	Main Occupation	Secondary Occupation	Any existing skill set/training	Total Monthly Income (Individual)
B1											
B2											
B3											
B4											
B5											
B6											
B7											
B8											
B9											
B10											
B11											
B12											
B13											

\*Please use code only where applicable. Code is given below page



Resettlement Action Plan (RAP) Survey

Relation with Household Head

Self (Household Head)	1	Son-in-law	10
Father	2	Daughter-in-law	11
Mother	3	Grandson	12
Wife	4	Grand-daughter	13
Husband	5	Brother-in-law	14
Daughter	6	Sister-in-law	15
Son	7	Niece	16
Brother	8	Nephew	17
Sister	9	Others (Specify)	

Sex

Female	1
Male	2
Transgender	3

Marital Status

Married	1	Widow/Widower	5
Single	2	Other specify	6
Divorced	3		
Separated	4		

Educational Qualification

Primary	1	Religious	6
Secondary	2	Vocational Training	7
Higher Secondary	3	Child (Not school going age)	8
Bachelor	4	No education	9
Masters/MS/MSC/	5	Others (Specify)	

Disability Types

No disability or incurable diseases	1	Disability/lower limb paralysis	5
Blind	2	Disability/upper limb paralysis	6
Deaf	3	Mental deficiency	7
Dumb	4	Incurable diseases	8
Others (specify)			

Main/Secondary Occupation

Farming (Crop and Livestock)	1
Agricultural Labour	2
Daily Labour	3
Unpaid Family Work/Housewife	4
Service	5
Unemployed Seeking Employment	7
Commercial business, shops etc.	8
Driving	9
Welding	10
Tailor	12
Carpentry	13
Mechanics	14
Technicians	15
Student	16
None	17
Others Specify	

Skill Set

Carpenter	1	Plumber	7
Electrician	2	Welding	8
Mechanic	3	Tailoring	9
Agro-based Training	4	Mason	10
Cattle Rearing	5	None	11
Driving	6	Others (Specify)	

*Resettlement Action Plan (RAP) Survey*

**C. Assessed Category of Impact**

C1	Land Owner (Having/Using land in the Project Boundary)	1
C2	Land User (Sharecropper/Rental/Lease)	2

**D. Affected Land Details (Only for Land Owners)**

D1	Ownership Status of the land parcel	1. Inherited	2. Privately Owned	3. State Land	4. Lease	5. Other, (specify):
<b>Acquired land Information</b>						
D2	Affected Land Parcel No.	Quantum of Acquired Land in the Plot/Parcel (in Hectare)			Type of Land	
	i.					
	ii.					
	iii.					
D3	If other than land owner, how many persons associated with land?					
D4	Current market value of the affected land (in BDT)					

**E. If Lessee/Share Cropper/Rent, Please Provide the Information**

Sl. No.	Lease/Rent/Sharecropper's Name	Father's Name	Village & District	Land Area (In Hectare)	Taken Year	For how many Years	Yearly Income from the Land (In BDT)
E1							
E2							
E3							
E4							
E5							
E6							

*Resettlement Action Plan (RAP) Survey*

**F. Crops Production Details (Only for Cultivators)**

Sl. No.	Type of Crop	Area (in Hectare)	Month From	Month To	Productivity (kg)	% Self Consumption	% Sold	Income from selling
F1								
F2								
F3								
F4								
F5								

**G. Other Land Information of HH (Except Impacted/Losses of Land)**

Sl. No.	Details Land Information (Type)	Location	Area (in Hectare)
G1			
G2			
G3			
G4			

**H. Affected Structures Details (Only for Structures Lose)**

Sl. No.	Structures 1= Residential, 2= Commercial, 3=Other, (specify)	Type 1= Concrete, 2= Concrete and GI Sheet, 3= Soil/Mud, 4= Other, (specify)	No. of Floor	Area (in Feet)
H1				
H2				
H3				
H4				
H5				
H6				
H7				
H8				



*Resettlement Action Plan (RAP) Survey*

**L. Persons Associated with the land**

I1	How many persons are associated (income earner) with the land that has been acquired for the project?		
I2	Have you taken any steps to relocate your current facilities to be functional after evacuating the acquired land?	1 Yes	2 No
I3	How long have you been running business in this place?		
I4	Any of your current land that you are using within the project area are leased?	1 Yes	2 No
I5	What amount of land you are using as leased?		
I6	Have you received any formal notice (written) from DC/DNCC regarding evacuation from the site?	1 Yes	2 No
I7	If yes how many days prior to evacuation?		
I8	Is the time enough for evacuation with all the associated facilities?	1 Yes	2 No
I9	Have you satisfied with the assistance given from DNCC/DC	1 Yes	2 No
I10	Can you describe the salary structure of the persons working here? State the number of employees after=		
	Below 20 thousand =	20-30 thousand=	30-40 thousand=
			40-50 thousand=
			50+thousand=

**J. Sources of Household Income (In BDT)**

Sl. No.	Source: Income	Average Income (Monthly)	Average Income (Yearly)
J1	Service / Wage		
J2	Agricultural income		
J3	Livestock		
J4	Fsheries		
J5	Business		
J6	Pension (Widow/ Soldier/service etc.)		
J7	Rent from Land		
J8	Rent from Property		
J9	Remittance from Family Member		
J10	Small Businesses (shop)		



*Resettlement Action Plan (RAP) Survey*

J11	Small Scale Enterprises (manufacturing and processing)		
J12	Any other (Specify):		
	<b>Total - Annual Income</b>		

**K. Household Expenditure (In BDT)**

Sl. No.	Expenditure items	Expenditure Monthly	Annual/ One time
K1	Food and consumables		
K2	Education		
K3	Fire wood/ Cooking Fuel		
K4	Diesel/ petrol/ Transport		
K5	Telephone/ mobile phone		
K6	Entertainment (movies, music, sightseeing, etc.)		
K7	Healthcare/ Medical Expenditure		
K8	Clothing		
K9	Electricity		
K10	Input cost (agriculture, fishing)		
K11	Input cost (business and manufacturing)		
K12	Rent paid for Agricultural Land Used		
K13	Festival and other religious cultural event		
K14	Loan repayment		
K15	Payment to employees (if any)		
K16	Other (specify)		
	<b>Total</b>		

**L. Quality of Life**

**a. Electricity**

a1	Access to Electricity	1. Yes		2. No	
a2	Electricity Source	1. Grid Electricity	2. Solar	3. Generator	4. Battery
		5. Kerosene		6. Others (Specify):	
a3	Monthly Cost for Electricity				



*Resettlement Action Plan (RAP) Survey*

**b. Sanitation**

b1	Toilet Facility	1. Sanitary water seal	2. Sanitary non-water seal	3. Non-sanitary	4. Kancha	5. Open Defecation
		6. Others (Specify):				

**c. Cooking**

c1	Fuel for cooking	1. LPG Gas	2. Charcoal	3. Firewood	4. Kerosene	5. Biogas
		6. Dried Cow dung with straw, leaf's		7. Others (Specify):		
c2	If firewood/charcoal, quantity per month?					
c3	Monthly cost for fuel purchase					
c4	Who collects the firewood/charcoal?					
c5	Fuel source (specifically for firewood/charcoal)					

**d. Water**

		<b>Source of drinking water</b>			
d1	Sources				
d3	Drinking water source (specifically for Tap/tube well/Deep tube well water)	1. Owned		2. Shared	
Supply*		1. Tap water                      4. River/Canal 2. Tube well                      5. Rain 3. Deep tube well                6. Pond/Ring well 4. River/Canal                    7. Others (specify)			

**e. Communication**

e1	Availability of mobile network	1. Yes		2. No	
e2	Access to internet	1. Mobile Internet	2. Broadband Connection		3. None

*Resettlement Action Plan (RAP) Survey*

**f. Access to Market**

f1	Market Facility	1. For daily needs		2. For buying and selling products	
f2	i. Location	1. Same village/town	2. Nearby village/town	1. Same village/town	2. Nearby village/town
f4	iii. Distance				

**g. Access to Education**

	Education institution	Distance
G1		

**h. Healthcare Service**

h1	Health Facility	1. Dispensary	2. Community Health Care	3. Pvt. Hospital	4. Govt. Hospital
h2	Distance (in Km)				

**i. Involvement with Bank/Financial Institutes**

i1	Do you have any bank account?	1. Yes	2. No
i2	Do you have regular deposit?		
i3	Have you taken any loan?	1. Yes	2. No
i4	If yes, then pls tell the following		
	Loan Provider	Amount	Received Year
i5	Bank		
i6	NGO		
i7	Relative/Friend		
i8	Others (specify):		

**M. Preference of Compensation**

M1	How would you like to get compensation for your losses?	1. Land for Land
		2. Cash for Land
		3. Compensation for agricultural produce
		4. Do not know or do not want to answer, no opinion expressed
		5. Others (specify):

## Appendix D-2: Attendance of the Public Consultation Meeting

Waste to Energy Power Project, Boliarpur, Savar, Dhaka

## Public Consultation Meeting

## Attendance of the participants

Date: 30/08/2022

Venue: Jamuna Natural Park,  
Baliarpur, Savar, Dhaka

SI	Name	Village	Occupation	Phone	Signature
1.	মোঃ সাইফুল ইসলাম		ইউপি চেয়ারম্যান, বনগাঁও ইউনিয়ন	০১৭৩১৮০২৫৮০	
2.	কামরুন নাহার		ইউনিয়ন পরিষদের মেম্বর, 4,5,6 no Ward	০১৭০৬২৪৫৭৫২	কামরুন নাহার
3.	মদিন মিয়া		ইউনিয়ন পরিষদের মেম্বর, 6 no Ward	০১৭১২০০৩২৬১	মদিন মিয়া
4.	মো: আরিফুর রহমান		ইউনিয়ন পরিষদের মেম্বর, 5 no Ward	০১৬৩৬৯৩১৬৬৯	আরিফুর
5.	ফিরোজ উদ্দিন		ইউনিয়ন পরিষদের মেম্বর, 8 no Ward	০১৬৭৫০৮৮৬১৪	
6.	Md. Najmul Hossain	Banani	Senior Consultant EQMS	01673821812	Najmul Hossain
7.	Md. Shafigul Islam	Banani	Consultant EQMS	01715156193	Shafigul Islam
8.	Bolortam Karamakera	Banani	Assistant Consultant	01843008586	Bolortam
9.	Md. Rakibul Hasan	Banani	Assistant Consultant	01750414948	Rakibul Hasan
10.	Mosabbir Hossain	Banani	Consultant	01812-568902	Mosabbir
11.	Lucas Liu	Baridhara	Representative	01957088065	Lucas Liu
12.	Hong Kong	Baridhara	Representative	01957088065	Hong Kong
13.	MD. Khalid Mahomud	Baridhara	Representative	01792-884709	MD. Khalid Mahomud
14.	Md. Faridul Islam	Banani	SAE	01716752658	Faridul Islam
15.	Md. Rakibul Islam	"	Surveyor	01715657595	Rakibul Islam
16.	Md. Habibur Rahman	Banani	Business	01912042936	Habibur Rahman

EQMS

EQMS Consulting Limited

Waste to Energy Power Project, Boliarpur, Savar, Dhaka

SI	Name	Village	Occupation	Phone	Signature
17.	Md. Khalique Rahman	Tolarbag	Business	01711113511	[Signature]
18.	Shamoh Sakkar	Konda	Student	01684869020	[Signature]
19.	ব্রজেন চন্দ্র সরকার	নগর কল্যাণ	কৃষক	01921588151	[Signature]
20.	আবিলিখ হুসাইন চৌধুরী	হুসাইন	শ্রমিক	01717103996	[Signature]
21.	MD. Imtiaz	Boliarpur	Head of a c at SFBL	01933344802	[Signature]
22.	Uttam Kumar		Distribution	01933-344833	[Signature]
23.	MD. ABU HASIN		SERVICE HOLD	0178053433	[Signature]
24.	MD. Ferdoush Ahmed	Hemantpur	UEBL Bank	01521324867	[Signature]
25.	Farooq	Dhanmendi	Job	01629611554	[Signature]
26.	Sohrab Khan	Boliarpur	Job	01933344804	[Signature]
27.	Sukanto Saha	Boliarpur	Student	01742245936	[Signature]
28.	Goutam Ghosh	Boliarpur	Manager	01831415115	[Signature]
29.	Md. Tojayed Ahmed	Boliarpur	Manager Shyamoli drinking water	01933344802	[Signature]
30.	Nitesh Chandra	BALER		01922429774	[Signature]
31.	আবুল কালাম	বলিয়ারপুর	কৃষক	01714817600	[Signature]
32.	আবুল কালাম	বলিয়ারপুর	কৃষক	01840-444880	[Signature]
33.	আবুল কালাম	বলিয়ারপুর	কৃষক	01715519755	[Signature]
34.	আবুল কালাম	বলিয়ারপুর	কৃষক	01701894622	[Signature]
35.	আবুল কালাম	বলিয়ারপুর	কৃষক	01716248817	[Signature]
36.	আবুল কালাম	বলিয়ারপুর	কৃষক	01611988850	[Signature]
37.	Jessore Engineer	Boliarpur	Business	01707-185454 01871-185454	[Signature]
38.	KAMOL	বলিয়ারপুর	কৃষক	01793290826	[Signature]

**EQMS**  
EQMS Consulting Limited

Waste to Energy Power Project, Boliarpur, Savar, Dhaka

Sl	Name	Village	Occupation	Phone	Signature
39.	ALOK	Konda	student	01638350316	[Signature]
40.	RAIAN	Konda	student	01305526237	RAIAN
41.	Shakib	Konda	student	01967862528	[Signature]
42.	Sh. Md. K. Hossain	Shakelak	Suplip Da	01716-275807	[Signature]
43.	Md. Nojom	Konda	Student	01885531333	[Signature]
44.	মিস্ত্রী	বলিয়ারপুর	চাকরি	01733180890	[Signature]
45.	মুন্সি	বলিয়ারপুর	চাকরি	01734386938	[Signature]
46.	শ্রী: ইলিয়াস	বলিয়ারপুর	চাকরি	01969525667	[Signature]
47.	মুন্সি	বলিয়ারপুর	চাকরি	017418528625	[Signature]
48.	মুন্সি	বলিয়ারপুর	চাকরি	01686990868	[Signature]
49.	মুন্সি	বলিয়ারপুর	চাকরি	0171907326	[Signature]
50.	মুন্সি	বলিয়ারপুর	চাকরি	01975911695	[Signature]
51.	Mazharul Islam	Baliarpur	Job	01933244843	[Signature]
52.	মুন্সি	শ্রীধর	চাকরি	01726023992	[Signature]
53.	Zakir Hossain	Mirpur-14	Business	01727080028	[Signature]
54.	TOFAZZAL	BARIDARA	চাকরি	01756076637	TOFAZZAL
55.	Jewel	Baridara	"	01917176675	[Signature]
56.	মুন্সি	বলিয়ারপুর	চাকরি	01768364248	[Signature]
57.	মুন্সি	"	"	01748258082	[Signature]
58.	মুন্সি	"	"	01724995681	[Signature]
59.	মুন্সি	"	"	0192472207	[Signature]
60.	মুন্সি	বলিয়ারপুর	"	01991633457	[Signature]

**EQMS**  
EQMS Consulting Limited

Waste to Energy Power Project, Boliarpur, Savar, Dhaka

Sl	Name	Village	Occupation	Phone	Signature
61.	শ্রী: এম এম এম এম	বলিয়ারপুর	শ্রমিক	০১৭১৫১১৯৯৭১	শ্রী: এম এম এম এম
62.	সাকিনা বেগম	বনগ্রাম	সেবার ২,২,৬	০১২১২১২১২১২	সাকিনা
63.	সাইফুল মামুন	বলিয়ারপুর	Service	০১৭৭৪০৭৭৬৬৬	সাইফুল
64.	আব্দুল মাকসুদ	ন	ন	০১৭৫৫০১৩৪২৬	আব্দুল
65.	চন্দন শ্রী	মহাশী, ঢাকা	স্বত্বাধী	০১৭১৭৬০২০০৫	Chander
66.					
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**EQMS**  
EQMS Consulting Limited

**Appendix D-3: Photographs of the Stakeholder Consultation and Focus Group Discussion**



Bongaon Union Chairman



DNCC Official of Waste Management Dept.



Head Teacher of Bongaon Primary School



Agriculture Officer of Savar Upazila



Female Member of Bongaon Union



Secretary of Local Mosque Committee



President of Local Temple Committee



Landowner



Landowner



Local Women



Local Youth



Waste Management Officer



Waste Management Officer



Waste Management Supervisor



Ward-level waste officer



Waste Vendor/Buyer



Waste Vendor/Buyer



Waste Vendor/Buyer



Waste Vendor/Buyer



Waste Vendor/Buyer



Waste Vendor/Buyer

**PCM Photographs**



Chairman of Bongaon Union



WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED Personnel



DNCC Personnel



Question Answer Moment-1



Question Answer Moment-2



Question Answer Moment-3



Question Answer Moment-4



Question Answer Moment-5



Question Answer Moment-6



Question Answer Moment-7



Participants of the PCM



Participants of the PCM

## Appendix E: Applicable Standards of DoE

### Appendix E-1: Standards for Ambient Air Quality in Bangladesh

Air Pollutant	Bangladesh Standard ( $\mu\text{g}/\text{m}^3$ )	Average Time
Carbon Monoxide (CO)	10,000 (9 ppm)	8 hours
	40,000 (35 ppm)	1 hour
Lead (Pb)	0.5	Annual
Oxides of Nitrogen (NO <sub>x</sub> )	100 (0.053 ppm)	Annual
Suspended Particulate Matters (SPM)	200	8 hours
Coarse Particulates (PM <sub>10</sub> )	50	Annual
	150	24 hours
Fine Particulates (PM <sub>2.5</sub> )	15	Annual
	65	24 hours
Ozone (O <sub>3</sub> )	235 (0.12 ppm)	1 hour
	157 (0.08 ppm)	8 hours
Sulfur Dioxide (SO <sub>2</sub> )	80 (0.03 ppm)	Annual
	365 (0.14 ppm)	24 hours

Source: Air pollution (Control) Rules, 2022

### Appendix E-2: Standards for Water Quality in Bangladesh

#### A. Standards for Inland Surface Water

S/N	Best Practice-Based Classification	Parameters											
		pH	DO	BOD	NO <sub>3</sub> -N	NH <sub>4</sub> -N	PO <sub>4</sub> -P	Total Cr	Pb	Hg	Total Coliform	TDS	COD
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	mg/L
1	Source of drinking water for supply only after disinfecting	6.5 - 8.5	≥6	≤2	7.0	0.1	0.1	0.02	0.03	0.001	≤100	1000	10
2	Water usable for recreational activity	6.5 - 8.5	≥5	≤3	7.0	0.3	0.5	0.2	0.05	0.001	≤50	1000	10
3	Source of drinking water for supply after conventional treatment	6.0 - 9.0	≥5	≤3	7.0	0.3	0.5	0.02	0.03	0.001	≤5000	1000	25
4	Water usable by fisheries	6.0 - 9.0	≥5	≤6	7.0	0.3	0.5	0.05	0.1	0.004	≤5000	1000	50
5	Water usable by various process	6.5 - 8.5	≥1	12	-	2.7	-	0.1	0.1	0.05	-	1000	100

S/N	Best Practice-Based Classification	Parameters											
		pH	DO	BOD	NO <sub>3</sub> -N	NH <sub>4</sub> -N	PO <sub>4</sub> -P	Total Cr	Pb	Hg	Total Coliform	TDS	COD
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	mg/L
	and cooling industries												
6	Water usable for irrigation	6.5 - 8.5	-	≤12	5.0	1.5	2.0	0.1	0.1	0.002	≤50000	1000	100

Notes: In water used for irrigation water, electrical conductivity is 2250 µS/cm (at a temperature of 25°C); Sodium is less than 26%; boron is less than 0.2%.

Source: The Environment Conservation Rules, 2023 (Schedule-2)

## B. Standards for Drinking Water

S/N	Parameters	Unit	Bangladesh Standards
1	Aldrin/Dieldrin	µg/L	0.03
2	Aluminum (Al)	mg/L	0.20
3	Ammonia (NH <sub>3</sub> )	mg/L	1.50
4	Anionic Detergent	mg/L	0.20
5	Arsenic (As)	mg/L	0.05
6	Barium (Ba)	mg/L	0.70
7	Benzene (C <sub>6</sub> H <sub>6</sub> )	mg/L	0.01
8	Boron (B)	mg/L	1.0
9	Cadmium (Cd)	mg/L	0.003
10	Calcium (Ca)	mg/L	75
11	Chloride	mg/L	250 <sup>33</sup>
	Chlorinated Alkanes		
12	Carbon Tetrachloride (CCl <sub>4</sub> )	mg/L	0.005
13	1,1 Dichloroethane (1,1 C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> )	mg/L	0.03
14	1,2 Dichloroethane (1,1 C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> )	mg/L	0.03
15	Tetrachloroethane (C <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub> )	mg/L	0.04
16	Trichloroethane (C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub> )	mg/L	0.02
	Chlorinated Phenols		
17	Pentachlorophenol	mg/L	0.009
18	2,4,6 Trichlorophenol	mg/L	0.20
19	Chlorine (Free Residual)	mg/L	0.20
20	Chloroform (CHCl <sub>3</sub> )	mg/L	0.09
21	Chromium (Total Cr)	mg/L	0.05
22	Coliform (Fecal)	CFU/100 mL	0
23	Coliform (Total)	CFU/100 mL	0
24	Color	Hazen unit	15

<sup>33</sup> In coastal area, the standard for chlorine is 1000 mg/L.

S/N	Parameters	Unit	Bangladesh Standards
25	Copper (Cu)	mg/L	1.5
26	Cyanide (CN)	mg/L	0.05
27	Fluoride	mg/L	1.0
28	Hardness (as CaCO <sub>3</sub> )	mg/L	500
29	Iron (Fe)	mg/L	0.3–1.0
30	Kjeldhl Nitrogen (Total)	mg/L	1.0
31	Lead (Pb)	mg/L	0.01
32	Magnesium (Mg)	mg/L	30–35
33	Manganese (Mn)	mg/L	0.40
34	Mercury (Hg)	mg/L	0.001
35	Nickel (Ni)	mg/L	0.05
36	Nitrate (NO <sub>3</sub> <sup>-</sup> )	mg/L	45
37	Nitrite (NO <sub>2</sub> <sup>-</sup> )	mg/L	1.0
38	Odor	-	Odorless
39	Oil and Grease	mg/L	0.01
40	pH	-	6.5 - 8.5
41	Phenolic Compounds (Phenols)	mg/L	0.002
42	Potassium (K)	mg/L	12
43	Radioactive Materials (Gross Alpha Activity)	Bq/L	0.1
44	Radioactive Materials (Gross Beta Activity)	Bq/L	1.0
45	Selenium (Se)	mg/L	0.01
46	Silver (Ag)	mg/L	0.02
47	Sodium (Na)	mg/L	200
48	Suspended Particulate Matters	mg/L	10
49	Sulfide as Hydrogen Sulfide (Sulfide as H <sub>2</sub> S)	mg/L	0.05
50	Sulfate (SO <sub>4</sub> <sup>-2</sup> )	mg/L	250
51	Total Dissolved Solids (TDS)	mg/L	1,000
52	Temperature	°C	20 - 30
53	Tin (Sn)	mg/L	2.0
54	Turbidity	NTU	5.0
55	Zinc (Zn)	mg/L	5.0

Source: The Environment Conservation Rules, 2023 (Schedule-2)

### Appendix E-3: Standards for Sound in Bangladesh

S/N	Category of Area/Zone	Limit in dB(A) Leq*	
		Day Time	Nighttime
1.	Silent zone	50	40
2.	Residential area	55	45

S/N	Category of Area/Zone	Limit in dB(A) Leq*	
		Day Time	Nighttime
3.	Mixed area	60	50
4.	Commercial area	70	60
5.	Industrial area	75	70

Notes:

1. The time from 6 am to 9 pm is counted as daytime.

2. The time from 9 pm to 6 am is counted as nighttime.

\* The time-weighted average of sounds related to the human ear for a certain period is expressed by dB(A) Leq which is indicated in the dB(A) scale.

Source: Noise Pollution (Control) Rules, 2006

#### Appendix E-4: Standards for Odor in Bangladesh

S/N	Parameter	Unit	Standard Limit
1	Acetaldehyde (C <sub>2</sub> H <sub>4</sub> O)	ppm	0.5 - 5.0
2	Ammonia (NH <sub>3</sub> )	ppm	1 - 5
3	Hydrogen Sulfide (H <sub>2</sub> S)	ppm	0.02 - 0.20
4	Methyl Disulfide (C <sub>2</sub> H <sub>6</sub> S <sub>2</sub> )	ppm	0.009 - 0.10
5	Methyl Mercaptan (CH <sub>4</sub> S)	ppm	0.02 - 0.20
6	Methyl Sulfide (C <sub>2</sub> H <sub>6</sub> S)	ppm	0.01 - 0.20
7	Styrene (C <sub>8</sub> H <sub>8</sub> )	ppm	0.4 - 2.0
8	Trimethylamine (C <sub>3</sub> H <sub>9</sub> N)	ppm	0.005 - 0.07

Source: Air Pollution (Control) Rules, 2022

#### Appendix E-5: Standards for Sewage Discharge in Bangladesh

S/N	Parameter	Unit	Standard Limit
1	Temperature	°C	30
2	pH	-	6.0 - 9.0
3	BOD <sub>5</sub> at 20°C	mg/L	30
4	COD	mg/L	125
5	Suspended Solids (SS)	mg/L	100
6	Oil and Grease	mg/L	10
7	Nitrate (NO <sub>3</sub> )	mg/L	50
8	Phosphate	mg/L	15
9	Total Coliform	CFU/100 mg/L	1000

Source: The Environment Conservation Rules, 2023 (Schedule-3)

### Appendix E-6: Standards for Waste from Industrial Units or Projects Waste in Bangladesh

S/N	Parameter	Unit	Guideline Values			
			National Standards			GIIP
			Place 1 <sup>34</sup>	Place 2 <sup>35</sup>	Place 3 <sup>36</sup>	
1.	Ammoniacal Nitrogen (as elementary N)	mg/L	50	50	50	5
2.	Ammonia (as free ammonia)	mg/L	5	5	5	-
3.	Arsenic (as As)	mg/L	0.2	0.2	0.2	-
4.	BOD <sub>5</sub> at 20°C	mg/L	30	250	100	-
5.	Boron (B)	mg/L	2.0	2.0	4.0	-
6.	Cadmium (as Cd)	mg/L	2.0	1.0	2.0	0.1
7.	Chloride (Cl <sup>-</sup> )	mg/L	600	600	-	-
8.	Chromium (as total Cr)	mg/L	0.5	1.0	1.0	0.5
9.	COD	mg/L	200	400	250	250
10.	Chromium (as hexavalent Cr)	mg/L	0.1	2.0	1.0	0.1
11.	Copper (as Cu)	mg/L	3.0	3.0	3.0	0.5
12.	Fluoride (as F)	mg/L	2	15	10	5
13.	Sulfide (as S)	mg/L	1	-	5	0.1
14.	Iron (as Fe)	mg/L	3	3	3	-
15.	Iron	mg/L	-	-	-	5
16.	Total Kjeldahl Nitrogen (as N)	mg/L	100	-	100	-
17.	Total Nitrogen	mg/L	-	-	-	30
18.	Lead (as Pb)	mg/L	0.1	1.0	2.0	0.2
19.	Manganese (as Mn)	mg/L	2.0	2.0	2.0	-
20.	Mercury (as Hg)	mg/L	0.01	0.01	0.01	0.1
21.	Nickel (as Ni)	mg/L	1.0	2.0	5.0	0.5
22.	Nitrate (as elementary N)	mg/L	10.0	-	20.0	
23.	Oil and Grease	mg/L	10	20	20	10
24.	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/L	1.0	5.0	5.0	0.5
25.	Dissolved Phosphorus (as P)	mg/L	5.0	-	-	-
26.	Total Phosphorus	mg/L	-	-	-	2
27.	Radioactive substance a. Alpha particle radiation b. Beta particle adiation	µCi/L	To be specified by Bangladesh Atomic Energy Commission			-

<sup>34</sup> Inland surface water.

<sup>35</sup> Public sewerage system connected to treatment at second stage.

<sup>36</sup> Coastal areas.

S/N	Parameter	Unit	Guideline Values			
			National Standards			GIIP
			Place 1 <sup>34</sup>	Place 2 <sup>35</sup>	Place 3 <sup>36</sup>	
28.	pH	-	6-9	6-9	6-9	6-9
29.	Selenium (as Se)	mg/L	0.05	0.05	0.05	-
30.	Zinc (as Zn)	mg/L	5	15	15	2
31.	Temperature	°C	Not more than 5°C of waterbody temperature	-	Not more than 5°C of waterbody temperature	-
32.	Suspended Solids (SS)	mg/L	100	500	100	35
33.	Cyanide (as Cn)	mg/L	0.1	2.0	0.2	-
34.	Cyanide (free)	mg/L	-	-	-	0.1
35.	Cyanide (total)	mg/L	-	-	-	0.5
36.	Total Residual Chlorine	mg/L	1.0	-	1.2	-
37.	Bio assay test <sup>37</sup>	-	90% of fisheries can survive in treated wastewater even after 96 hours			-

Source: The Environment Conservation Rules, 2023 (Schedule-4) and Bangladesh Bank Guidelines on Environmental and Social Risk Management (ESRM) for Banks and Financial Institutions in Bangladesh, June 2022.

#### Appendix E-7: Incinerator Operation Standard

Parameter	Specification	Standard
Temperature	Primary Chamber	> 850°C
	Secondary Chamber	Minimum 1000°C
	Incoming Gas at Air Pollution Control Equipment	< 2000°C
Gas residence time	After last injection of combustion air/Secondary Chamber	≥ 2 Sec
Air flow	Total combustion air	Additional 140-200%
	Incinerator air supply and distribution	Sufficient
	All zone air and combustion gas mixed	Good Mixing
	Particulate matter entrainment into Flue gas	Minimize by keeping moderate air velocity
Oxygen Concentration (excess)	-	Maximum 6%
Combustion Efficiency	$CE = \frac{CO_2}{\% CO_2 + \% CO} \times 100$	Minimum 99%
Monitoring	Continuous emission monitoring	Particulate Matter, CO, SO <sub>2</sub> , HF, HCl, NOx and other parameters might be added

<sup>37</sup> Applicable for pesticide and pharmaceutical industries.

Parameter	Specification	Standard
		based on clearance certificate condition
	Continuous process parameters monitoring	Furnace Temperature, Flue Gas outlet temperature, pressure, Water vapor or other parameters will be monitored as per clearance certificate condition
	Regular Emission Monitoring (2-4 times in a year)	Heavy Metal, Dioxin and Furan
Pollution Control Equipment	Air pollution control device setup	Fabric Filter Dry (Which have Dry Injection Facilities, Packed bed, Venturi or other wet Scrubber, Electrostatic Precipitation (ESP))
Chimney Height	Incinerator Power < 300 Ton/day	45 meters
	Incinerator Power > 300 Ton/day	70 meters

Note: Chimney height must be finalized through dispersion modelling and this height will be not less than above mentioned table.

Source: Solid Waste Management Rules, 2021

#### Appendix E-8: Stack Emission Standard

Parameters	Average Duration	Standard Limit (mg/Nm <sup>3</sup> )
Particulate Matter	1 Hour	30
	24 Hour	20
CO	1 Hour	100
	24 Hour	80
NO <sub>2</sub>	1 Hour	300
	24 Hour	250
HCl	1 Hour	60
	24 Hour	50
Hg	.05-8 Hour	0.05
Cd and Tl	.05-8 Hour	0.1
Sb, As, Pb, Cr, Co, Cu, Mg and Ni	.05-8 Hour	0.5
HF	.05 Hour	1.0
Dioxin and Furan	6-8 Hour	0.1 ng TEQ/Nm <sup>3</sup>

Source: Solid Waste Management Rules, 2021

## Appendix F: Laboratory Test Report

SL. No:0626

Ref: EQMS/Air Quality/20220102249



### EQMS ENVIRONMENTAL LABORATORY Monitoring Results of Ambient Air Quality

**Project Name** : EIA study of Waste to Energy Incineration Power Project at Amin Bazar, Dhaka, Bangladesh  
**Monitoring Activity** : Ambient Air Quality  
**Monitoring Personnel** : EQMS Personnel (Syed Galib Shah)  
**Monitoring Date** : 11.04.2022-25.05.2022  
**Analysis Date** : 12.06.2022

#### Description of Analysis:

Monitoring Code	CO	NO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	O <sub>3</sub>
	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )				
AQ1	1.12	82.24	95.33	37.51	57.07	36.25
AQ2	0.43	58.17	61.84	22.62	50.83	35.87
AQ3	0.62	70.35	147.11	34.40	62.42	38.22
AQ4	0.70	92.02	93.18	48.92	52.02	36.14
AQ5	0.59	63.46	64.57	38.80	39.40	34.97
AQ6	0.48	57.87	65.23	24.98	52.83	36.05
AQ7	0.44	53.13	58.84	23.19	50.65	33.54
AQ8	0.42	52.83	58.27	22.06	51.64	33.53
Duration (Hours)	8	24	24	24	24	8
Weather	Sunny					
Bangladesh Standard*	5	80	150	65	80	100
WHO Standard**	10	25	45	15	40	100

Note:

\* Air Pollution (Control) Rules, 2022

Legend:

PM<sub>10</sub> -Particulate Matter of a diameter of 10 microns or less. PM<sub>2.5</sub> -Particulate Matter of a diameter of 2.5 microns or less, SO<sub>2</sub> -Sulphur Dioxide; NO<sub>x</sub> -Nitric Oxide; CO -Carbon Monoxide

\*\* WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines

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SL. No:0627



Ref: EQMS/Noise Level/ 20220102339

**EQMS ENVIRONMENTAL LABORATORY**  
**Monitoring Results of Noise Level Measurement in the Study Area**

**Project Name** : EIA study of Waste to Energy Incineration Power Project at Amin Bazar, Dhaka, Bangladesh  
**Monitoring Activity** : Noise Level  
**Monitoring Personnel** : EQMS Personnel (Md. Abdur Rab)  
**Monitoring Date** : 10.04.2022 – 17.04.2022  
**Analysis Date** : 16.05.2022

**Description of Analysis:**

Location	Noise level (dB(A))						Bangladesh Standard (dB(A))*		IFC EHS Guideline (2007)**		Location setting (DOE/IFC)
	Leq (day)	L <sub>max</sub>	L <sub>min</sub>	Leq (night)	L <sub>max</sub>	L <sub>min</sub>	Day	Night	Day	Night	
NL1	66.8	84.4	35.9	57.5	78.3	35.5	75	70	70	70	Industrial
NL2	54.8	76.6	34.6	43.1	59.9	33.2	55	45	55	45	Residential area
NL3	67.3	89.3	34.3	64.6	85.1	35.5	60	50	70	70	Mixed/Commercial area
NL4	76.9	97.1	46.6	72.8	96.6	42.2	60	50	70	70	Mixed/Commercial area
NL5	55.1	76.3	40.2	44.6	53.7	33.4	55	45	55	45	Residential area
NL6	51.5	67.4	37.2	43.2	55.32	34.7	50	40	55	45	Silent area

\*Environmental Conservation Rules, 1997 (subsequent amendment in 2006)

\*\*Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

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SL. No:0628



Ref: EQMS/Water Quality/20220102251

**EQMS WET LABORATORY**  
**Test Results of Surface Water Quality**

**Project Name** : EIA study of Waste to Energy Incineration Power Project at Amin Bazar, Dhaka, Bangladesh  
**Description of Sample** : Surface Water  
**Sample Collector** : EQMS Personnel (Md. Abdur Rab)  
**Sampling Date** : 12.04.2022  
**Reporting Date** : 07.05.2022

**Description of Analysis:**

Parameters	Unit	Concentration Present							
		SW1_US	SW2_US	SW3_US	SW4_US	SW1_DS	SW2_DS	SW3_DS	SW4_DS
DO	mg/l	6.0	5.5	6.6	6.1	6.4	5.6	6.6	6.0
BOD	mg/l	0.9	1.1	0.8	0.9	0.8	1.2	0.8	1.0
Temperature	(°C)	22.1	22.2	22.0	22.1	22.0	22.3	22.2	22.3
EC	µS/cm	180	170	160	160	170	170	170	160
Turbidity	NTU	5.7	8.5	8.9	16.8	5.5	9.0	8.7	24.9
pH		7.87	7.80	7.24	7.13	7.39	7.50	7.11	7.10
TDS	ppm	90	80	80	80	80	80	80	80
Salinity	ppt	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Iron	mg/L	0.02	0.04	0.04	0.01	0.03	0.05	0.06	0.02
Arsenic	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phosphate	mg/L	1.2	1.4	1.4	1.8	1.0	1.2	1.3	1.6
Zinc	mg/L	0.02	0.04	0.08	0.03	0.01	0.05	0.07	0.06
Chromium	mg/L	0.00	0.00	0.02	0.04	0.01	0.01	0.02	0.06
Nitrate	mg/L	1.7	2.1	2.0	1.8	1.6	2.2	2.2	1.6
Magnesium	mg/L	12	16	12	14	10	14	11	12
Aluminum	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coper	mg/L	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01
COD	mg/L	11	14	12	15	13	16	11	12
Hardness	mg/L	78	93	105	84	84	90	99	81
Ammonia	mg/L	0.48	0.38	0.41	0.40	0.47	0.38	0.41	0.37
Ammonium	mg/L	0.47	0.37	0.40	0.40	0.46	0.36	0.40	0.36
Color	PCU	37	27	26	26	39	29	28	25
TSS	mg/L	128	122	126	115	110	114	128	108
Oil and Grease	mg/L	11.42	10.28	8.85	5.42	11.24	10.18	8.81	5.41

DO: Dissolved Oxygen; BOD: Biological Oxygen Demand; EC: Electric Conductivity  
 TDS: Total Dissolved Solids; COD: Chemical Oxygen Demand; TSS: Total Suspended Solids

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SL. No:0629



Ref: EQMS/Water Quality/20220102253

**EQMS WET LABORATORY**  
**Test Results of Ground Water Quality**

**Project Name** : EIA study of Waste to Energy Incineration Power Project at Amin Bazar, Dhaka, Bangladesh  
**Description of Sample** : Ground Water  
**Sample Collector** : EQMS Personnel (Md. Abdur Rab)  
**Sampling Date** : 12.04.2022  
**Reporting Date** : 07.05.2022

**Description of Analysis:**

Sl	Parameter	Unit	GW1	GW2	Bangladesh Standard*	WHO**
1.	Temperature	°C	22.0	21.9	20-30	-
2.	Electric Conductivity (EC)	µS/cm	290	420	--	(2,000 by EPA)
3.	Turbidity	NTU	0.05	0.08	10	
4.	pH	-	6.81	6.78	6.5 – 8.5	6.5 – 8.5
5.	TDS	ppm	140	210	1000	1500
6.	DO	mg/L	6.0	6.1	6.0	-
7.	Salinity	ppt	0.12	0.19	--	-
8.	Iron	mg/L	0.00	0.00	0.3 – 1.0	0.3
9.	Fluoride	ppm	0.8	0.9	1	
10.	Arsenic	mg/L	0.00	0.00	0.05	
11.	Total Coliform	n/100 ml	0	0	0	-
12.	Faecal Coliform	n/100 ml	0	0	0	-
13.	Chloride	mg/L	16	15	150-600	
14.	Total Alkalinity	mg/L	245	185	--	--
15.	Total Hardness	mg/L	85	70	200-500	

\* Bangladesh Environment Conservation Rules, 1997 [Schedule 3 (B)]

\*\* WHO Standard for Groundwater

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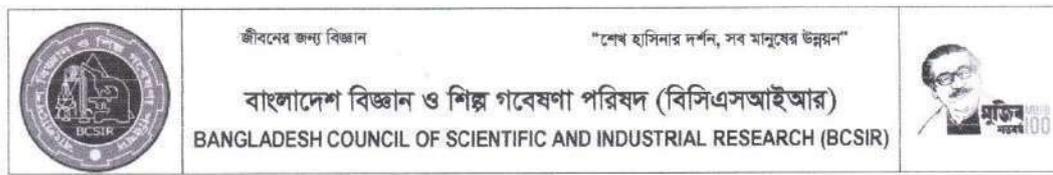
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Laboratories / Institute / Center: BCSIR LABORATORIES, DHAKA

**ANALYSIS REPORT**

ASC Ref No: E-310, Date: 13.04.2022	Unit (lab/inst.) Ref No: E-310, Date: 13.04.2022
Sample Description: Test report on supplied samples (as mentioned)	Lab ID: D 198
Clients Details: Kazi Farhed Iqbal, EQMS Consulting Limited, House#53, Road no: 4, Dhaka-1208	
Number of Samples: 2	

**Details:**

Parameters	Methodology/Instrument	Results		
		SQ1	SQ2	
Texture	Marchel triangle using sand, silt and clay %.	Sandy Loam	Sandy Loam	
Particle Size Distribution	Hydrometer Method	Sand	63.6 %	57.97 %
		Silt	26.3 %	27.19 %
		Clay	10.1 %	14.84 %
Salinity	Salinity measuring meter HACH, USA	2.41 ppt	2.53 ppt	
pH	Benchtop pH meter Metrohm 906, Switzerland	7.27	7.19	
Cation Exchange Capacity	Soil leaching column	6.78 Meq/100g soil	57.43 Meq/100g soil	
Nitrogen (Total)	Kjeldahl nitrogen digestion and distillation	0.219 %	0.224 %	
Potassium	Flame Photometer	2288 ppm	2189 ppm	
Magnesium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	4170 ppm	4051 ppm	
Sodium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	294.4 ppm	287.19 ppm	
Phosphorus	Vanadomolybdophosphoric acid colorimetric method using UV-Visible Spectrophotometer	1580 ppm	1560 ppm	
Iron	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	1.785 %	1.491 %	
Chromium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	37.825 ppm	29.91 ppm	
Cadmium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	0.223 ppm	0.197 ppm	

*[Signature]*  
22.06.22  
Analyst:  
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Senior Scientific Officer  
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22/06/22  
Director / Officer-In-Charge:  
পরিচালক  
স্ব. বি. গ. অ. অ. অ. গবেষণা  
কেন্দ্র, বঙ্গবন্ধু জাতীয়  
পার্কে  
১২০৫

**Notes:**

- The results reported here pertained to the sample(s) received in this laboratory only.
- Complain and/or query regarding test report(s) should be lodged within one month of report delivery date.
- The laboratory is not responsible for the data quality affected due to sampling, transporting and storage conditions of the sample(s) maintained before received in the laboratory.
- The report/result shall not be reproduced / published partly or fully without prior approval of the authority.

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	<p>জীবনের জন্য বিজ্ঞান</p> <p>“শেখ হাসিনার দর্শন, সব মানুষের উন্নয়ন”</p> <p>বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)</p> <p>BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)</p>	
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Laboratories / Institute / Center: **BCSIR LABORATORIES, DHAKA**

### ANALYSIS REPORT

ASC Ref No: E-310, Date: 13.04.2022	Unit (lab/Inst.) Ref No: E-310, Date: 13.04.2022
Sample Description: Test report on supplied samples (as mentioned)	Lab ID: D 197
Clients Details: Kazi Farhed Iqbal, EQMS Consulting Limited, House#53, Road no: 4, Dhaka-1208	
Number of Samples: 2	

#### Details:

Parameters	Methodology/Instrument	Results	
		SedQ1	SedQ2
pH	Benchtop pH meter Metrohm 906, Switzerland	7.51	7.47
Nitrogen (Total)	Kjeldahl nitrogen digestion and distillation	0.1287 %	0.101 %
Potassium	Flame Photometer	3432 ppm	3086 ppm
Calcium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	1674 ppm	1661 ppm
Magnesium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	8249 ppm	8769 ppm
Sodium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	472.5 ppm	441.81 ppm
Phosphorus	Vanadomolybdophosphoric acid colorimetric method using UV-Visible Spectrophotometer	695 ppm	671 ppm
Iron	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	3.249 %	3.153 %
Zinc (Zn)	Atomic absorption spectrometry (AAS)	126 ppm	120 ppm
Cadmium	Flame Atomic Absorption Spectrometry (AA 7000, Shimadzu, Japan)	1.423 ppm	1.132 ppm

*[Signature]*  
22.06.22

Analyst

BADHAN SAHA  
Senior Scientific Officer  
Soil and Environment Section  
Biological Research Division  
BCSIR Laboratories Dhaka  
BCSIR, Dhanmondi, Dhaka-1205

*[Signature]*  
22/06/22

Supervisor

DR. MOHAMMAD MONIRUZZAMAN  
Principal Scientific Officer  
Soil and Environment Section  
Biological Research Division  
BCSIR Laboratories, Dhaka  
BCSIR, Dhanmondi, Dhaka-1205

*[Signature]*  
22/04/22

Director / Officer-In-Charge

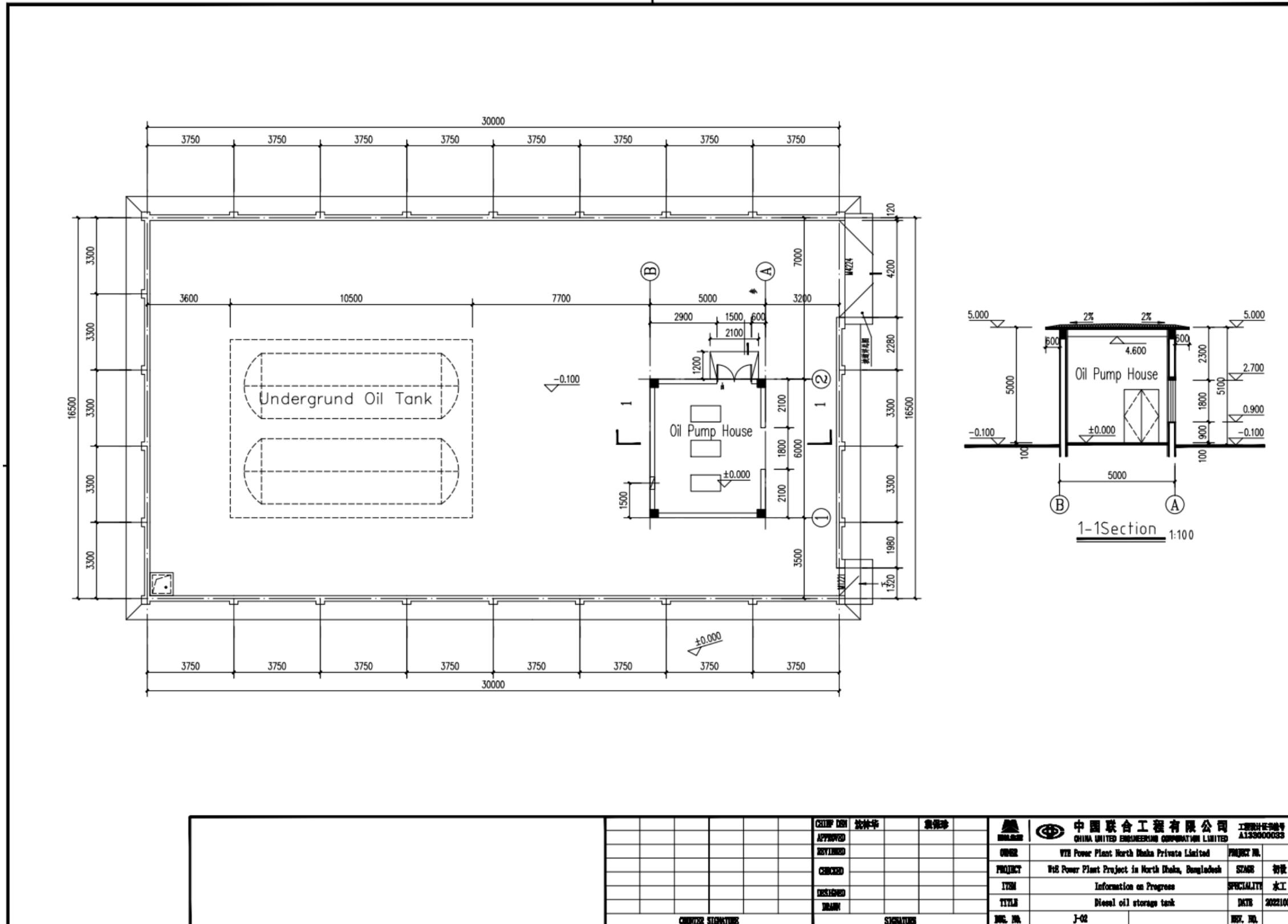
পরিচালক  
বি. বি. ও. আই. অর গবেষণা  
আবু-আবু-আবু  
১২০৫

#### Notes:

1. The results reported here pertained to the sample(s) received in this laboratory only.
2. Complain and/or query regarding test report(s) should be lodged within one month of report delivery date.
3. The laboratory is not responsible for the data quality affected due to sampling, transporting and storage conditions of the sample(s) maintained before received in the laboratory.
4. The report/result shall not be reproduced / published partly or fully without prior approval of the authority.

Analytical Service Cell (ASC)  
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh  
Phone: 02-9671108 Fax: 88-02-9671108 E-mail: asc@bcsir.gov.bd

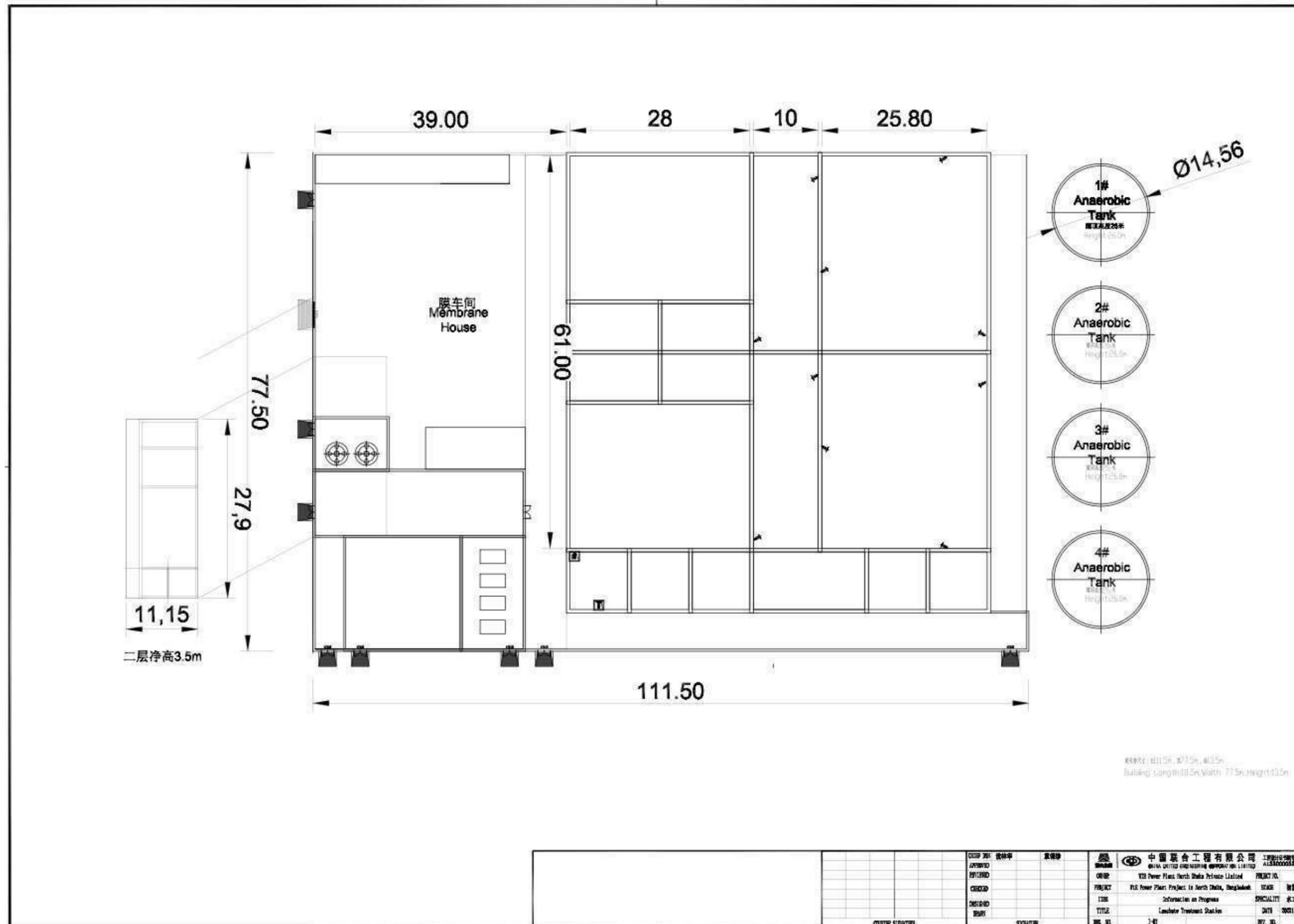
Appendix G: Diesel Oil Storage Tank



		CHIEF DESIGNER 沈林华	张明珍	中国联合工程有限公司 CHINA UNITED ENGINEERING CORPORATION LIMITED 工程编号: A133000033
		APPROVED		
		REVISED		
		CHECKED		
		DESIGNED		
		DRAWN		
OWNER SIGNATURE		SIGNATURE		PROJECT NO. WTE Power Plant North Dhaka Private Limited PROJECT WTE Power Plant Project in North Dhaka, Bangladesh ITEM Information on Progress TITLE Diesel oil storage tank REV. NO. J-02
				PROJECT NO. 初设 SPECIALITY 水工 DATE 20221008 REV. NO.



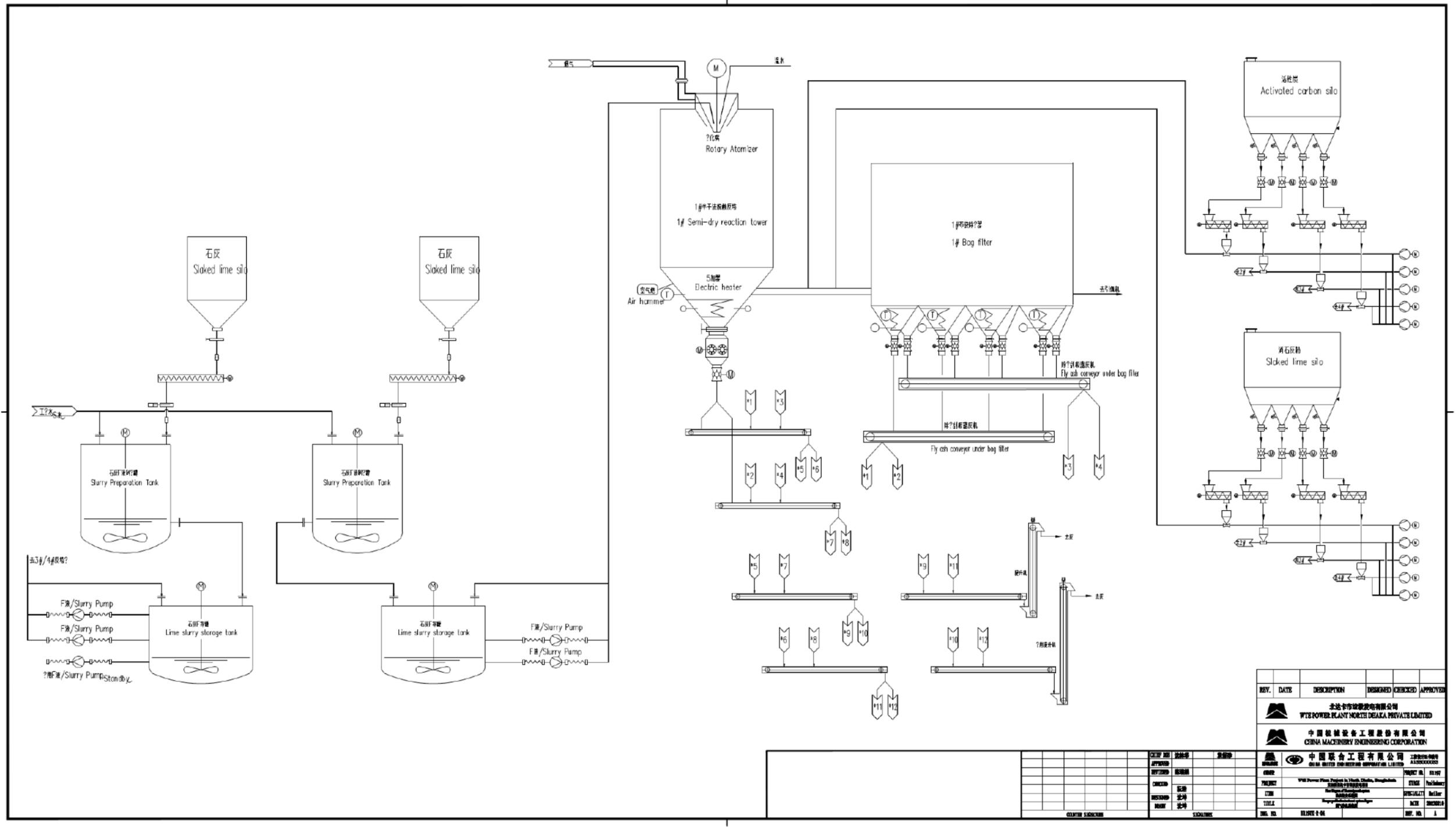
Appendix I: Leachate Treatment Station



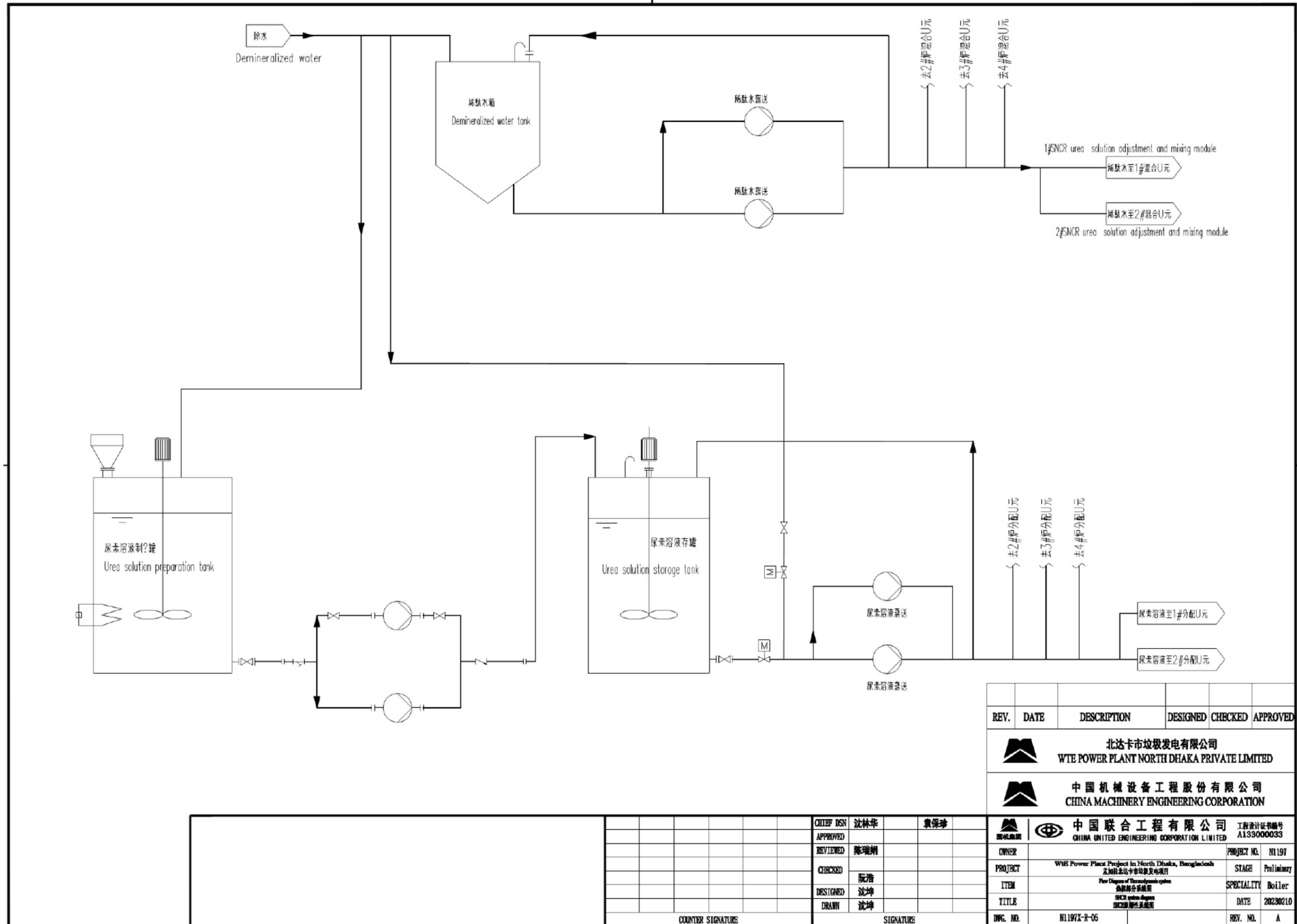




Appendix J-3: Flow diagram of Flue gas purification treatment



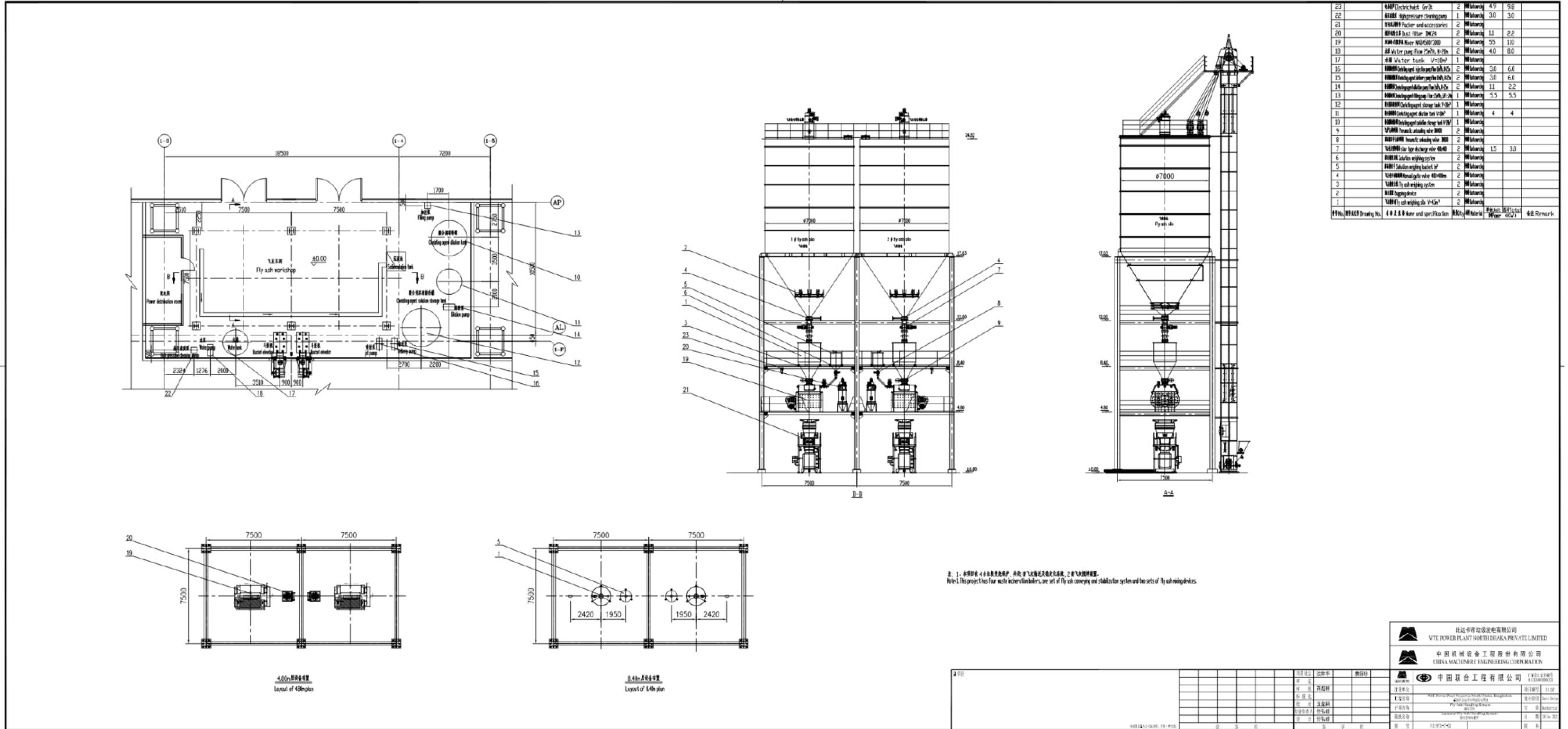
Appendix J-4: Flow diagram of SNCR system





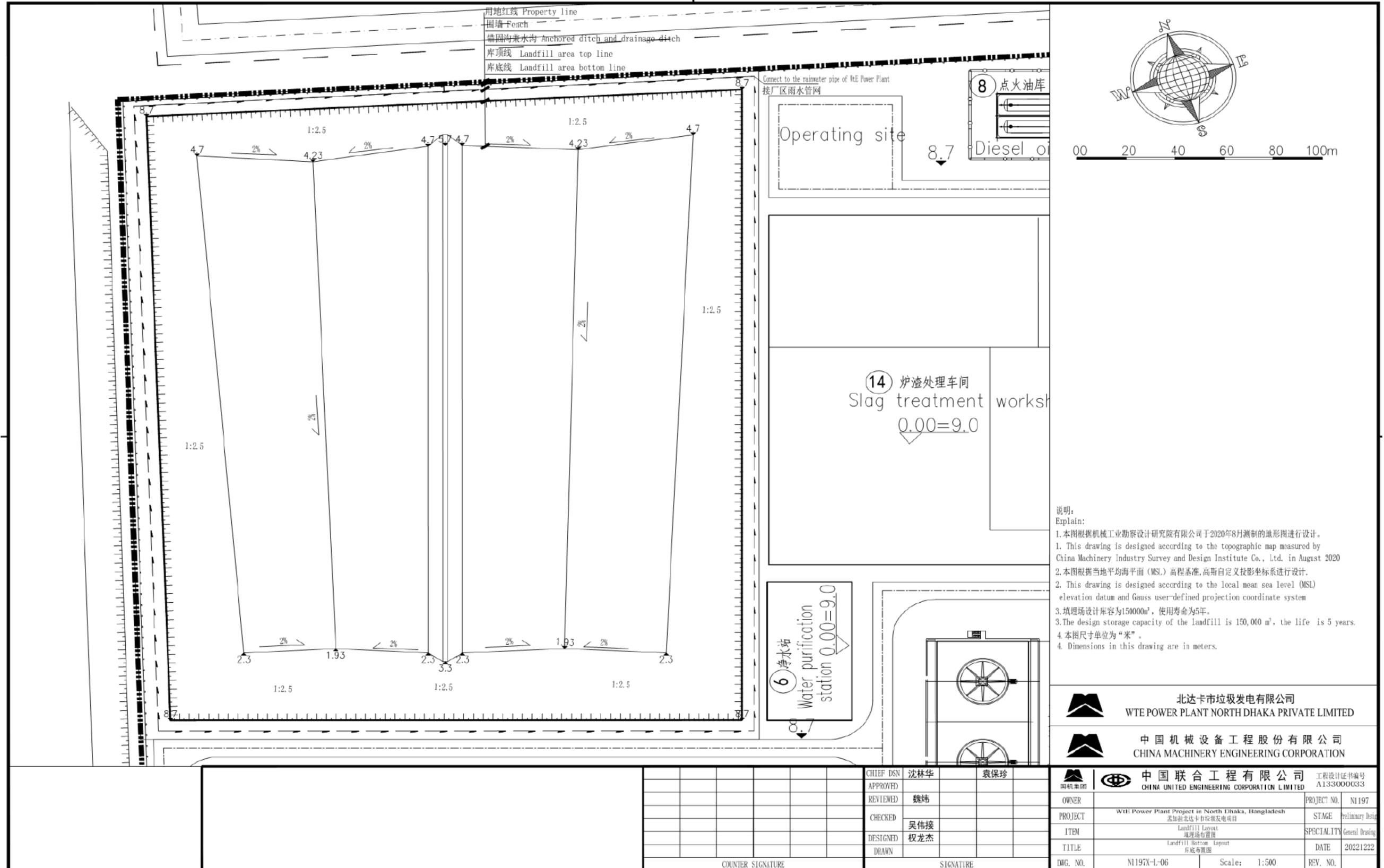


Appendix J-7: Layout of Fly Ash Stabilization system





Appendix J-9: Landfill bottom layout



说明:  
Explain:

1. 本图根据机械工业勘察设计院有限公司于2020年8月测制的地形图进行设计。  
1. This drawing is designed according to the topographic map measured by China Machinery Industry Survey and Design Institute Co., Ltd. in August 2020
2. 本图根据当地平均海平面 (MSL) 高程基准, 高斯自定义投影坐标系进行设计。  
2. This drawing is designed according to the local mean sea level (MSL) elevation datum and Gauss user-defined projection coordinate system
3. 填埋场设计库容为150000m<sup>3</sup>, 使用寿命为5年。  
3. The design storage capacity of the landfill is 150,000 m<sup>3</sup>, the life is 5 years.
4. 本图尺寸单位为“米”。  
4. Dimensions in this drawing are in meters.

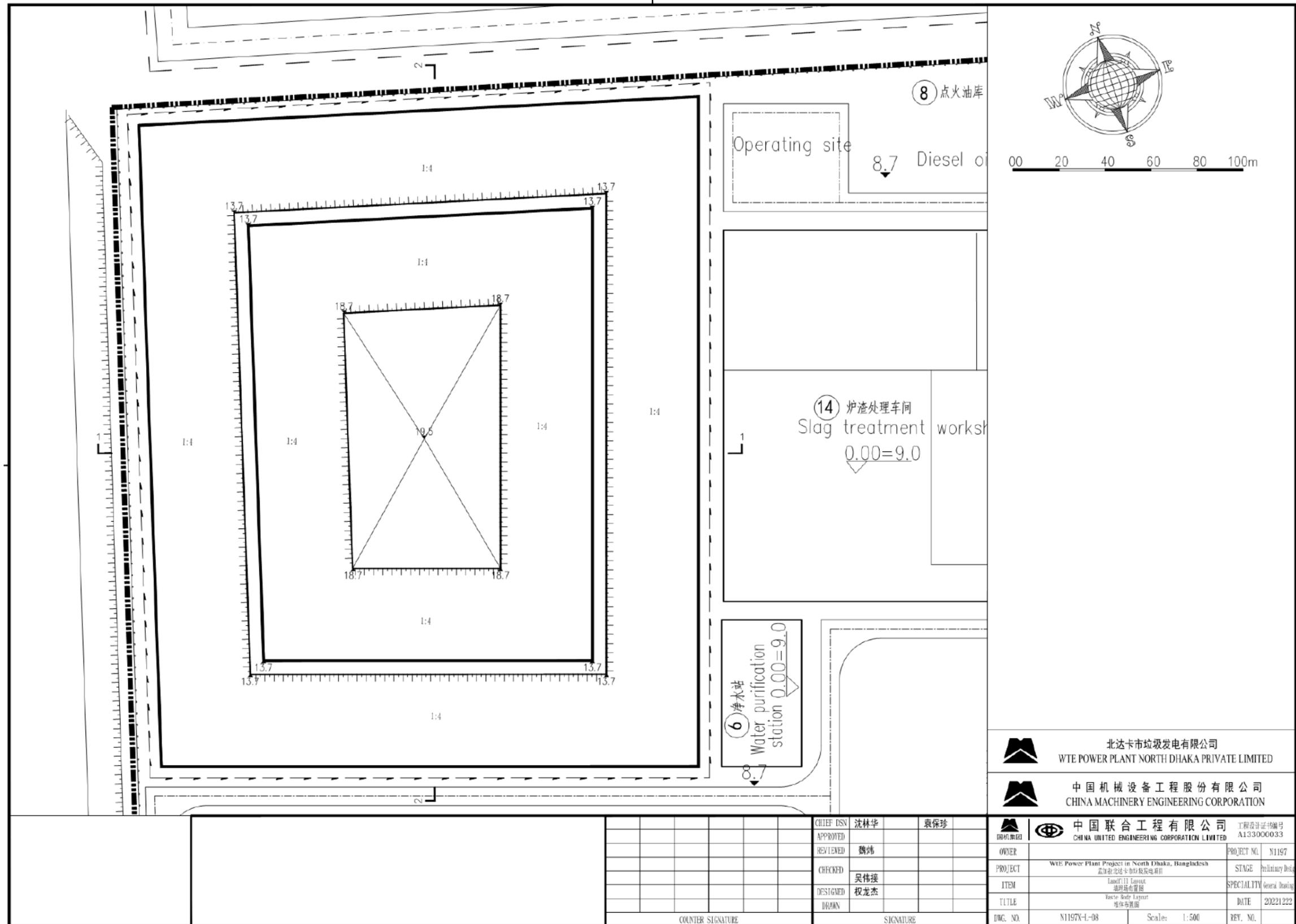
北达卡市垃圾发电有限公司  
WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED

中国机械设备工程股份有限公司  
CHINA MACHINERY ENGINEERING CORPORATION

CHIEF DSN	沈林华	袁保珍
APPROVED		
REVIEWED	魏炜	
CHECKED	吴伟接	
DESIGNED	权龙杰	
DRAWN		

中国联合工程有限公司 CHINA UNITED ENGINEERING CORPORATION LIMITED	工程设计证书编号 A133000033
OWNER	PROJECT NO. N1197
PROJECT	WTE Power Plant Project in North Dhaka, Bangladesh 孟加拉北达卡垃圾发电项目
ITEM	STAGE preliminary design
TITLE	Landfill Layout 填埋场布置图
DATE	20221222
DWG. NO. N1197X-L-06	Scale: 1:500
REV. NO.	

Appendix J-10: Waste body layout



北达卡市垃圾发电有限公司  
WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED

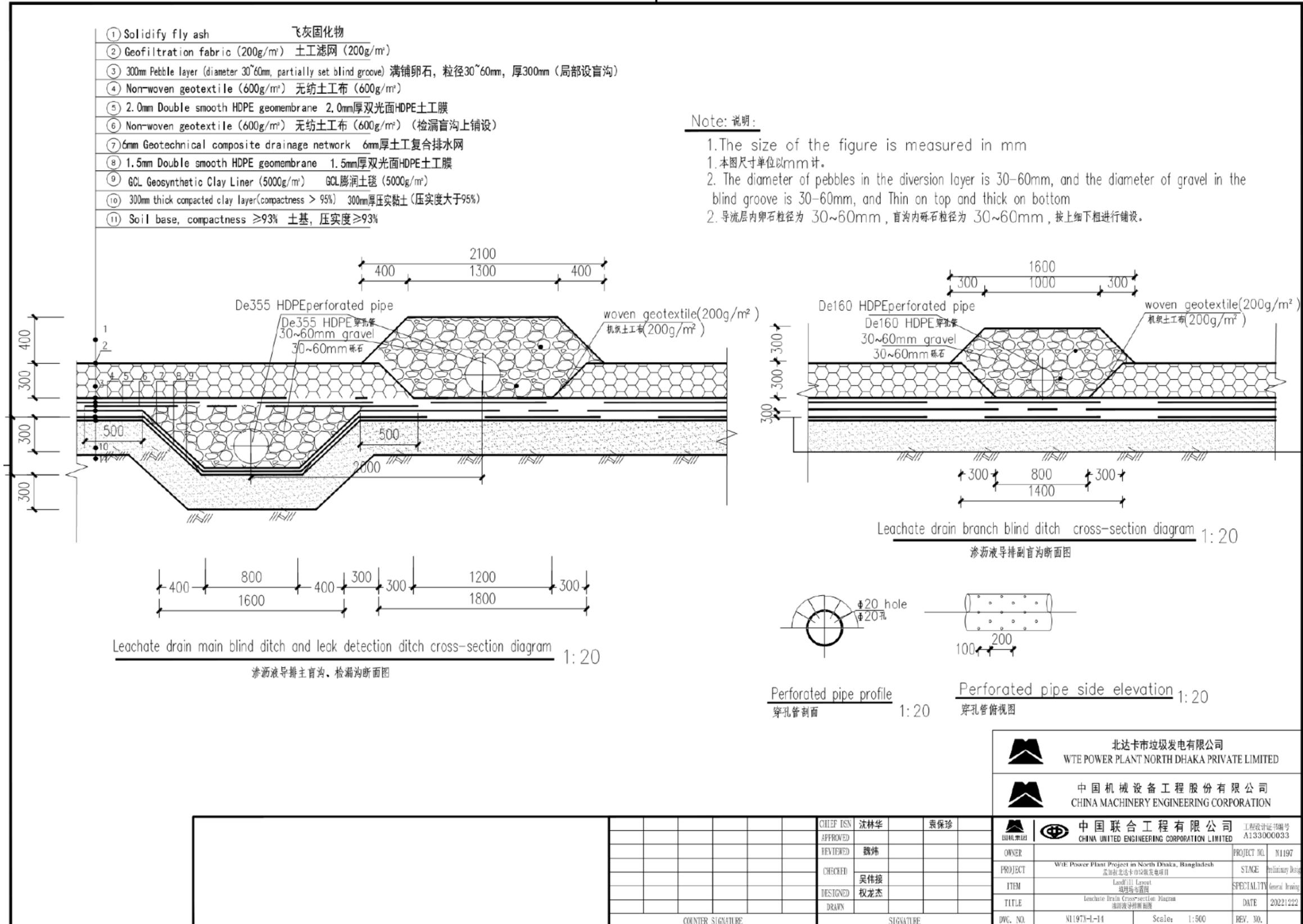
中国机械设备工程股份有限公司  
CHINA MACHINERY ENGINEERING CORPORATION

CHIEF/EN	沈林华	袁保珍
APPROVED		
REVIEWED	魏炜	
CHECKED	吴伟接	
DESIGNED	权龙杰	
DRAWN		

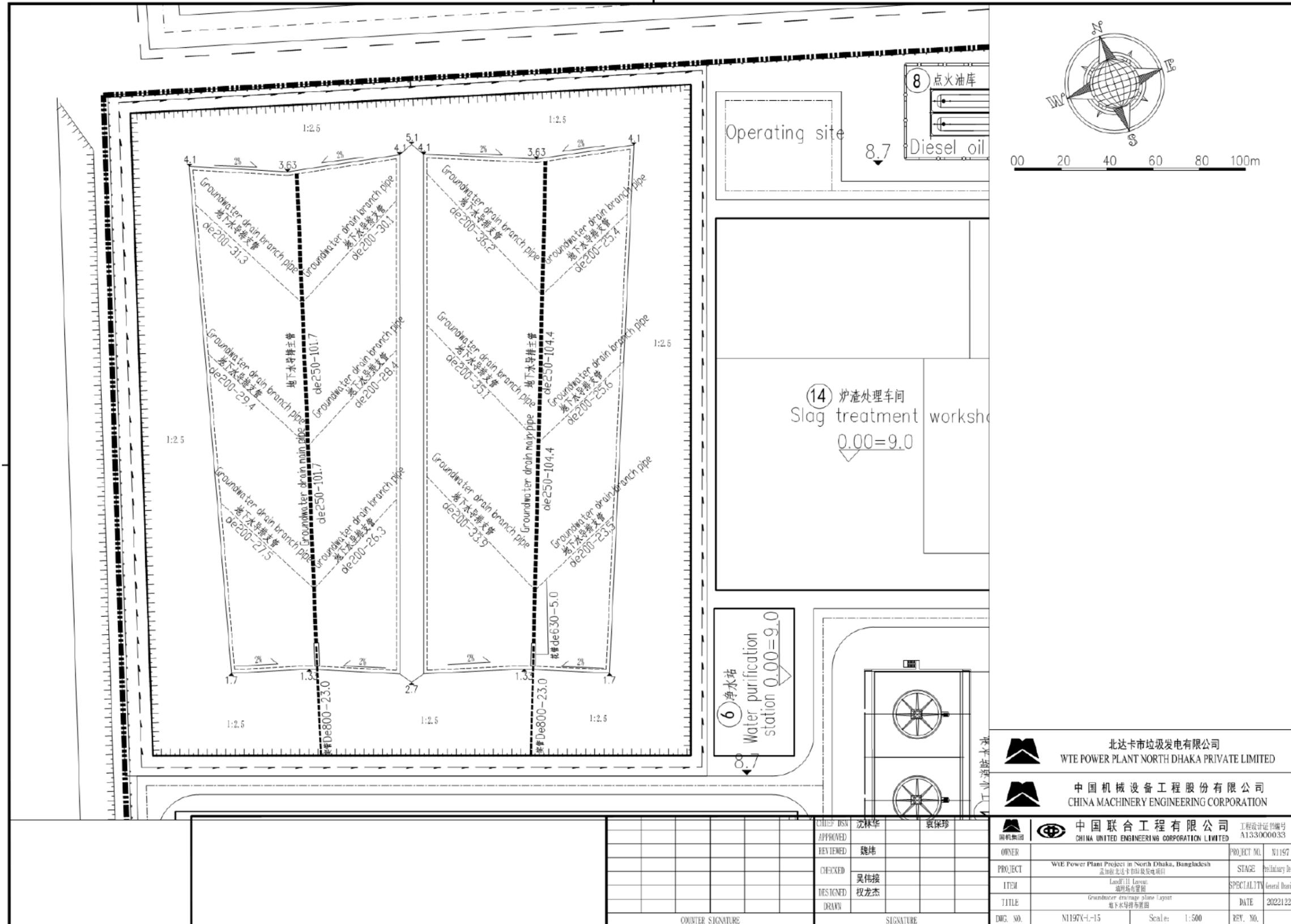
中国联合工程有限公司 CHINA UNITED ENGINEERING CORPORATION LIMITED	工程资质证书编号 A133000033
OWNER	PROJECT NO. N1197
PROJECT	WTE Power Plant Project in North Dhaka, Bangladesh 孟加拉北达卡市垃圾发电项目
STAGE	Preliminary Design
ITEM	Landfill Layout 填埋场布置图
SPECIALITY	General Drawing
TITLE	Waste Body Layout 堆体布置图
DATE	20221222
DWG. NO.	N1197X-L-08
Scale:	1:500
REV. NO.	



Appendix J-12: Leachate drain cross-section diagram



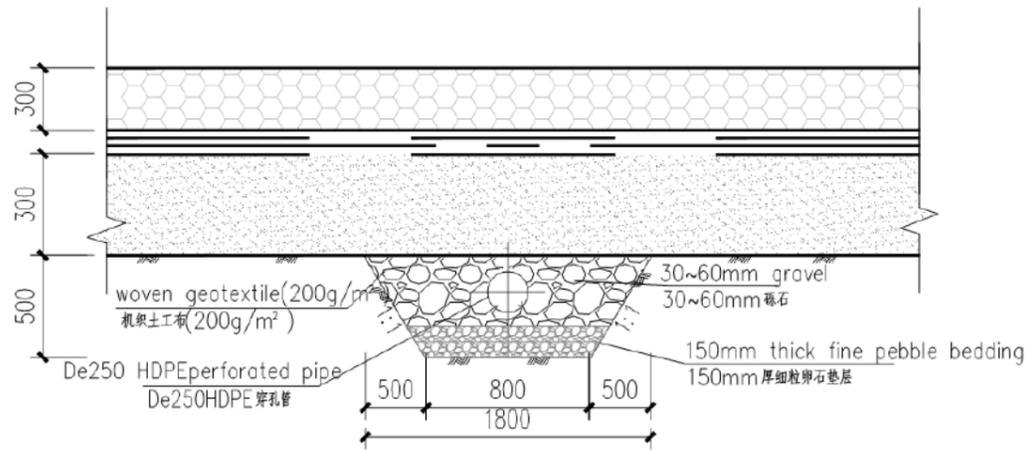
Appendix J-13: Groundwater drainage plane layout



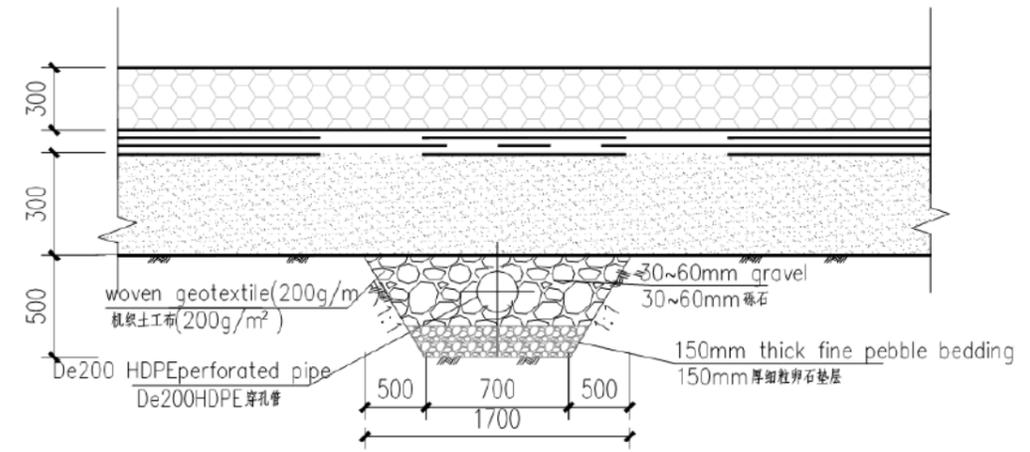
CHEF DSN	沈林华	袁保珍
APPROVED		
REVIEWED	魏伟	
CHECKED	吴伟报	
DESIGNED	权龙杰	
DRAWN		

OWNER	北达卡市垃圾发电有限公司 WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED	PROJECT NO.	N1197
PROJECT	WTE Power Plant Project in North Dhaka, Bangladesh 孟加拉北达卡市垃圾发电项目	STAGE	preliminary Design
ITEM	Landfill Layout 填埋场布置图	SPECIALITY	General Design
TITLE	Groundwater drainage plane Layout 地下水导排布置图	DATE	20221222
DWG. NO.	N1197X-1-15	Scale:	1:500
		REV. NO.	

Appendix J-14: Groundwater drain cross-section diagram



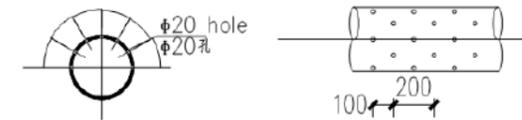
Groundwater drain main blind ditch cross-section diagram  
地下水导排主盲沟断面图 1:30



Groundwater drain branch blind ditch cross-section diagram  
地下水导排副盲沟断面图 1:30

Note: 说明:

1. The size of the figure is measured in mm  
1. 本图尺寸单位以mm计。
2. The diameter of pebbles in the diversion layer is 30~60mm, and the diameter of gravel in the blind groove is 30~60mm, and thin on top and thick on bottom  
2. 导流层内卵石粒径为 30~60mm, 盲沟内砾石粒径为 30~60mm, 按上细下粗进行铺设。



Perforated pipe profile  
穿孔管剖面 1:30

Perforated pipe side elevation  
穿孔管侧视图 1:30

	CHIEF	ISN	沈林华	袁保珍
	APPROVED			
	REVIEWED		魏伟	
	CHECKED		吴伟接	
	DESIGNED		权龙杰	
DRAWN				
COUNTER SIGNATURE		SIGNATURE		

 北达卡市垃圾发电有限公司 WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED			
 中国机械设备工程股份有限公司 CHINA MACHINERY ENGINEERING CORPORATION			
 中国联合工程有限公司 CHINA UNITED ENGINEERING CORPORATION LIMITED			
OWNER	WTE Power Plant Project in North Dhaka, Bangladesh 孟加拉国达卡市垃圾发电项目	PROJECT NO.	N1197
PROJECT	Landfill Layout 填埋场布置图	STAGE	Preliminary Design
ITEM	Groundwater Drain Cross-section Diagram 地下水导排断面图	SPECIALITY	General Drawing
TITLE		DATE	20221222
DWG. NO.	N1197X-1-16	Scale:	1:500
		REV. NO.	

**Appendix K: Challan Documents**

**Appendix K-1: Bank Challan**

**চালান ফরম**

টি, আর ফরম নং ৬ (এস, আর ৩৭ ড্রইব্য)

চালান নং: ৫৫৪ তারিখ: 17/01/2022

বাংলাদেশ ব্যাংক/সোনালী ব্যাংক: Dhaka জেলা: Banani শাখায় টাকা জমা দেওয়ার চালান

কেড নং: 1 4541 0000 2681

যাহার মারফত প্রদত্ত হইল তাহার নাম ও ঠিকানা।	জমা প্রদানকারী কর্তৃক পূরণ করিতে হইবে		মুদ্রা ও সোর্টের বিবরণ/ ড্রাফট, পে-অর্ডার ও চেকের বিবরণ।	টাকার অংক		বিভাগের নাম এবং চালানের পূর্তাকেনাকাঠী কর্মকর্তার নাম, পদবী ও দপ্তর।*
	যে ব্যক্তি/অফিসের পক্ষ হইতে টাকা প্রদত্ত হইল তাহার নাম, পদবী ও ঠিকানা।	কি বালদ জমা দেওয়া হইল তাহার বিবরণ।		টাকা	পয়সা	
Huang Zhengrong	Name: Huang Zhengrong, Managing Director (Local Representative)  WTE Power Plant North Dhaka Private Limited  Add: Anamicka Concord, H-583, 11- F, West, Shewrapara, Begum Rokyea Shoroni, Mirpur, Mirpur, Dhaka, PO: 1216, Bangladesh	DoE Govt. Fee Bank Challan	Cash	5,00,000		= 500,000/
টাকা (কথায়) Five Lac Taka Only			মোট টাকা	5,00,000		
টাকা পাওয়ার সেল						

নোট: ১. নির্দিষ্ট মতবের সঠিক যোগাযোগ করিয়া সঠিক ভেদে নম্বর জানিবার হইবে।  
২. শূন্য সকল ক্ষেত্রে কর্তৃক পূর্তাকেন প্রয়োজন, সে সকল ক্ষেত্রে প্রযোজ্য হইবে।

বাংলাদেশ সরকারের ই-সিটিজেন সার্ভিস অ্যাপ্লিকেশন থেকে মুদ্রিত

Download site: <http://www.firms.gov.bd>

**চালান ফরম**

টি, আর ফরম নং ৬ (এস, আর ৩৭ ড্রইব্য)

চালান নং: ৫৫৭ তারিখ: 17/01/2022

বাংলাদেশ ব্যাংক/সোনালী ব্যাংক: Dhaka জেলা: Banani শাখায় টাকা জমা দেওয়ার চালান

কেড নং: 1 1133 0035 0311

যাহার মারফত প্রদত্ত হইল তাহার নাম ও ঠিকানা।	জমা প্রদানকারী কর্তৃক পূরণ করিতে হইবে		মুদ্রা ও সোর্টের বিবরণ/ ড্রাফট, পে-অর্ডার ও চেকের বিবরণ।	টাকার অংক		বিভাগের নাম এবং চালানের পূর্তাকেনাকাঠী কর্মকর্তার নাম, পদবী ও দপ্তর।*
	যে ব্যক্তি/অফিসের পক্ষ হইতে টাকা প্রদত্ত হইল তাহার নাম, পদবী ও ঠিকানা।	কি বালদ জমা দেওয়া হইল তাহার বিবরণ।		টাকা	পয়সা	
Huang Zhengrong	Name: Huang Zhengrong, Managing Director (Local Representative)  WTE Power Plant North Dhaka Private Limited  Add: Anamicka Concord, H-583, 11- F, West, Shewrapara, Begum Rokyea Shoroni, Mirpur, Mirpur, Dhaka, PO: 1216, Bangladesh	VAT Challan 15%	Cash	75,000		= 75,000/
টাকা (কথায়) Seventy Five Thousand Taka			মোট টাকা	75,000		
টাকা পাওয়ার সেল						

নোট: ১. নির্দিষ্ট মতবের সঠিক যোগাযোগ করিয়া সঠিক ভেদে নম্বর জানিবার হইবে।  
২. শূন্য সকল ক্ষেত্রে কর্তৃক পূর্তাকেন প্রয়োজন, সে সকল ক্ষেত্রে প্রযোজ্য হইবে।

বাংলাদেশ সরকারের ই-সিটিজেন সার্ভিস অ্যাপ্লিকেশন থেকে মুদ্রিত

Download site: <http://www.firms.gov.bd>

**Appendix K-2: Vat Challan**

**চালান ফরম**

টি, আর ফরম নং ৬ (এস, আর ৩৭ ট্রটব্য)

চালান নং: 559 তারিখ: 17/01/2022

বাংলাদেশ ব্যাংক/সোনালী ব্যাংকের: Dhaka জেলা: Banarshi শাখায় টাকা জমা দেওয়ার চালান

সেঞ্চ নং: **1 1133 0035 0311**

যাত্রার মারফত প্রদত্ত হইল অথবা নাম ও ঠিকানা।	কিস্তি বা কিস্তিগণের পক্ষ হইতে টাকা প্রদত্ত হইল অথবা নাম, পদবী ও ঠিকানা।	কি বাবদ জমা দেওয়া হইল অথবা বিবরণ।	মুদ্রা ও নোটের বিবরণ/ ড্রাফট, পে-অর্ডার ও চেকের বিবরণ।	টাকার অংক		বিভাগের নাম এবং চালানের পূষ্ঠাকর্মকারী কর্মকর্তার নাম, পদবী ও সপ্তর।
				টাকা	পয়সা	
Huang Zhengrong	Name: Huang Zhengrong, Managing Director (Local Representative)  WTE Power Plant North Dhaka Private Limited  Add: Anamicka Concord, H-683, 11-F, West, Shawrapara, Begum Rokyea Shoron, Mirpur, Mirpur, Dhaka, PO: 1216, Bangladesh	VAT Challan 15%	Cash	75,000		<b>75,000/-</b>
টাকার (যেথায়) <b>Seventy Five Thousand Taka</b>				মোট টাকা	75,000	
টাকার পাওরী শেল				ম্যানেজার বাংলাদেশ ব্যাংক/সোনালী ব্যাংক <b>Nipa Ghosh</b> Senior Officer Cash Joint Custodian Cash Sonali Bank Ltd Dhaka Branch, Dhaka		
তারিখ: .....				বাংলাদেশ ব্যাংক পিএস সোনালী ব্যাংক, ঢাকা <b>17 JAN 2022</b> সফটওয়্যার মাস্টার প্রিন্ট		

নোট: ১। পূর্ণস্ট্রিক্ট দস্তুরের সহিত যোগাযোগ করিয়া সঠিক কোড নম্বর জানিয়া লইবেন।  
 ২। পূর্ণ সঠিক কোডের কর্মকর্তার কর্তৃত্ব পূষ্ঠাকর্ম প্রদানের, সে সঠিক কোডে প্রবেশ করাইবে।

**Appendix L: Legal Documents of WTE North Dhaka Private Limited**

**Appendix L-1: Trade License**

ঢাকা উত্তর সিটি কর্পোরেশন  
www.dncc.gov.bd  
(রাজস্ব বিভাগ)  
**অঞ্চল-৪ (মিরপুর)**




**ট্রেড লাইসেন্স**  
(TRADE LICENCE)  
No: 313759

লাইসেন্স ইস্যুর বিবরণ		
ওয়ার্ড নম্বর	ইস্যুর ক্রমিক নম্বর	ইস্যুর তারিখ
২৪	১১৫৫২	১০/১১/১৯

স্থানীয় সরকার (সিটি কর্পোরেশন) আইন ২০০৯-এর ধারা ৮৪-এর প্রদত্ত ক্ষমতাবলে সরকার প্রণীত আদর্শ কর তফসিল ২০১৬ এর ১০ নং অনুচ্ছেদ অনুযায়ী ব্যবসা, বৃত্তি, পেশা বা শিল্প প্রতিষ্ঠানের উপর আরোপিত কর আদায়ের লক্ষ্যে নিম্ন বর্ণিত ব্যক্তি/প্রতিষ্ঠানের অন্তর্গতে এ ট্রেড লাইসেন্স ইস্যু করা হলো। যার কার্যকারিতার মেয়াদ ২০১৯-২০২১ হইতে ২০২৫-২০২৬ পর্যন্ত ঘণ্টার সাংকেতিক

১। মালিকের নাম : মুহাম্মদ হোসেন

২। পিতার নাম : মুহাম্মদ নবির হোসেন

৩। মাতার নাম : শ্রীমতী মাহবুবা

৪। স্বামী / স্ত্রীর নাম : \_\_\_\_\_

৫। মালিকের ঠিকানা : \_\_\_\_\_

বর্তমান বসবাসের ঠিকানা : \_\_\_\_\_ স্থায়ী/রেজিস্টার্ড ঠিকানা : \_\_\_\_\_

হোল্ডিং নং : ৫৬৬ কোম্পানী (কো-১) হোল্ডিং নং / গ্রাম : ১৮, ৭১৫ - ০৫ গুলশান (কো-১)

রোড নং : \_\_\_\_\_ রোড নং / পোস্ট অফিস : হাসান ডিবি

ধানা : মিরপুর ধানা : \_\_\_\_\_

ঢাকা ১২১৫ (পোস্ট কোড) জেলা : \_\_\_\_\_

৬। ব্যবসা প্রতিষ্ঠানের নাম : "ডব্লিউ টি ইন্ডাস্ট্রিয়াল প্রাইভেট লিমিটেড"

৭। পরিশোধিত মূলধন (লিঃ কোম্পানীর ক্ষেত্রে) : টাকা ৪০, ০০০০০/-

৮। ব্যবসা প্রতিষ্ঠানের ঠিকানা : ৫৬৬ কোম্পানী (কো-১) মিরপুর, ঢাকা-১২১৫।

ফোন : \_\_\_\_\_ ই-মেইল : \_\_\_\_\_

৯। ব্যবসায় ধরণ : ডব্লিউ টি ইন্ডাস্ট্রিয়াল প্রাইভেট লিমিটেড (জিএফ) আমদানী/রপ্তানী

১০। আদর্শ কর তফসিল ২০১৬ এর ক্রমিক নং : ১৫০ (জিএফ) আমদানী/রপ্তানী

১১। ট্রেড লাইসেন্স/নবায়ন ফি (বার্ষিক) : টাকা (অংকে) ৫৫০০/- (কথায়) পাঁচ হাজার পাঁচশত টাকা।

১২। সাইনবোর্ড কর (বার্ষিক) : টাকা (অংকে) ৪৮০/- (কথায়) চার হাজার আশি টাকা।

১৩। ইস্যুকৃত চালান : ৩১৩৭৫৯

লাইসেন্সধারী নিম্নে সফল বকেয়া পাওনা বিবিধ বশিদ নম্বর \_\_\_\_\_ তাৎ \_\_\_\_\_ এর মাধ্যমে আদায় করা হয়েছে।  
লাইসেন্সটি \_\_\_\_\_ নম্বর ডি.সি.আর. \_\_\_\_\_ বইয়ের \_\_\_\_\_ নং পৃষ্ঠায় লিপিবদ্ধ করা হয়েছে।

মুহাম্মদ হোসেন  
লাইসেন্স ও বিজ্ঞাপন সুপারভাইজার  
(নাম ও পদবীসহ সীল)

"সকল প্রকার সাইনবোর্ড  
বাংলায় লিখা বাধ্যতামূলক"

মুহাম্মদ হোসেন  
কর কর্তৃক  
(নাম ও পদবীসহ সীল)

মোঃ গোলাম মস্তফা  
লাইসেন্স ও বিজ্ঞাপন সুপারভাইজার  
অঞ্চল-৪ (মিরপুর-১০)  
ঢাকা উত্তর সিটি কর্পোরেশন

মোঃ আজিজুর রহমান  
কর কর্তৃক  
অঞ্চল-৪, (মিরপুর-৬)  
রাজস্ব বিভাগ, বিবিধ আদায় শাখা  
ঢাকা উত্তর সিটি কর্পোরেশন, ঢাকা।

ঢাকা উত্তর সিটি কর্পোরেশন  
(স্বাস্থ্য বিভাগ)

(নবায়ন পাতা)



ট্রেড লাইসেন্স  
(TRADE LICENCE)

No : 313759

লাইসেন্স গ্রহীতা কর্তৃক চালানের সাথে হাল মাসের জাভার মর্শিদ/ রশিদের ফটোকপি, দাখিলক্রমে ফি/ কর নির্ধারিত চালানে ব্যাংক জমা প্রদান এবং ব্যাংক কর্তৃপক্ষের সীল মোহরযুক্ত স্বাক্ষর থাকতে হবে।

নবায়ন কার্যকারিতার মেয়াদ

২০২১-২০২২ খ্রিঃ

১। জমার তারিখ	ঃ	_____
২। লাইসেন্স বই নম্বর	ঃ	_____ চালান বই নম্বর _____
৩। টাকার পরিমাণ	ঃ	লাইসেন্স/ নবায়ন ফি = _____ সাইনবোর্ড কর = _____ সারচার্জ = _____ মোট টাকা (অংকে) = _____ মোট টাকা (কথায়) = _____
ক্রম নম্বর	_____	তারিখ _____
ব্যাংক ক্যাশিয়ারের স্বাক্ষর ও সীল	(ব্যাংকের সীল)	ব্যাংক কর্মকর্তার স্বাক্ষর ও সীল

মোঃ শোলায় মন্ডল  
লাইসেন্স ও নিয়ন্ত্রণ সুপারভাইজার  
অফিস-৪ (মিরপুর-১০)  
ঢাকা উত্তর সিটি কর্পোরেশন

নবায়ন কার্যকারিতার মেয়াদ

২০২২-২০২৩ খ্রিঃ

১। জমার তারিখ	ঃ	_____
২। লাইসেন্স বই নম্বর	ঃ	_____ চালান বই নম্বর _____
৩। টাকার পরিমাণ	ঃ	লাইসেন্স/ নবায়ন ফি = _____ সাইনবোর্ড কর = _____ সারচার্জ = _____ মোট টাকা (অংকে) = _____ মোট টাকা (কথায়) = _____
ক্রম নম্বর	_____	তারিখ _____
ব্যাংক ক্যাশিয়ারের স্বাক্ষর ও সীল	(ব্যাংকের সীল)	ব্যাংক কর্মকর্তার স্বাক্ষর ও সীল

পৃষ্ঠা-৪



বিবিধ রশিদ বই  
অঞ্চল: ৪

**ঢাকা উত্তর সিটি কর্পোরেশন**  
1971 (রাজস্ব বিভাগ)

বহি নং: ..... তারিখ: ১০/১২/১১

ক্রমিক নং: 197002

প্রতিষ্ঠান/দাতার নাম: ডব্লিউ টি ইন্সট্রুমেন্টাল রথ ঢাকা  
প্রতিষ্ঠান/দাতার নাম: ৫৮৬, কলিকাতা

কি বাবদ: ..... আদায়কৃত টাকা: .....

ট্রেড লাইসেন্স: নতুন ট্রেড লাইসেন্স ফি	<input checked="" type="checkbox"/>	টাকা	৫৫০০/-	+
বকেয়া ফি	<input type="checkbox"/>	টাকা		+
সার চার্জ	<input type="checkbox"/>	টাকা		+
বিজ্ঞাপন ফি	<input checked="" type="checkbox"/>	টাকা	৪৮০/-	+
সংশোধনী ফি	<input type="checkbox"/>	টাকা		+
ট্রেড লাইসেন্স বহি মুদ্রা	<input checked="" type="checkbox"/>	টাকা	২০০/-	+
হুইল ট্যাক্স: রিকসা, ভ্যান, ট্রেলি, মোড়ার গাড়ীর লাইসেন্স/স্বাধীন/নামজারী ফি	<input type="checkbox"/>	টাকা		+
চালক লাইসেন্স ফি	<input type="checkbox"/>	টাকা		+
প্রমোদ কর: সিনেমা/প্রচারনী, উল্লিঙ্গ উদ্যান, (প্রবেশ ফি এর ৫%) চিত্রিয়স্থান, মেলা, প্রদর্শনী ফি	<input type="checkbox"/>	টাকা	/	+
অন্যান্য ফি/কর:	<input type="checkbox"/>	টাকা		+

= মোট টাকা (অঙ্ক) ৬১৮০/-

কথায়: ছয় হাজার একশত আশি টাকা  
ঢাকা উত্তর সিটি কর্পোরেশনের পক্ষে

মোঃ গোলাম মস্তফা  
অতিরিক্ত ও বিকল্পে যুগ্মসচিব  
অঞ্চলিক (রাজস্ব-৪) ও সীল  
ঢাকা উত্তর সিটি কর্পোরেশন

প্রধান-রাজস্ব কার্যক্রম  
সেয়ার/প্রশাসক/সচিব  
অর্থনৈতিক অফিসার  
ঢাকা উত্তর সিটি কর্পোরেশন, ঢাকা।

## Appendix L-2: TIN Certificate



**Government of the People's Republic of Bangladesh**  
**National Board of Revenue**  
Taxpayer's Identification Number (TIN) Certificate  
**TIN : 166311700668**

This is to Certify that **WTE Power Plant North Dhaka Private Limited** is a Registered Taxpayer of National Board of Revenue under the jurisdiction of **Taxes Circle-068 (Company)**, Taxes Zone **04, Dhaka**.

**Taxpayer's Particulars :**

- 1) Name : **WTE Power Plant North Dhaka Private Limited**
- 2) Registered Address/Permanent Address : **Anamicka Concord, H -583, 11- F, West, Shewrapara, Begum Rokyee Shoroni, Mirpur,, Mirpur, Dhaka, PO : 1216, Bangladesh**
- 3) Current Address : **Anamicka Concord, H -583, 11- F, West, Shewrapara, Begum Rokyee Shoroni, Mirpur,, Mirpur, Dhaka, PO : 1216**
- 4) Previous TIN : **Not Applicable**
- 5) Status : **Company**

Date : October 18, 2021

**Please Note:**

1. A Taxpayer is liable to file the Return of Income under section 75 of the Income Tax Ordinance, 1994.  
2. Failure to file Return of Income under section 75 is liable to-  
(a) Penalty under section 124; and  
(b) Prosecution under section 164 of the Income Tax Ordinance, 1994.

**Deputy Commissioner of Taxes**  
Taxes Circle-068 (Company)  
Taxes Zone 04, Dhaka  
Address : 72, Kakrail, Dhaka-1000 Phone : 48316918



N.B: This is a system generated certificate and requires no manual signature.

**Appendix L-3: BIN Certificate**

  
**Government of the People's Republic of Bangladesh**  
**National Board of Revenue**

**Mushak-2.3**

Customs, Excise and VAT Commissionerate, Dhaka (West)  
Mirpur Division

**Value Added Tax Registration Certificate**

This is to certify that the person whose details are given below is registered under  
Value Added Tax and Supplementary Duty Act, 2012 (Act No. 47 of 2012)

**BIN : 004411036-0401**

Name of the Entity	: WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED
Trading Brand Name	: N/A
Old BIN	: N/A
e-TIN	: 166311700668
Address	: 583, Shewrapara (F-11); Mirpur PS; Dhaka-1216; Bangladesh
Issue Date	: 10/01/2022
Effective Date	: 01/2022
Type of Ownership	: Private Limited, Trading
Major Area of Economic Activity	: Services



*This is a system generated certificate and doesn't require any signature*

**Appendix L-4: Certificate of Incorporation (COI)**

Issue No. 242552 Date: 01/09/2021



## Certificate of Incorporation (under Act XVIII of 1994)

**No. C-173495/2021**

*I hereby certify that **WTE Power Plant North Dhaka Private Limited** is this day incorporated under the Companies Act (Act XVIII) of 1994 and that the Company is Limited.*

*Given under my hand at **Dhaka** this **First** day of **September** two thousand and **twenty-one**.*

*By order of*  
*Registrar*

*Assistant Registrar*  
*Registrar of Joint Stock Companies & Firms*  
*Bangladesh*



N.B. This certificate is digitally signed. Please find the soft copy to verify the signature.

**Appendix M: Agreements**

**Appendix M-1: Implementation Agreement**

*Implementation Agreement-Dhaka North City Corporation 42.50 MW Waste to Power IPP Power Plant*

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**IMPLEMENTATION AGREEMENT**

BY AND BETWEEN

THE GOVERNMENT OF  
THE PEOPLE'S REPUBLIC OF BANGLADESH

AND

POWER GRID CORPORATION OF BANGLADESH LIMITED

AND

WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED

---

- RELATING TO-

A 42.50 MW (NET) WASTE TO POWER GENERATION FACILITY

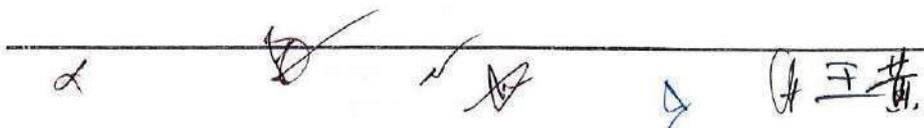
AT

AMINBAZAR, Dhaka, BANGLADESH

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Dated as of \_\_\_\_\_ 2021

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**Appendix M-2: Power Purchase Agreement**

NO. 10623

Date: 01-12-2021

**POWER PURCHASE AGREEMENT**

BY AND BETWEEN

**THE BANGLADESH POWER DEVELOPMENT BOARD**  
(Constituted under the Bangladesh Power Development Board's Order, 1972  
(P.O. No. 59 of 1972))

AND

**WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED**

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- RELATING TO-

**A 42.50 MW (NET) WASTE TO POWER GENERATION FACILITY**

AT

**AMINBAZAR , DHAKA, BANGLADESH**

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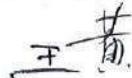
Dated as of 01 DECEMBER, 2021

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9



(2)



**Appendix M-3: Land Use Agreement**

# LAND USE AGREEMENT

BY AND BETWEEN

DHAKA NORTH CITY CORPORATION (DNCC)

AND

WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED

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- RELATING TO -

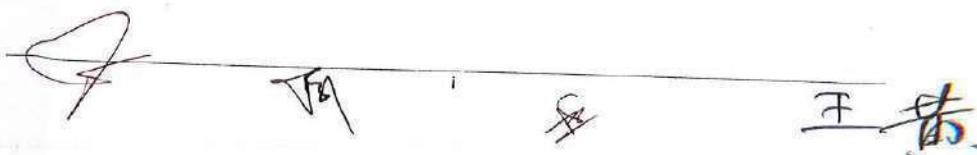
A 42.5 MW (NET) WASTE TO POWER GENERATION FACILITY

AT

DHAKA, BANGLADESH

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....., 2021



**Appendix M-4: Waste Supply Agreement**

**WASTE SUPPLY AGREEMENT**

BY AND BETWEEN

DHAKA NORTH CITY CORPORATION (DNCC)

AND

WTE POWER PLANT NORTH DHAKA PRIVATE LIMITED

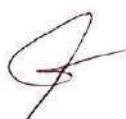
-RELATING TO-

42.5 MW (NET) WASTE TO POWER GENERATION FACILITY

AT

AMINBAZAR, DHAKA, BANGLADESH

....., 2021



## Appendix N: Calculation of Carbon Emission Reduction as per WTE North Dhaka Private Company Limited

### Calculation of Carbon Emission Reduction for WtE Power Plant Project in North Dhaka, Bangladesh

The carbon emission accounting of domestic waste incineration power plant project is based on the fact that the power in developing countries is mainly coal power, and the waste treatment is mainly landfill, as the baseline for carbon emission accounting. On this baseline, the carbon emissions of waste-to-energy projects are related to three aspects at the same time. One is that the incineration process will generate carbon emissions, mainly due to the fossil carbon components in the waste, which account for most of the carbon emissions in the incineration process; The second is that the electricity generated by waste incineration can replace coal electricity, indirectly reducing carbon emissions; The third is to treat garbage through incineration, which indirectly reduces greenhouse gases such as methane generated by garbage landfill. The result of carbon emissions of the waste-to-energy power plant projects is that the carbon emissions of the waste incineration process minus the greenhouse gases such as methane generated by the same amount of waste landfill, and then minus the carbon emissions of the same amount of electricity produced by coal, that is, carbon emissions from waste incineration-Coal Electricity Carbon Offset - Landfill Carbon Offset.

The annual average value of the domestic waste components of the Amin Bazar landfill in Bangladesh from November 2020 to October 2021 is used as the basis for the calculation of carbon emission reduction. See the table below for details:

Table 1 Composition of MSW at Amin Bazar Landfill in Bangladesh from November 2020 to October 2021

components	2020.11	2020.12	2021.1	2021.2	2021.3	2021.4	2021.5	2021.6	2021.7	2021.8	2021.9	2021.10	annual average
Food waste	70.39	76.75	72.47	77.68	70.83	72.15	73.93	74.50	72.59	65.11	62.67	68.22	71.44
Rubber and plastic	14.24	15.92	18.88	10.59	17.20	15.45	12.28	11.89	16.15	20.36	21.66	18.50	16.09
Bamboo	5.48	0.72	0.90	6.51	3.16	5.35	7.29	6.90	3.66	4.46	3.49	3.88	4.32
Textile	3.73	1.93	4.59	2.89	5.40	3.45	2.43	2.25	3.79	6.23	3.23	7.38	3.94

<b>Paper</b>	4.95	3.93	1.36	1.51	2.49	2.85	3.75	3.51	2.94	2.67	6.04	1.89	3.16
<b>Brick ash</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>metal</b>	0.00	0.00	0.02	0.11	0.14	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.03
<b>other</b>	1.20	0.75	1.78	0.72	0.78	0.65	0.32	0.95	0.87	1.18	2.91	0.13	1.02

Based on the project’s annual incineration of 1.09 million tons of domestic waste , calculated according to the industry’s direct emissions (IPCC method, the period is 7 years), the waste incineration mineral carbon emissions are 270,200 tons of CO<sub>2</sub> , methane (CH<sub>4</sub> ) and Dinitrogen monoxide (N<sub>2</sub>O) emission converted into carbon dioxide (CO<sub>2</sub> ) equivalent is 1.36 CO<sub>2</sub> e ; waste incineration technology is used instead of traditional waste landfill process, during the period the average annual carbon emission offset is 418,900 tons CO<sub>2</sub> e; carbon emission offset of waste incineration power generation replacing coal-fired power generation is 226,700 tons of CO<sub>2</sub> (according to the average emission factor of China's power grid in 2022 is 0.5703t CO<sub>2</sub> /MWh), so this project is relatively waste landfill treatment process, The annual average carbon emission reduction during the period is 361,700 tons of CO<sub>2</sub> , which is equivalent to 0.332 t CO<sub>2</sub> of carbon emission reduction per ton of waste . See the table below for details:

Table 2 Calculation of carbon emissions of this project

Baseline emissions	Landfill discharge	tons	418,900.00
	Energy Production Emissions	tons	226,700.00
Project emissions	Waste Incineration of Mineral Carbon Emissions	tons	270,200.00
	Methane and nitrous oxide emissions from waste incineration	tons	13,600.00
Leakage		tons	0.00
Total emission reduction during period		tons	2,532,000.00
Average annual emission reduction		tons	361,700.00

The implementation of the WtE Power Plant Project can increase the energy supply in a clean energy way. The project will promote local sustainable development in the following aspects:

(1) Reduce greenhouse gas emissions: After the incineration method is adopted for the treatment of urban domestic waste in this project, the decomposition and release of CH<sub>4</sub> during the stacking process of this part of waste in the landfill site are avoided; The project uses the superheated steam generated by the waste incineration boiler to generate electricity for the steam turbine generator unit, which can replace the equivalent electricity of the main coal-fired power plants, thus avoiding the greenhouse gas emissions caused by the corresponding electricity generated by thermal power generation, and achieving greenhouse gas emission reduction;

(2) Reduced discharge of pollutants: After the project adopts the incineration method to treat the waste, the waste reduction reaches about 85%. At the same time, the implementation of the project will eliminate the secondary pollution such as sewage and waste gas produced by the original simple landfill site, improve the environmental quality, and benefit the health of residents and the improvement of environmental quality, which has huge environmental benefits;

(3) Increase employment opportunities: The construction and operation of WtE Power Plant Project can increase employment opportunities, promote the transfer of labor force, improve the living standards of local residents, and generate good social benefits.

## Appendix O: Cultural Heritage Chance Find Procedure

Cultural property includes monuments, structures, works of art, or sites of significant points of view, and are defined as sites and structures having archaeological, historical, architectural, or religious significance, and natural sites with cultural values. During the project induction meeting, all contractors will be made aware of the presence of an on-site archaeologist who will monitor earthmoving and excavation activities.

The initial phase of the proposed emergency reconstruction operations poses limited risks in damaging cultural property since sub-projects will largely consist of small investments in community infrastructure and income-generating activities, reconstruction of existing structures, and minor public works. Further, it is understood by the Consultant that any activity that would adversely impact cultural property would make a subproject ineligible. Nevertheless, the Consultant will check that the following procedures for identification, protection from theft, and treatment of discovered artifacts should be followed if archaeological material is discovered:

- Stop all construction activities in the area of the chance find.
- Delineate the discovered site or area.
- Record the found location, and all remains are to be left in place.
- Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the Department of Archaeology immediately (within 24 hours or less);
- Notify the supervisory Engineer who in turn will notify the responsible local authorities and the Ministry of Culture (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include aesthetic, historic, scientific, or research, and social and economic values.
- Decisions on how to handle the findings shall be taken by the responsible authorities and the Ministry of Culture. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration, and salvage.
- Implementation of the authority decision concerning the management of the finding shall be communicated in writing by the Department of Archaeology.
- Construction work could resume only after permission is given from the responsible local authorities and the Department of Archaeology concerning the safeguarding of the heritage.
- The Consultant will ensure that during project supervision, the Site engineer will monitor the above regulations relating to the treatment of any chance find encountered and observed.

## **Appendix P: Incineration system process and combustion control Instructions**

### **1. Incineration system process and combustion control Instructions**

#### **1.1 Overview of incineration process**

Municipal domestic waste is stored in the garbage pit and then sent to the garbage hopper for hygienic, reasonable and economical incineration treatment, which realizes the reduction of garbage volume and energy recovery, and at the same time realizes the harmless and stable garbage below the pollutant discharge and dissolution limit values change. It can prevent secondary pollution without affecting the surrounding residents, society and the natural environment.

Considering the characteristics of waste in this project, the following design is adopted in order to deal with waste with low calorific value.

- 1) primary air is heated up to 220°C by the steam air preheater.
- 2) In order to fully mix and burn the reducing gas generated by the burning of garbage on the grate and adjust the temperature of the furnace, the secondary air is injected into the most suitable part of the back arch of the incineration furnace.
- 3) The side furnace wall of the incinerator adopts an air-cooled furnace wall.
- 4) There is a drop between each segment of the grate.

##### **1.1.1 Waste feeding system**

This system uses the garbage grab crane to put the garbage into the hopper and transport the garbage to the grate continuously and safely. The system is composed of the following machinery and equipment:

- garbage hopper
- Hopper baffle and bridge breaking device
- Garbage chute
- pusher
- connection expansion joint
- Level detector
- Water cooling jacket

Features of machinery and equipment: Appropriate measures have been taken for the garbage hopper to make it anti-collision, corrosion-resistant, and wear-resistant; advanced designs have been adopted for bridge breaking devices and pushers.

The garbage in the hopper is sent to the pusher through the garbage chute arranged at the bottom. In the design, it is fully considered to avoid the occurrence of bridges between garbage hoppers and chute pipes, so as to keep the material supply smooth.

In order to make the pusher continuously and stably feed the grate, the speed of the hydraulic cylinder is controlled by continuous flow, and it makes repeated reciprocating movements.

##### **1.1.2 Grate system**

###### **1.1.2.1 Grate**

This system sends the garbage sent by the pusher to the slag hopper while burning on the grate. In order to fully burn the garbage, its delivery speed is controlled by the automatic combustion control system. Garbage is dried on the drying grate, burnt on the burning grate, and completely embers on the ember grate. The system consists of the following equipment:

- drying grate
- combustion grate
- Ember Grate \_
- Combustion device control cabinet
- Furnace pressure measuring device.
- Grate thermocouple
- Grate cooling device
- grate lubrication equipment

The grate is composed of movable furnace arrangement and fixed furnace arrangement. The movable grate and the fixed grate are alternately arranged in a row of movable and fixed rows, and the movable grate moves forward and backward repeatedly. As a result, the garbage is gradually transported downstream while being burned. The grate is divided into two rows, and the drying, burning and embering grates are respectively driven by 4 hydraulic cylinders at constant speed, and the action interval is controlled by ACC. According to calculations, the mechanical load of this project when processing 750t of waste per day in a single furnace is 269.95 kg/m<sup>2</sup>h.

The pressure in the two furnaces of each incinerator is measured by the differential pressure transmitter, and the DCS continuously monitors it. At the same time, in order not to let the high-temperature flue gas in the incinerator leak out of the furnace, the inlet baffle of the induced draft fan and the speed of the induced draft fan are controlled to keep the furnace at a negative pressure.

If the grate body is used in a temperature range above 450°C for a long time, corrosion will be accelerated due to the alkali in the garbage and incineration residue. Therefore, in order to monitor the combustion state, thermocouples are installed on the grate plate in the combustion grate area to measure the temperature of the grate surface. When the temperature rises, the operation method of increasing the thickness of the garbage layer to reduce the influence of radiant heat and increasing the combustion air to improve the cooling effect is adopted.

The primary air passes through the slag hopper under the grate to cool the grate plate. The primary air is evenly blown out from the ventilation holes arranged between the movable grate and the fixed grate and on the grate sheet.

The grate surface temperature detector is set on the combustion grate, and its status is always monitored by DCS. If there is an H alarm sent to DCS, manually adjust the primary air volume, combustion air temperature, combustion load, etc.

#### **1.1.2.2 Incinerator system**

This system is set up to incinerate the garbage stably and discharge the slag to the slag remover. The system consists of the following equipment and subsystems:

- Incinerator body
- refractory material
- Insulation Materials
- The slag hopper under the grate and the primary air duct
- Secondary air duct and nozzle
- Dross pipe
- Furnace Flame Monitor
- Sensors and Transmitters
- Ignition and Auxiliary Combustion Systems

##### **(1) Incinerator body**

- a. The incinerator consists of grates, boiler water pipes and refractory brick walls. To avoid high temperature and flue gas corrosion, boiler water pipes are covered with refractory materials.
- b. On the basis of considering the flue gas flow pattern, determine the shape of the furnace body. The combustion chamber has sufficient volume to meet the combustion heat load and improve combustion efficiency. In view of the large variation of the calorific value of waste in this project, the design of the front and rear arches can maximize the drying of garbage through radiation, which is conducive to the stability of combustion. The flue gas generated by this project under rated working conditions is 150,000 m<sup>3</sup>/h, in order to achieve complete combustion and ensure that the flue gas temperature of a flue is 850 °C for more than 2s, the flow rate of flue gas is basically controlled at 3~4m/s, according to which, the design volume of the furnace volume of this project is about 468 m<sup>3</sup>.
- c. Furnace steel structure has sufficient strength.

## **(2) Refractory material**

- a. According to long-term accumulated experience, various suitable refractory materials are selected in consideration of the required heat resistance, wear resistance and heat transfer rate of each part of the furnace body.
- b. Use silicon carbide refractory castables with good wear resistance in places where the furnace wall on the side of the pusher, the bottom of the side wall above the grate, etc. are in contact with slag and garbage.
- c. Taking into account the reduction of flue gas volume due to the reduction of ventilation when the heat load is high (increase the heat recovery of the boiler water wall to increase the boiler efficiency) and the temperature of the flue gas should be kept above 850°C for 2 seconds when the heat load is low (Adjust the heat recovery of the water wall of the boiler to reduce the combustion point), so silicon carbide refractory is used in the first flue of the boiler.

## **(3) Primary air duct**

- a. In order to prevent the spread of bad smell, the primary air is drawn from the upper part of the garbage pit, and then supplied to the furnace with sufficient pressure from the bottom of each grate. The pressure of the primary air is detected at the outlet of the steam air preheater.
- b. The primary air is heated to the required temperature by the steam air preheater. The set point for this temperature is determined by ACC.
- c. The air volume provided to each grate is determined by the ACC according to the amount of garbage, steam, and excess air coefficient, and is controlled by each damper.

## **(4) Secondary air duct and nozzle**

- a. is sprayed into the incinerator through nozzles installed on the front wall of the furnace body and the first partition wall at the nose of the waste heat boiler. The function of the secondary air is to prevent abnormal high temperature in the furnace, provide suitable oxygen concentration and properly mix combustible gas. To prevent thermal damage to the secondary air nozzles, a minimum secondary air volume is always maintained.
- b. In order to fully mix the combustion air with the flue gas, and make the flue gas burn completely, secondary air is injected through rows of nozzles. The secondary air is extracted from the incineration room and sent to the front and rear walls of the first flue of the combustion chamber by a variable frequency secondary air fan so as to enhance the disturbance so that the gas generated in the waste incineration process can be completely burned, and the flue gas can stay at 850°C for more than 2 seconds to ensure the complete decomposition of dioxin. The amount of secondary air injected into the incinerator is

determined according to the actual temperature measured by the thermocouple in the furnace and the oxygen concentration at the outlet of the economizer.

**(5) Furnace flame monitor**

The flame in the furnace is monitored by a CCTV camera installed on the back wall of the incinerator, and the signal is sent to the monitor in the central control room.

Air-cooling is used to prevent thermal damage to the camera, and the camera is cleaned by air blowing. In addition, the installation position of the camera also considers that it can observe the combustion state well and be least affected by slag dust.

**(6) Sensors and Transmitters**

Process data signals such as the temperature in the furnace measured by the sensor, the oxygen concentration at the outlet of the economizer, and the thickness of the garbage layer are input to the ACC.

**1.1.3 Combustion system**

**a) Pilot burner**

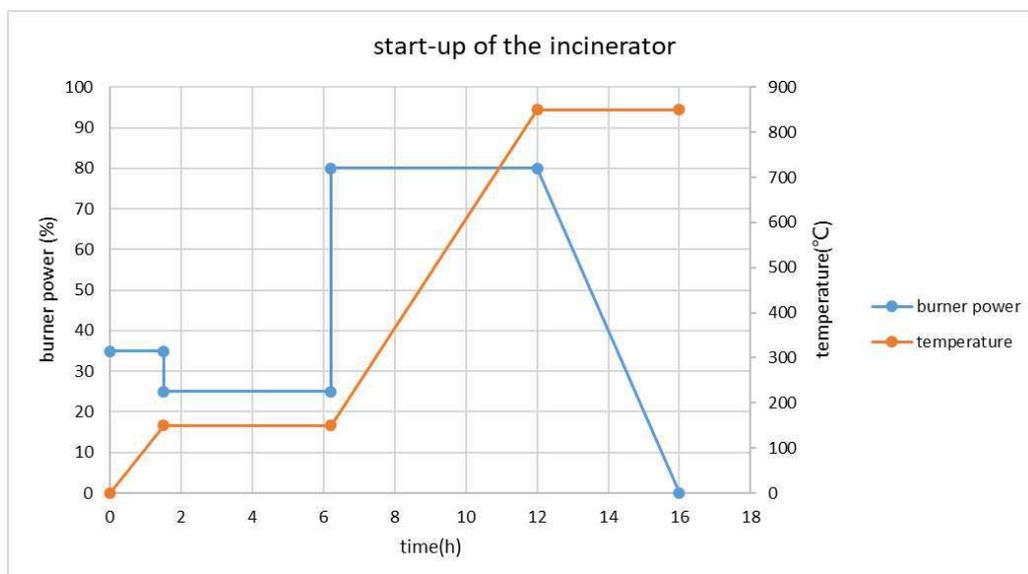
This system is set up to increase the furnace temperature when the incinerator is started. Consists of the following equipment:

- ignition burner
- Piping, Valves and Instrumentation
- pilot burner control panel

The system operation and control method is as follows:

1. The ignition burner has a heating capacity of 11.8 MW/unit, the fuel used is 0# diesel oil , and one unit is installed for each furnace.

The time required for the boiler to go from cold start-up to normal operating temperature is about 16 hours, as shown in the figure below.



## **b) Auxiliary burner**

- This system is set up to increase the temperature in the furnace during the start-up stage and maintain the temperature when the temperature in the furnace is lowered .
  - The heating capacity, operation and control principle of the auxiliary burner are the same as those of the pilot burner. The main difference is the installation location and the auxiliary burner has the function of automatic ignition when the temperature in the furnace decreases. The two points are described as follows.
1. The heating capacity of the auxiliary burner is 17.7 MW/unit, and the fuel is 0# light diesel oil.
  2. Auxiliary burners are installed on the side wall of the first flue of the boiler, and two are installed for each boiler.

### **1.1.4 Combustion air system**

Combustion air system is mainly composed of primary air fan, secondary air fan, filter screen, air preheater, etc. The primary air is heated to 160°C~220°C by steam air preheater, and it is supplied from under the grate in sections. Secondary air is injected from the front and rear arches of the incinerator to enhance the disturbance of flue gas so that the air and flue gas can be fully mixed and the waste can be burned more thoroughly.

#### **1.1.4.1 Primary air system**

This equipment is designed to provide primary air to the incinerator and preheat the primary air to the required temperature according to the calorific value of the garbage. It consists of the following equipment and auxiliary systems.

- Primary fan
- Primary air preheater
- Primary air control damper
- Duct

#### **(1) Primary air fan**

- 1) The primary air fan is a single-side suction centrifugal fan controlled by frequency conversion.
- 2) The primary air fan sucks air from the garbage pit and uses it as combustion air to provide air to each grate from the slag hopper under the grate. In order to prevent damage to the equipment caused by inhalation of foreign matter, a metal mesh is installed at the suction port of the garbage pit.
- 3) The start and stop of the primary fan are controlled by DCS or locally. When starting, if the opening of the primary air door exceeds 5% or the speed of the fan is above 10% of the rated speed, the safety interlock will prevent the fan from starting to protect the motor and prevent overload.

#### **(2) Primary air preheater**

In order to preheat the primary air, a primary air preheater is provided. The preheater is a four-stage type, using steam drum extraction and steam turbine extraction as heating steam sources. The heat exchange surface of the preheater adopts fin type.

#### **(3) Primary air control damper**

Flow meters and ACC automatic dampers are installed at the inlets of each flow control damper. ACC calculates the required air volume according to the combustion state and steam volume. Therefore, the

damper can adopt linkage/automatic/manual control. The manual actuator can adjust the distribution ratio of the air volume.

In addition to the above-mentioned functions, in order to minimize the heat loss, the air volume control damper of the ember grate is automatically controlled according to the temperature of the upper part of the ember grate.

#### **(4) Air duct**

The air velocity in the air duct shall not exceed 20m/s.

#### **1.1.4.2 Secondary air system**

This equipment is a device for supplying air into the furnace for complete combustion of combustible gas, adjustment of temperature in the furnace and control of oxygen content at the boiler outlet. Consists of the following equipment and auxiliary systems.

- Secondary air fan
- Duct

#### **(1) Secondary fan**

- 1) The secondary air fan is a single-side suction centrifugal fan controlled by frequency conversion.
- 2) The secondary air fan sucks air from the vicinity of the incinerator chamber and the exit of the slag remover and supplies it to the furnace through the secondary air nozzle. In order to avoid inhalation of foreign matter that damages the machine, a metal mesh is installed at each suction port.
- 3) The start and stop of the secondary air fan is controlled by DCS or locally. When starting, if the opening of the secondary air door exceeds 5% or the speed of the fan is above 10% of the rated speed, the safety interlock will prevent the fan from starting to protect the motor and prevent overload.
- 4) The secondary air flow is controlled by the secondary air fan frequency converter which is linked with the temperature in the incinerator and operated by the secondary air flow controller. This air volume is measured at the secondary air fan inlet.

#### **(2) Duct**

The air velocity in the air duct shall not exceed 15m/s.

#### **1.1.5 Induced draft fan system**

During garbage incineration, due to the instability of the calorific value of garbage into the furnace, the furnace pressure will fluctuate within a certain range, and the induced draft fan is equipped with a frequency conversion speed regulation device, which can adjust the speed of the induced draft fan according to the negative pressure of the furnace, so as to adjust the air volume and wind pressure of the induced draft fan. When the primary air volume is large, the combustion is violent, and the negative pressure of the incinerator is positive, the furnace is easy to spray dust outward, which not only affects environmental hygiene, but also may endanger the safety of equipment and operators, at this time the frequency of the induced draft fan can be adjusted to increase the output of the induced draft fan. When the negative pressure of the furnace pressure is large, the air leakage volume of the furnace increases, the flue gas flow rate increases, and the power consumption and flue gas heat loss of the induced draft fan are increased, and the frequency of the induced draft fan can be reduced and the output of the induced draft fan can be reduced. During operation, the negative pressure of the waste incinerator furnace is controlled between -30~-50Pa.

### 1.1.6 Methods of cooling the furnace and flue gas

The grate adopts the form of air cooling, and the combustion air enters the burning fuel layer through the gap between the ventilation hole on the grate block and the grate piece, which can not only ensure that the combustion air is blown out evenly, but also cool the grate piece to prevent the grate piece from burning.

In order to avoid coking on the side wall of the incinerator due to excessive temperature during garbage combustion, the side wall of the incinerator adopts an air-cooled wall structure. The incinerator cooling air fan draws in the cooling air from the boiler room, supplies it to the air chamber of the air cooling wall, and then the cooling air is exhausted from the air chamber by the cooling air induced draft fan. The temperature of the incinerator side wall is reduced by cooling the air.

The front and rear arches of the incinerator are designed with water-cooled walls, which can effectively reduce the temperature of the front and rear arches and prevent the coking of the front and rear arches. Each incinerator is equipped with a set of waste heat boiler, the flue gas generated by the incinerator enters the waste heat boiler for heat exchange, and the high-temperature flue gas enters the flue gas purification device at an exhaust gas temperature of 190 °C after heat exchange.

### 1.1.7 Slag conveying system

The system is designed to convey the slag discharged from the ember grate to the slag pit. Consists of the following equipment:

- Grate slag conveyor
- Grate slag baffle
- Dross pipe and chute
- Slag machine

Slag is produced during waste incineration, and most of the slag that is larger than the gap between the grates is pushed to the ember grate, discharged from the rear of the incinerator, and falls into the slag discharger. The slag falling from the grate gap is introduced into the slag conveyor through the slag hopper and the slide pipe at the bottom of the grate and sent to the slag discharger by the conveyor. These slags and slags are cooled by a water-filled slag extractor and transported to the slag pit.

## 1.2 Automatic combustion control system

### 1) Overview

According to the parameters of various media such as garbage, primary air, secondary air, flue gas, boiler feed water, and main steam, the combustion process of the incinerator-waste heat boiler can be automatically controlled, and the whole process control from ignition to shutdown can be realized.

- a. The optimized design of the incinerator structure and the mature automatic combustion control (ACC) system will be able to cope with a variety of severe operating conditions. The grate of this project is divided into a three-stage design, namely a drying grate, a combustion grate and an ember grate, with a drop of about 1.3m between each section. When the garbage forms a lump during the combustion process, the drop section plays a very favorable role in the flipping and crushing of the garbage, and at the same time, the disturbance and dispersion of the garbage can be realized by controlling the movement speed of the active grate.
- b. When the furnace temperature is too high during operation, the furnace temperature can be adjusted by reducing the primary air temperature, increasing the secondary air volume, and reducing the running speed of the ejector.
- c. The grate sheet material is high chromium heat-resistant cast steel (chromium content greater than

- 20%) widely used in current European incineration plants, which has strong wear and corrosion resistance, can withstand high mechanical strength, and has a low average annual replacement rate. The grate piece structure design is ingenious, the grate piece adopts buckle design, convenient for maintenance, if a few grate pieces are found to be worn during the shutdown period, and need to be replaced, the replacement operation can be completed by a single person, which is convenient and fast.
- d. In the normal operation process, when the grate is not in place within the established time due to the grate mechanical jamming, cylinder limit guide rail and supporting limit switch failure, etc., the ACC automatic control system can automatically monitor the location of the grate with delay problem, and simultaneously carry out local (PLC cabinet side) and remote (DCS operation screen side) sound and light alarm. At this point, the ACC system can automatically suspend the grate where the problem occurred, while the grate in other locations can still operate normally. When the field fault is eliminated, the operator can perform the reset operation through the local or remote fault reset button. After reset, grates with delayed action can resume normal operation.
  - e. The grate area of this project is designed with a large margin, the mechanical load of the grate is small, the grate overload capacity is strong, and continuous and stable combustion can be achieved at the same time. The garbage stays in the incinerator for up to 1.5~2.5h, which can ensure the complete combustion of the garbage. When the waste supply exceeds the rated mechanical load during operation, the feedback layer thickness can be monitored through the differential pressure of the material layer, and the ACC control system will reduce the feeding speed of the ejector and the movement speed of the drying grate in time to achieve combustion stability.
  - f. Equipped with mature ACC automatic combustion control system. ACC is equipped to maintain a pre-set amount of evaporation. Mainly by adjusting the grate speed, the layer thickness of garbage and the amount of garbage disposal are stable; In addition, by adjusting the amount of combustion air, the evaporation amount is controlled at a certain level. It has the following advantages:
    - ◆ Constant steam evaporation: efficient use of energy
    - ◆ Stabilize furnace temperature: Reduces NO<sub>x</sub> occurrence and reduces refractory damage
    - ◆ Thermal burn minimization: Prevents secondary contamination
    - ◆ Averaging of garbage disposal
    - ◆ Reduced operator: Relatively simple operation and control

## 2) Design functional requirements:

- a. Each incineration line is equipped with an independent combustion automatic control system.
- b. Measure and record the parameters of waste heat boiler, such as steam flow, pressure and temperature.
- c. Measure and record the flue gas temperature at each heating surface of the combustion chamber and waste heat boiler.
- d. Measure the oxygen content in the flue gas.
- e. Adjust the amount of garbage feeding.
- f. Adjust the moving speed of the grate.
- g. Interlock protections for personal and equipment safety.
- h. Measure the thickness of the grate garbage or/and the primary air pressure under the hearth.
- i. Adjust the air volume, temperature, and proportion of the air supply, such as primary air, secondary air, etc.

- j. The automatic combustion control system shall adopt an independent PLC control system and incorporate it into the DCS of the whole plant, and the performance shall be guaranteed by the bidder.
- k. The central control room can get the following signals:
  - all alarms
  - device status
  - Motor starting and stopping.
  - Location of drives, dampers, and valves
  - Measured parameters (such as temperature, pressure, material level, flow, etc.)
  - Can start and stop equipment.
  - Ability to switch dampers and valves.
  - Parameters that can be changed
  - Can change the parameters of each control part (such as grate, feeding, slag discharger)

### **3) Scheme description of combustion control system**

In order to control, operate, and monitor the combustion of the incinerator, an automatic combustion control (ACC) system is installed.

A series of processes of drying, burning and embers of the garbage are completed on the grate, and the garbage on the grate is stirred and mixed by the movement of the movable grate pieces. The incinerator is equipped with a drying grate, a burning grate, and an embering grate. The garbage is dried on the drying grate by the primary air and the radiant heat of the incineration furnace. Combustion in the first stage of the embering grate, and the second stage of the embering grate makes use of the residual heat in the slag and cools the slag. Burning and embers provide favorable conditions. There are a large number of unstable components in the garbage, and the solid phase combustion of the garbage occurs on the grate, and other components are burned out in the process of passing through the combustion chamber after being separated from the garbage by heating. Since the garbage contains a certain proportion of sandstone and unstable components, and the distribution on the grate is uneven, it is easy to cause unstable combustion and produce partially incompletely burned smoke. The high-speed secondary air is mixed and disturbed to prolong the flue gas combustion journey, so that the garbage can be completely burned.

In order to realize the control of garbage burning, it is necessary to control the primary fan, secondary fan and the negative pressure of the incinerator, control the running speed of the garbage pusher, control the operating cycle of the drying grate, combustion grate, and ember grate, and control The thickness of the garbage layer, the burning position of the garbage, the heat loss rate, the O<sub>2</sub> concentration in the flue gas, etc. According to different garbage characteristics and different seasonal garbage calorific value changes, the ACC system has set up different control methods to adapt to the stable operation of various working conditions. The following briefly discusses the automatic combustion control (ACC) system:

#### **(a) Thickness control of garbage material layer**

The thickness control of the waste material layer is realized by automatically adjusting the speed of the pusher and the operating cycle of the grate, and the feeding of the incinerator is coordinated and controlled by the set value of the main steam volume of the waste heat boiler, the heat value of waste, and the specific gravity of waste. System to ensure that the thickness of the garbage material layer tends to be stable. The thickness of the garbage material layer can be obtained by calculating the pressure difference between the upper part of the garbage on the fire grate and the supply air flow of the next wind of the fire grate.

#### **(b) Primary air and secondary air temperature control**

The LHV value of garbage also affects the temperature of primary air and secondary air required for waste incineration. In order to improve the combustion efficiency of garbage, the combustion air is heated to the design temperature through the air preheater, and the combustion air temperature is controlled by single-loop PID control.

#### **(c) Main steam flow control**

Steam flow of the boiler at the set value by adjusting the flow of combustion air supplied to the combustion grate. The primary air volume control loop is to ensure the economy of the waste burning process. In order to ensure the economy of the combustion process, the amount of garbage and air volume have a suitable ratio in the combustion process.

According to the characteristics of the incinerator in this project, the next air system supply of the grate adopts the independent air distribution method of each air chamber. The opening of each primary air branch pipe regulating valve under the grate directly affects the primary air supply of the incinerator. The ACC system calculates the total primary air flow rate based on different waste calorific value, waste feeding amount and main steam flow set value. In different combustion conditions or seasonal changes, it is distributed to each air chamber under the grate in different proportions, and the measured value of the primary air flow meter at the entrance of each air chamber under the fire grate is compared with the air volume of the air chamber allocated by the ACC system in a single circuit PID control is used to adjust the opening of the air door baffle to promote the scientific and complete combustion of garbage; at the same time, the difference between the detected value and the set value of the main steam flow directly affects the total flow supplied by the primary air system .

#### **(d) Waste burning position control and heat loss minimization control**

Due to the quality of the garbage, the burning position of the garbage on the main grate tends to move, and the burning position also moves. For example, when the lower heating value (LHV) of the waste decreases, the burning position of the waste on the main grate will move downstream. The garbage burning position control can control the burning and embers of the garbage to a proper position on the grate. Garbage combustion position control, by measuring the temperature of the upper part of the ember grate, to adjust the moving speed of the main grate, so that the combustion and ember of garbage can be maintained in a suitable position range.

#### **(e) Oxygen concentration control in flue gas**

O<sub>2</sub> concentration in the flue gas. When the air is insufficient, the CO concentration in the flue gas will rise, and the O<sub>2</sub> concentration will drop. The O<sub>2</sub> concentration control in the flue gas can well control the compliance and emission of pollutants in the flue gas. The O<sub>2</sub> concentration control in the flue gas is achieved by adjusting the flow of secondary air and the supply of the next air flow of the ember grate. Maintain the O<sub>2</sub> concentration at the set value.

#### **(f) Furnace flue gas temperature control (850°C, 2S)**

Maintaining a stable temperature in the furnace can well maintain the stable output of boiler steam and reduce the emission of pollutants; by adjusting the secondary air flow and automatically starting and stopping to maintain the temperature in the furnace at the set value, in order to make The amount of dioxin produced by combustion in the furnace is minimized, and the flue gas temperature must be kept within 850°C or higher for more than 2 seconds.



### 1.3 Description of Measuring Instrument

Field instruments are mature products with excellent performance and reliable technology. Field instruments include temperature instruments, pressure instruments, flow meters, etc. The field intelligent transmitter signal adopts 4 ~ 20mADC protocol communication signal.

The specific selection principles of temperature instruments are as follows:

#### Temperature Gauge

The waste incineration power generation industry uses contact-type temperature-measuring element thermocouples to measure the furnace temperature and flue temperature to ensure continuous and stable temperature measurement, control a reasonable furnace temperature range, improve combustion efficiency, and avoid secondary pollution caused by low-temperature combustion. Therefore, according to the special requirements of the medium and temperature, a special alloy material is selected for the protection tube of the thermocouple to prolong the service life of the thermocouple for about 6 months in a high temperature and corrosive environment. This scheme also takes into account that the replacement frequency is relatively reasonable. It is the most cost-effective choice for furnace and flue temperature measurement in the future operation period.

The remote thermometer selects thermal resistance or thermocouple according to the temperature measurement range, the thermal resistance selects Pt100 platinum thermal resistance, and the thermocouple selects thermocouples with different graduations according to the measurement temperature.

This project adopts thermocouple specifications: graduation number K, L=1150mm, d=Φ25, sheath GH3039, super-grade wear-resistant head using tungsten-cobalt alloy material (where cobalt content is required to be ≥43 %, hardness ≥45%) L=400, with anti-flange and installation accessories.

The temperature measurement method of the first flue in the furnace adopts 3 rows and 3 columns, a total of 9 temperature measurement points, and the probe insertion depth is 400mm.

The local thermometer adopts φ150mm radial or universal bimetal thermometer.



Control of pressure detection accuracy: the pressure measurement of the boiler part, the steam engine part, the common part of the main plant, the water system part and the power part adopts an intelligent transmitter with an accuracy of 0.075 to ensure the stability of the differential pressure measurement of the pressure cargo of each system.

In particular, the pressure measurement status of the furnace pressure, primary air and secondary air system of the boiler part is directly related to the combustion efficiency of the boiler system, controlling the reasonable combustion system pressure range, improving the combustion efficiency, and avoiding secondary pollution caused by unstable pressure combustion. Therefore, according to the special requirements of the system and the medium and temperature of each part of the plant, the membrane box and display unit of the core components of the intelligent transmitter are selected accordingly to extend the service life of the transmitter in a complex environment of about 24 months and ensure the stable operation of the equipment. For example, the flue gas pressure measurement value is small, and the intelligent differential pressure transmitter is used to measure the pressure value, and the differential pressure value of some air flow is small, and the intelligent differential pressure transmitter is more needed. The above solutions ensure the stability and economy of the future operation period.

## **Appendix Q: Special Report on Calorific Value of Furnace Waste Design Point**

### **1.1 Overview**

For the design of waste incineration plant, the determination of calorific value of design point for furnace waste is related to the operation efficiency and operation cost during the whole life period of incineration plant. If the design point is set too low, the waste disposal capacity will decrease in order to meet the heat load requirements of incinerator when the calorific value of the waste is high. If the incineration line still maintains the original design disposal capacity, it will lead to high incinerator temperature, incinerator chamber coking, reduced boiler heat surface life and other problems; Conversely, if the design point is set too high, the equipment design margin is too large, which not only leads to long-term low-level operation of the incinerator chamber volume heat load and reduced energy utilization efficiency, but also leads to increased initial equipment investment.

For local wastes in Dhaka, Bangladesh, the basic guiding ideology for determining the waste calorific value of design point is mainly as follows:

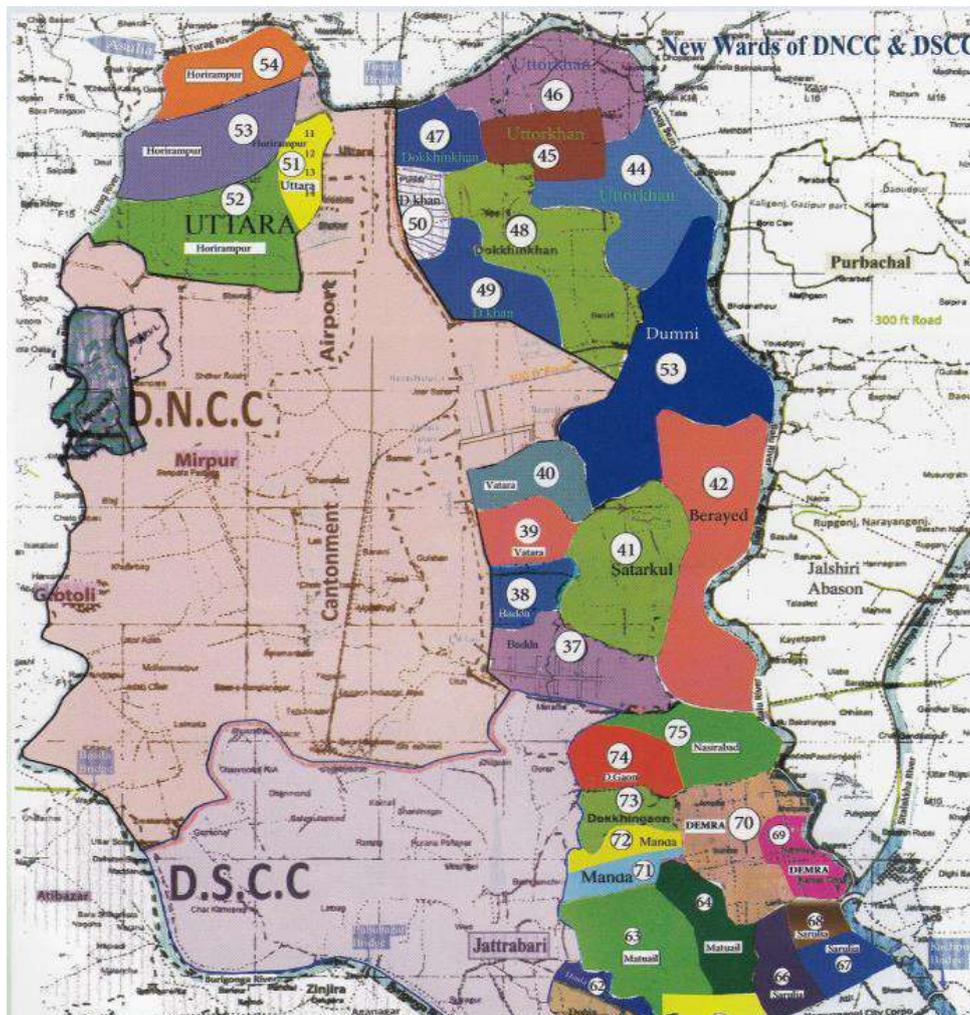
- (1) Through field investigation and observation of the waste compositions of local waste transfer stations and landfills, preliminary qualitative analysis is made:
- (2) By collecting the waste at different sampling points and analyzing the physical compositions, the detection report of raw wastes (including physical compositions, element analysis, industrial analysis, etc.) is obtained for data analysis, and the original judgment is justified by correcting the data through empirical method and contrast method.
- (3) After gravity compression, fermentation and dehydration in waste pond, the raw wastes become the final input fuel of incinerator, and the low calorific value at this stage is used as the design parameter of waste incinerator and waste heat boiler.

### **1.2 Collection of calorific value of raw wastes**

#### **1.2.1 Waste transfer in project service area**

The purpose of this project construction is to dispose of and accommodate waste within the DNCC's jurisdiction and complete the final disposal of waste. The specific jurisdiction is shown in the following figure. The DNCC has 54 wards divided into 10 large areas. The wards of No. 1 ~ 36 are old areas with an area of 83.68 square kilometers, which are divided into five large areas. wards of No. 37-54 were created in 2015 and included in the management of DNCC. These new 18 wards (113 km<sup>2</sup>) are divided into large areas of No. 6 to 10.

Figure 1: Areas governed by DNCC.



Note: The 37-54# areas marked with the serial numbers in the figure all belong to the jurisdiction of DNCC but are not included in this project. The above information is cited from < Dhaka North City Corporation Waste Report 2017-2018 >.

The purpose of the construction of this project is to absorb the household waste generated in the management area 1~36 in the DNCC jurisdiction. Administrative area 1~36 has an area of 83.68 square kilometers and is divided into 5 large regions, with a total population of about 4.4 million people.

According to the waste supply agreement of this project, the treatment capacity of this project is 3000 tons/day ~ 3600 tons/day, according to the empirical formula of the waste incineration industry, the amount of garbage is positively correlated with the proportion of population, that is,  $Q=R*C*A1*A2$ .

Thereinto:

R: The number of people that can be served by this project

Q: The maximum amount of garbage (tons) processed per day is 3600 tons

C: The average daily discharge (converted to: tons/person/day) is measured according to the predicted per capita waste generation of 0.0006 tons/person/d

A1: The uneven coefficient of garbage daily discharge is 1.1~1.15

A2: The coefficient of change of the resident population is 1.02~1.05

Taking into account the development of local urban management level in Bangladesh, in this planning forecast, it is proposed to take 1.12 for A1 and 1.03 for A2.

The calculation shows that  $R=3600/0.0006/1.12/1.03=5201109$ , that is, about 5.2 million people.

Based on the above calculations, we can conclude that the project can absorb up to 5.2 million people to generate household waste.

### 1.2.2 Current Status of MSW Output

See the table below for the per capita waste output at each collection sites and the amount of waste produced per day at each collection sites in DNCC from 2016 to 2019:

Collection site		The per capita waste output (kg/person. day)			Waste output at each collection sites (t/d)		
SL	Population	2016	2017	2018	2016	2017	2018
1	202,613	0.19	0.93	1.15	38.29	187.82	232.80
2	167,871	0.23	0.23	0.26	38.44	38.27	43.65
3	104,639	0.28	0.39	0.35	28.88	40.70	36.31
4	83,175	0.41	0.38	0.30	34.10	31.27	25.20
5	130,556	0.50	0.29	0.39	64.76	37.73	50.79
6	181,027	0.40	0.35	0.44	71.69	63.54	79.65
7	125,736	0.39	0.54	0.47	49.41	67.27	59.35
8	122,974	0.33	0.51	0.58	40.83	62.96	70.71
9	78,769	0.49	0.57	0.73	38.83	44.90	57.11
10	97,139	0.46	0.14	0.23	44.59	13.41	22.24
11	107,258	0.18	0.37	0.35	18.77	39.79	37.54
12	128,825	0.52	0.58	0.54	66.47	74.59	68.92
13	173,771	0.16	0.21	0.29	27.63	37.01	50.22
14	181,057	0.44	0.35	0.46	79.48	63.37	83.65
15	192,160	0.23	0.09	0.14	43.81	17.68	26.52
16	157,420	0.23	0.23	0.30	36.21	36.05	47.07
17	217,183	0.24	0.36	0.51	52.34	78.84	110.33
18	70,319	1.45	1.40	1.34	101.96	98.24	93.95
19	106,438	0.66	1.35	1.94	70.14	143.80	206.28
20	109,010	0.45	0.77	0.92	49.16	83.94	99.96
21	106,239	0.69	1.82	1.31	72.88	192.93	139.39
22	177,209	0.25	0.31	0.29	43.59	54.93	51.57
23	70,482	0.29	0.24	0.37	20.72	17.13	25.73
24	114,156	0.24	0.64	0.79	26.94	73.52	90.41
25	110,236	0.35	0.57	1.09	38.80	63.05	120.60
26	75,028	0.94	1.06	1.11	70.15	79.30	82.98
27	99,731	0.38	0.63	0.54	37.80	63.13	54.15
28	72,937	0.42	0.68	0.60	30.49	49.38	43.54

Collection site		The per capita waste output (kg/person. day)			Waste output at each collection sites (t/d)		
29	60,507	0.44	1.06	0.79	26.62	64.38	47.74
30	206,306	0.24	0.35	0.33	50.13	73.03	68.29
31	56,799	0.32	0.61	0.63	18.12	34.53	35.90
32	80,662	0.60	0.49	0.64	48.64	39.20	51.70
33	126,848	0.26	0.34	0.39	33.11	42.75	49.09
34	117,775	0.61	0.55	0.53	72.08	64.31	62.54
35	81,874	0.45	0.45	0.49	37.01	37.09	39.71
36	78,464	0.47	0.29	0.27	37.04	23.07	21.03

Remark: The above data come from DNCC report.

### 1.2.3 Quantity of solid waste generation and its weekly and seasonal variations.

The project company has collected data on the amount of waste entering the Aminbazar landfill for July~December 2021 and January~June 2022, as shown in the table below.

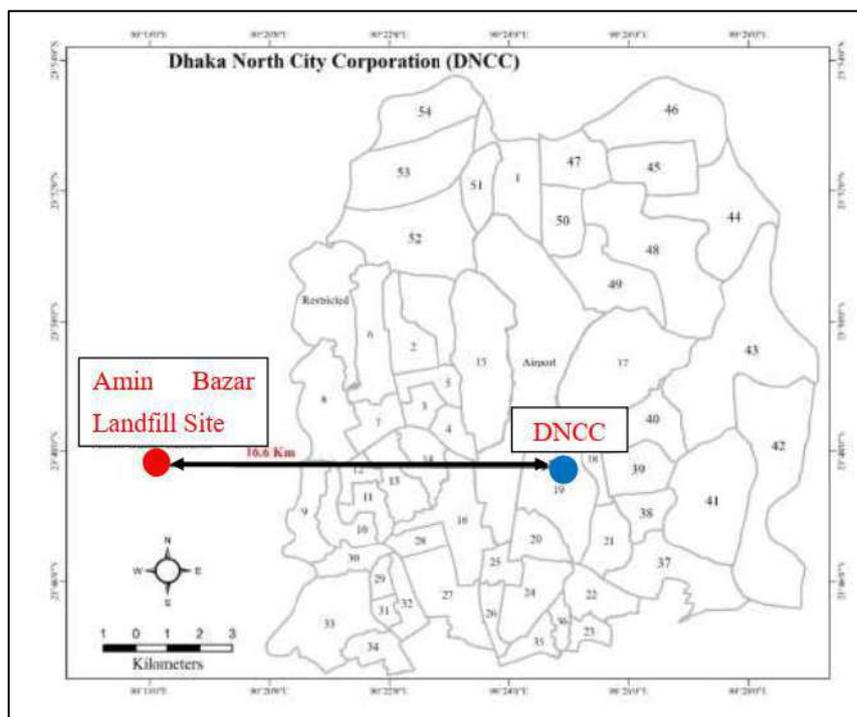
Table 1-Solid Waste Quantity Analysis

No	Items	Unit	2021											
			Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Waste/month	Tons/m	105226	97737	93780	100198	95591	96017	94523	82957	96306	106817	99941	117823
2	Vehicles/month	Units/m	19109	18037	17051	17727	17004	17024	16836	15149	17121	17887	17918	19368
3	Days	Days/m	31	31	30	31	30	31	31	28	31	30	31	30
4	Average Waste/d	Tons/d	3394	3153	3126	3232	3186	3097	3049	2963	3107	3561	3224	3927
5	Average Vehicles/d	Units/d	616	582	568	572	567	549	543	541	552	596	578	646

The above data collected by DNCC every month and sent to landfills is the real situation of solid waste generation and collection within the scope of this project's services. The above data show that landfill waste intake is higher during the rainy season than during the dry season. The average daily amount of garbage entering the garbage in 2021~2022 is 3250 tons, considering the garbage growth brought about by the population growth of the service area, this project predicts the amount of garbage entering the market after the construction period of 5~6 years to reach 3600 tons.

### 1.3 Field investigation

At the end of December 2019, our technicians conducted an investigation of municipal waste collection facilities and Amin Bazar landfill in Dhaka, Bangladesh. The distance between the urban center and the landfill is about 17km, and the spatial relationship between the two is shown in the figure below.



At present, the wastes in Dhaka urban area are first transported to the waste transfer stations by small manpower waste transportation vehicles, and then transported to the landfills by waste vehicles.

Through the field investigation of 3 DNCC waste transfer stations, it can be seen that there are still many plastic, paper, grass and wood compositions in Dhaka solid wastes, the real picture is as follows, and the wastes here mainly come from relatively prosperous downtowns, markets or residential areas for the rich.





There are many plastic products in the raw wastes of waste transfer stations, along with ashes and soil, which is in line with the relatively complex situation of waste compositions in developing countries.

The situation of field investigation at Amin Bazar landfill is different from that at the transfer station (as shown in the figure below). Fewer plastic products and more kitchen compositions (mostly fruit shells) are mixed in the wastes, and there are many waste pickers nearby, which is an important reason for reduced combustible compositions in the waste.

Figure 2: Raw wastes Transported to Landfill



Figure 3: Waste pickers collecting raw wastes



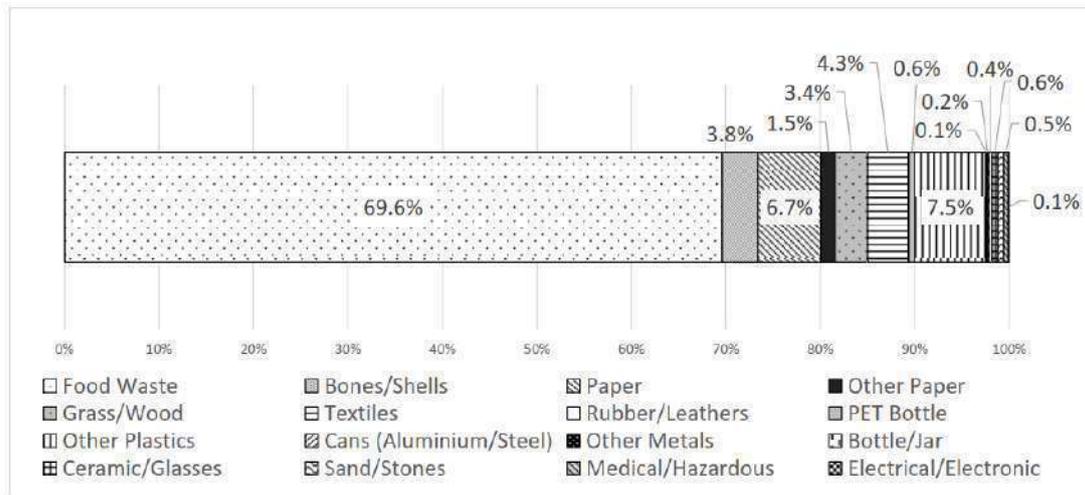
Through investigation, combined with the experience of environmental sanitation treatment in mainland China, the combustible component of the wastes in Amin Bazar landfill is generally low, and the calorific value of the raw wastes may be below 1,000 kcal/kg; While in the rich areas without waste pickers, the combustible component of the wastes urban transfer stations is relatively high, and the calorific value of the raw wastes may be in 1,000 ~ 1,400 kcal/kg.

### 1.4 Analysis of Waste Analysis Report

#### 1.4.1 Summary of Waste Quality Status

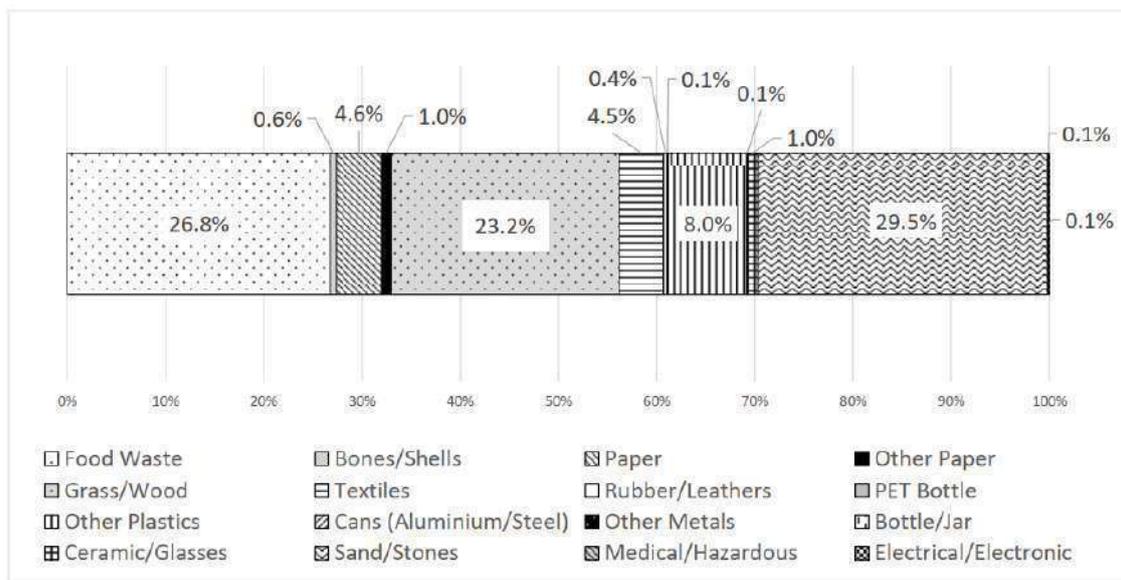
Considering the state of economic development in Dhaka, the capital city of Bangladesh, the calorific value of the wastes should be in the rising stage, but their compositions are still dominated by organic matters. According to the relevant contents in <DNCC SWM Masteplan 2018-2032>, the general waste quality status in four types of local places (homes, downtowns, markets, restaurants, and hotels) can be learned.

Figure 4: Basic compositions of household wastes



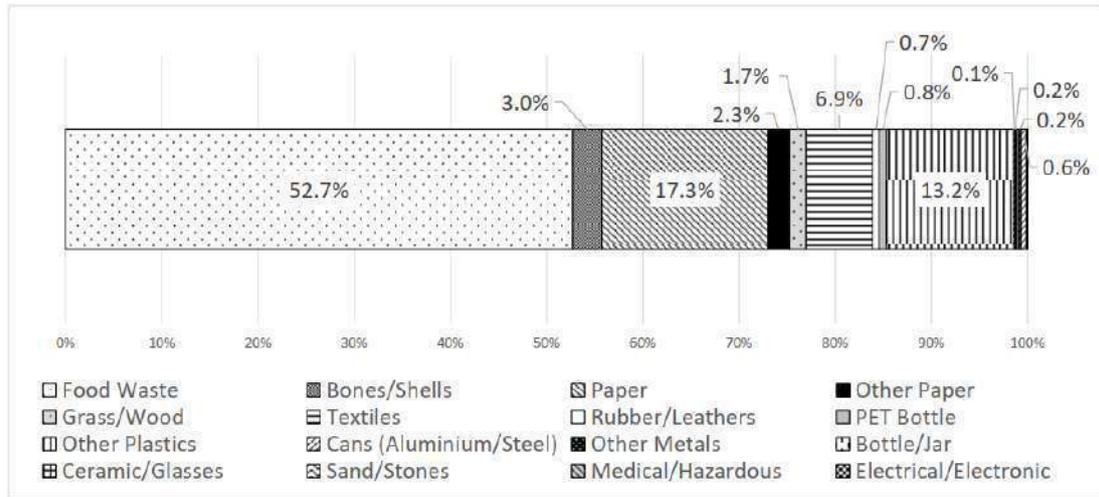
Source: DNCC SWM Masteplan 2018-2032

Figure 5: Basic compositions of downtown wastes



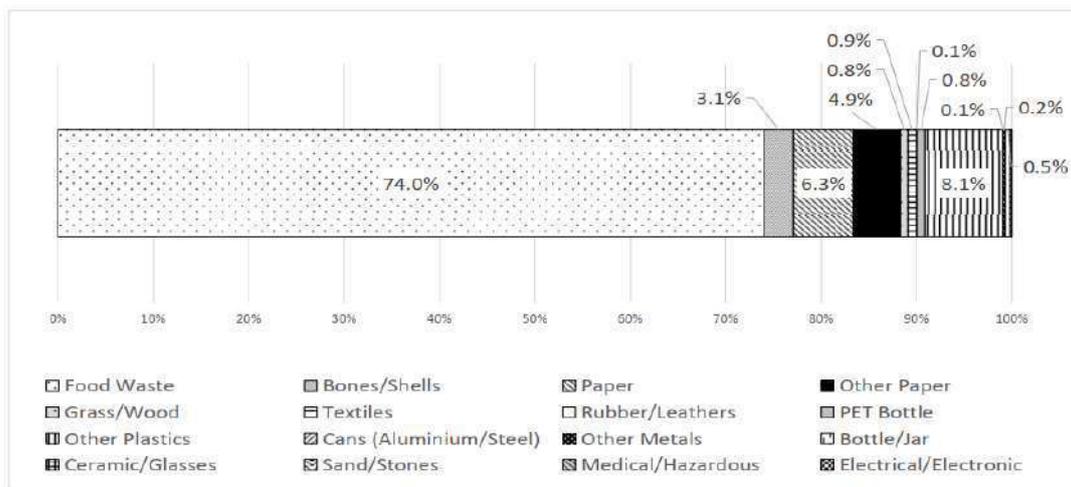
Source: DNCC SWM Masteplan 2018-2032

Figure 6: Basic compositions of market wastes



Source: DNCC SWM Mastepplan 2018-2032

Figure 7: Basic compositions of wastes in restaurants and hotels

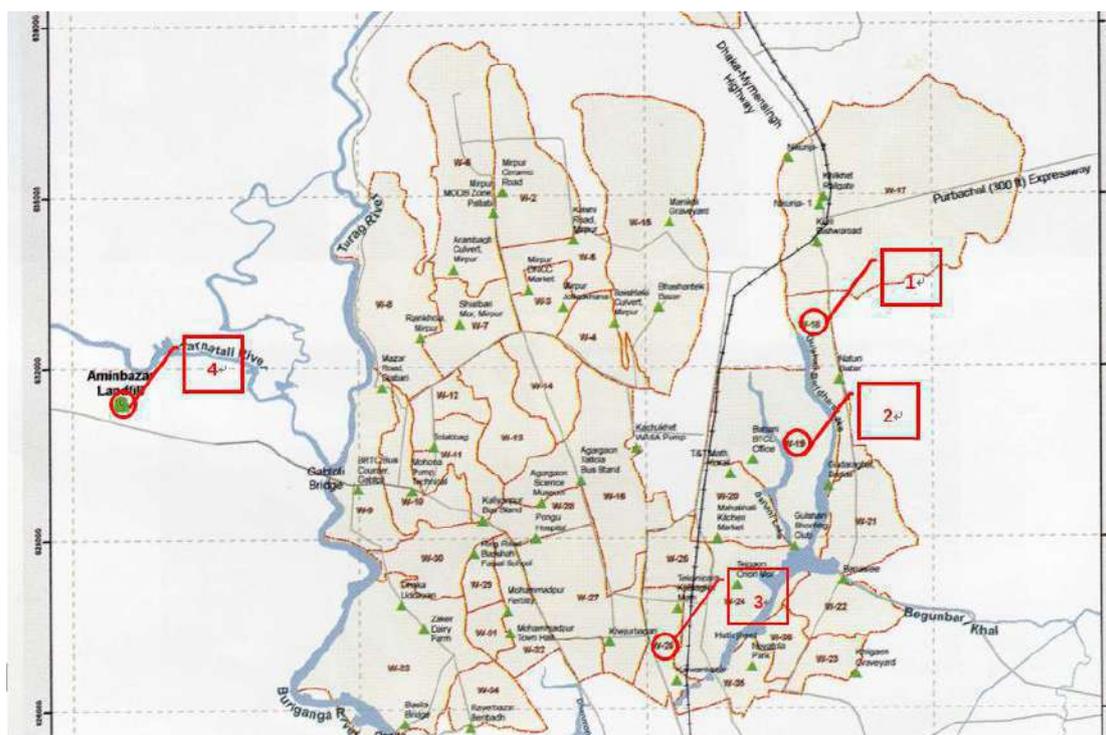


Source: DNCC SWM Mastepplan 2018-2032

Kitchen wastes in homes, restaurants, hotels and other places account for a high proportion, and the kitchen wastes compositions in market wastes are relatively few, but with more paper chips, glass ceramic products. The waste compositions in downtowns are more complex, with kitchen wastes, wood wastes and building materials wastes each accounting for certain proportions. In general, the waste quality conforms to the basic normal of less developed areas and has certain similarity with the waste quality of less developed cities outside the third-tier cities of mainland China.

#### 1.4.2 Brief introduction of waste sampling

In this project, several district transfer stations with large population density and median GDP per capita were selected as representative sampling points. The finally selected sampling points were: 18# district transfer station (STS, Gulshan 1, Sample 1), 19# district transfer station (STS, Notun Bazar, Sample 2), 26# district transfer station (STS, Indira Road, Sample 3) and landfill (Amin Bazar, Sample 4), which were representative. Specific locations are as follows:



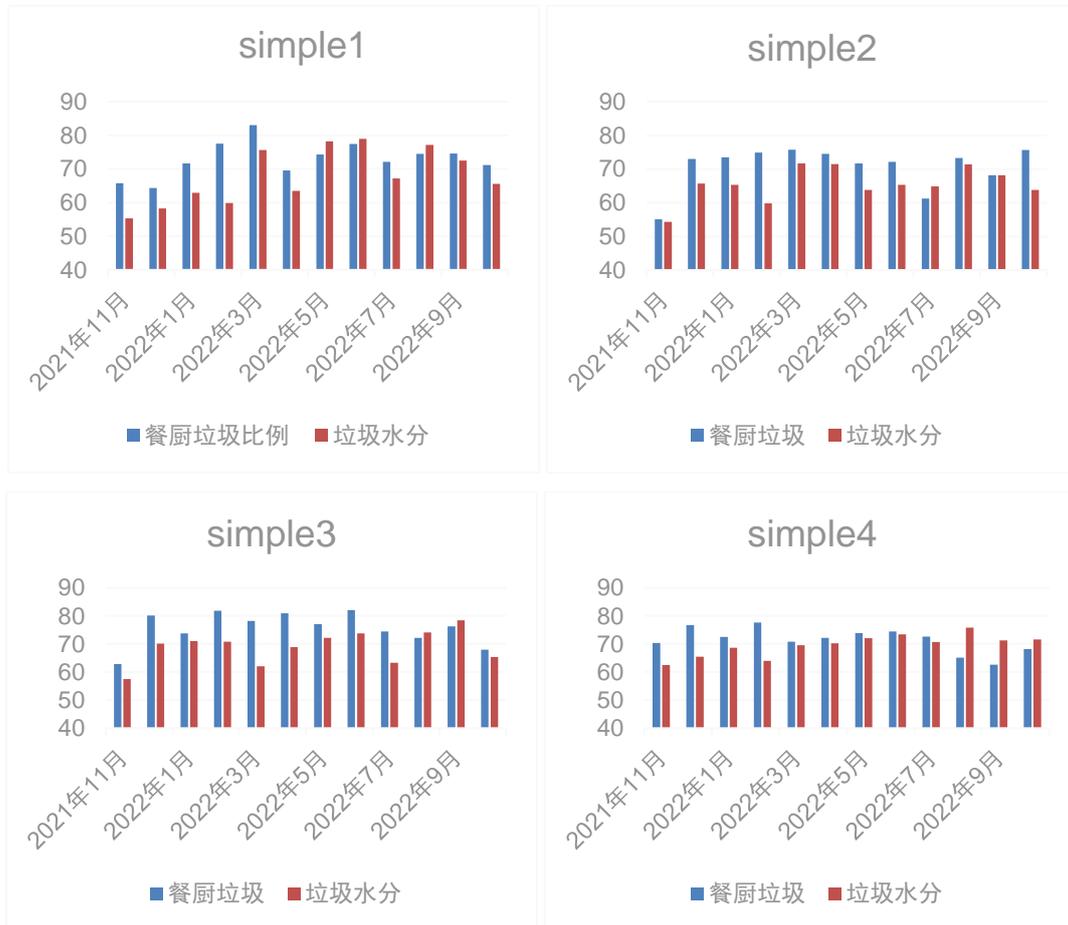
The sampling and analysis of solid wastes were performed on an annual basis, and the sampling frequency was suggested to be once a month. During the period when the waste compositions changed due to the environment, the sampling frequency was increased in some months. At this stage, the analysis reports of 12 times of waste sampling were received, which were 2020-11 (sampled on 8-11, November), 2020-12 (sampled on 27-30, December), 2021-01 (sampled on 3-6, January), 2021-02 (sampled on 7-10, February), 2021-03 (sampled on 7-13, March), 2021-04 (sampled on 3-7, April), 2021-05 (sampled on 8-14, June), 2021-06 (sampled on 19-22, June), 2021-07 (sampled on 14-18, July), 2021-08 (sampled on 24-29, August), 2021-09 (sampled on 12-15, September) and 2021-10 (sampled on 2-5, October). A total of 4 sampling points were set for each sampling. The physical compositions, industry analysis and element analysis are shown in the attached tables (see Attached Tables 1-12 for details).

### 1.4.3 Initial Analysis of Sampling Report

The 12 sampling reports mainly have two aspects of determination results: 1. Physical compositions: including kitchen wastes, rubbers and plastics (combustible component), wood (combustible component), textiles (combustible component), paper (combustible component), ash (ash component), metal (recyclable component) and other unexplored substances. The analysis standard of physical compositions is: ASTM D 5231, see the attachment of waste detection report for details. 2. Element analysis and industry analysis: including the mass percentages of moisture, ash content, carbon element, hydrogen element, nitrogen element, sulfur element, oxygen element and chlorine element as well as the high calorific value of dry bases. The analysis standards for element analysis and industry analysis are: ASTM E 871, ASTM D1102, ASTM E 711, ASTM E 777, ASTM E 778, ASTM E 775, ASTM E 870 and ASTM E 776, respectively. See the attachment of waste detection report for details.

All 12 reports reflect the characteristics of an extremely high proportion of kitchen wastes in local wastes, and the quality of kitchen wastes accounts for more than 55%, with the maximum up to more than 80%. At the same time, the moisture in waste industry analysis is also relatively high, with a fluctuation range between 55% and 70%. Empirically, there is a strong correlation between the two (as shown in the following figure), and the high kitchen waste content is the root cause of the high moisture in the wastes.

Figure 8: Relationship between moisture and proportion of kitchen wastes in previous samplings (November 2020 ~ October 2021)



Therefore, the basic conclusion can be obtained, the most important feature of the raw wastes collected from this batch of sampling points is that the kitchen wastes account for an extremely high proportion, resulting in a large proportion of moisture.

#### 1.4.4 Calculation of Low Calorific Value of Wet Base for raw wastes

Attached Tables 1~12 only indicate the high calorific value of the dry base, but the low calorific value of the wet base is more used as the design parameter of raw wastes in waste incineration project practice to fully consider the effect of moisture in wastes on combustion exothermicity (moisture absorbs heat during combustion and reduces the heating capacity of the fuel). Therefore, the corresponding conversion is required. The conversion coefficient only considers the effect of moisture. The relationship between the low calorific value of wet base and the high calorific value of dry base is shown in the formula.

$$Q_{\text{低(湿)}} = Q_{\text{高(干)}} \times (100 - \text{Mar}) / 100 - 25\text{Mar}$$

$$Q_{\text{low (wet)}} = Q_{\text{high (dry)}} \times (100 - \text{Mar}) / 100 - 25\text{Mar}$$

Where:

Q low (wet) - low calorific value of wet base, kJ/kg;

Q high (dry) - high calorific value of dry base, kJ/kg;

Mar — Moisture content in wet waste, %

Thus the corresponding low calorific values of the wet base (kcal/kg) can be obtained.

At the same time, the low calorific value of wet base of the wastes can also be approximated according to the industry analysis and element analysis results in Attached Tables 1~12 to check the measured calorific values. The calorific values of element analysis can be calculated using Mendeleev formula, which is as follows:

$$Q_{low} (wet) = 339C_{ar} + 1030H_{ar} - 109 (O_{ar} - S_{ar}) - 25M_{ar}$$

Where:

Q low (wet) - low calorific value of wet base, kJ/kg;

C<sub>ar</sub> - Carbon element content in wet wastes, %;

H<sub>ar</sub> - Hydrogen element content in wet wastes, %;

O<sub>ar</sub> - Oxygen element content in wet wastes, %;

S<sub>ar</sub> - Sulfur element content in wet wastes, %;

M<sub>ar</sub> - Moisture content in wet wastes, %

From this, the corresponding low calorific values of the wet base (kcal/kg) can be obtained.

The correlation analysis is shown in the table below

Sampling time 2020.11								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	39.88	17.83	41.05	18.77	40.01	17.00	39.74	14.92
H	5.95	2.66	6.11	2.79	5.83	2.48	5.94	2.23
O	42.06	18.81	34.67	15.85	38.47	16.34	37.62	14.12
N	1.49	0.67	1.20	0.55	1.33	0.56	1.44	0.54
S	0.11	0.05	0.10	0.05	0.14	0.06	0.10	0.04
Cl	2.01	0.90	0.61	0.28	0.84	0.36	0.83	0.31
A	8.50	3.80	16.26	7.44	13.38	5.68	14.33	5.38
W	0.00	55.29	0.00	54.27	0.00	57.52	0.00	62.46
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	20135	7620	16828	6339	18063	6235	15701	4333
Formula Calculation	15075	5358	16441	6162	15390	5100	15500	4257

Sampling time 2020.12								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet

C	34.61	14.44	40.19	13.79	38.17	11.40	41.57	14.35
H	5.10	2.13	6.11	2.10	5.66	1.69	6.42	2.22
O	37.27	15.55	31.93	10.96	45.54	13.60	40.35	13.93
N	1.30	0.54	1.30	0.45	1.59	0.47	1.46	0.50
S	0.09	0.04	0.06	0.02	0.11	0.03	0.06	0.02
Cl	0.60	0.25	0.52	0.18	0.43	0.13	0.47	0.16
A	21.03	8.77	19.89	6.82	8.50	2.54	9.67	3.34
W	0	58.29	0	65.69	0	70.14	0	65.48
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	16187	5294	17781	4458	17906	3593	19392	5057
Formula Calculation	12933	3937	16444	4000	13818	2372	16313	3994

Sampling time 2021.01								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	44.96	16.67	46.46	16.14	45.44	13.18	46.21	14.48
H	6.56	2.43	6.94	2.41	6.64	1.93	7.08	2.22
O	34.72	12.87	29.94	10.40	30.40	8.82	25.48	7.98
N	1.16	0.43	1.18	0.41	1.19	0.35	1.17	0.37
S	0.33	0.12	0.32	0.11	0.32	0.09	0.31	0.10
Cl	0.49	0.18	0.57	0.20	0.61	0.18	0.65	0.20
A	11.78	4.37	14.59	5.07	15.40	4.47	19.10	5.98
W	0	62.93	0	65.27	0	71	0	68.67
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	20392	5986	17541	4460	18636	3629	15024	2990
Formula Calculation	18250	5192	19670	5199	18965	3725	20214	4616

Sampling time 2021.02								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	46.28	18.57	50.05	20.10	46.62	13.59	47.08	16.96
H	7.12	2.86	7.67	3.08	7.10	2.07	7.08	2.55
O	16.96	6.81	27.71	11.13	32.76	9.55	15.86	5.71
N	2.06	0.83	1.97	0.79	2.11	0.61	2.23	0.80
S	0.10	0.04	0.10	0.04	0.10	0.03	0.10	0.04

CI	0.06	0.02	0.11	0.04	0.13	0.04	0.31	0.11
A	27.42	11.00	12.39	4.97	11.18	3.26	27.34	9.85
W	0	59.87	0	59.85	0	70.86	0	63.97
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	15783	4837	17549	5550	19247	3837	13166	3144
Formula Calculation	21185	7005	21858	7280	19557	3927	21535	6160

Sampling time 2021.03								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	37.38	9.10	43.12	12.23	43.34	16.46	44.66	13.58
H	5.54	1.35	6.24	1.77	6.28	2.39	6.38	1.94
O	39.94	9.73	36.63	10.39	36.10	13.71	30.90	9.40
N	1.80	0.44	1.99	0.56	1.92	0.73	1.73	0.53
S	0.32	0.08	0.33	0.09	0.33	0.13	0.29	0.09
CI	0.05	0.01	0.06	0.02	0.09	0.03	0.12	0.04
A	14.97	3.65	11.62	3.30	11.94	4.54	15.92	4.84
W	0	75.65	0	71.63	0	62.01	0	69.59
Σ	100	100	99.99	99.9972	100	100	100	100
Laboratory calorific value	17813	2446	19013	3603	17721	5182	16889	3396
Formula Calculation	14059	1532	17088	3057	17262	5007	18375	3848

Sampling time 2021.04								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	38.30	13.98	41.75	13.01	43.63	12.43	44.22	13.18
H	5.63	2.05	6.10	1.90	6.30	1.79	6.37	1.90
O	34.87	12.72	37.12	11.56	31.57	8.99	40.02	11.93
N	1.51	0.55	2.11	0.66	1.85	0.53	1.85	0.55
S	0.26	0.09	0.38	0.12	0.32	0.09	0.32	0.10
CI	0.09	0.03	0.06	0.02	0.12	0.03	0.05	0.01
A	19.34	7.06	12.48	3.89	16.21	4.62	7.17	2.14
W	0	63.51	0	68.85	0	71.52	0	70.19
Σ	100	100	100	100	100	100	100	100
Laboratory	16405	4398	18863	4155	16848	3010	19290	3996

calorific value								
Formula Calculation	15010	3889	16432	3397	17873	3302	17224	3380

Sampling time 2021.05								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	43.14	9.41	43.93	15.89	44.31	12.32	45.34	12.69
H	6.29	1.37	6.34	2.29	6.40	1.78	6.45	1.81
O	39.18	8.55	38.02	13.76	37.02	10.30	35.97	10.07
N	1.75	0.38	1.95	0.71	1.80	0.50	1.76	0.49
S	0.31	0.07	0.33	0.12	0.31	0.09	0.26	0.07
Cl	0.07	0.02	0.08	0.03	0.04	0.01	0.07	0.02
A	9.26	2.019606	9.35	3.38283	10.12	2.814372	10.15	2.840985
W	0	78.19	0	63.82	0	72.19	0	72.01
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	17199	1796	14551	3669	18442	3324	16627	2854
Formula Calculation	16866	1724	17314	4669	17612	3093	18121	3272

Sampling time 2021.06								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	42.68	8.98	39.39	13.66	44.27	11.62	44.72	11.88
H	6.25	1.31	5.81	2.01	6.40	1.68	6.39	1.70
O	36.34	7.64	42.01	14.57	37.13	9.74	34.50	9.16
N	1.85	0.39	2.04	0.71	1.96	0.51	1.64	0.44
S	0.33	0.07	0.38	0.13	0.34	0.09	0.29	0.08
Cl	0.07	0.01	0.08	0.03	0.04	0.01	0.07	0.02
A	12.48	2.62	10.29	3.57	9.86	2.59	12.39	3.29
W	0	78.97	0	65.32	0	73.76	0	73.44
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	17353	1675	14507	3398	18496	3009	16231	2475
Formula Calculation	16981	1597	14800	3500	17589	2771	18013	2948

Sampling time 2021.07								
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	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	44.20	14.51	43.52	15.32	45.47	16.70	43.26	12.70
H	6.36	2.09	6.26	2.20	6.54	2.40	6.29	1.85
O	34.98	11.48	28.09	9.89	28.52	10.48	31.33	9.20
N	1.73	0.57	1.57	0.55	1.84	0.68	1.95	0.57
S	0.28	0.09	0.26	0.09	0.31	0.11	0.35	0.10
Cl	0.08	0.03	0.13	0.05	0.12	0.04	0.07	0.02
A	12.37	4.06	20.17	7.10	17.20	6.32	16.75	4.92
W	0	67.17	0	64.8	0	63.27	0	70.65
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	17129	3944	14964	3647	17770	4945	14715	2553
Formula Calculation	17752	4149	18168	4775	19076	5425	17767	3448

Sampling time 2021.08								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	40.05	9.14	43.63	12.50	42.73	12.74	45.17	10.94
H	5.72	1.31	6.30	1.81	6.20	1.85	6.43	1.56
O	35.39	8.08	33.36	9.56	38.18	11.38	33.23	8.05
N	1.33	0.30	1.68	0.48	1.75	0.52	1.56	0.38
S	0.21	0.05	0.28	0.08	0.31	0.09	0.26	0.06
Cl	0.09	0.02	0.08	0.02	0.08	0.02	0.07	0.02
A	17.21	3.93	14.67	4.20	10.75	3.20	13.28	3.22
W	0	77.18	0	71.34	0	70.19	0	75.78
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	17769	2125	18968	3653	16245	3088	17317	2300
Formula Calculation	15634	1638	17674	3282	16744	3237	18342	2548

Sampling time 2021.09								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	44.13	12.12	40.26	12.68	45.62	9.85	43.10	12.37
H	6.36	1.75	5.76	1.81	6.50	1.40	6.15	1.76
O	38.75	10.64	35.53	11.19	33.54	7.24	27.21	7.81

N	1.88	0.52	1.21	0.38	1.75	0.38	1.39	0.40
S	0.30	0.08	0.15	0.05	0.27	0.06	0.23	0.07
Cl	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00
A	8.57	2.35	17.08	5.38	12.39	2.68	21.91	6.29
W	0	72.53	0	68.51	0	78.4	0	71.31
Σ	100	100	100	100	100.09	100.019	100	100
Laboratory calorific value	19457	3532	15096	3041	18146	1960	16232	2874
Formula Calculation	17320	2945	15725	3239	18534	2043	18005	3383

Sampling time 2021.10								
	STS Gulshan		STS Notun Bazar		STS India road		Aminbazar	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	44.91	15.46	44.34	16.06	40.57	14.06	45.89	13.04
H	6.48	2.23	6.41	2.32	5.85	2.03	6.59	1.87
O	41.05	14.13	31.40	11.37	26.03	9.02	27.52	7.82
N	1.81	0.62	1.83	0.66	1.74	0.60	1.83	0.52
S	0.31	0.11	0.32	0.12	0.30	0.10	0.31	0.09
Cl	0.01	0.00	0.02	0.01	0.02	0.01	0.03	0.01
A	5.43	1.87	15.68	5.68	25.49	8.83	17.83	5.07
W	0	65.57	0	63.79	0	65.35	0	71.59
Σ	100	100	100	100	100	100	100	100
Laboratory calorific value	20067	5270	15792	4124	16232	3991	18146	3366
Formula Calculation	17458	4372	18246	5012	16974	4248	19379	3716

The above data are converted to the corresponding wet base calorific value through the formula after measured dry base calorific value in the laboratory.

### 1.4.5 Data analysis

According to the laboratory analysis results and the verification by Mendeleev formula, two of them with large thermal chasing deviations were removed. Meanwhile, considering the deviation of sampling points during garbage sampling, errors would inevitably occur in garbage sampling and analysis, so the extreme value of water content in garbage samples could be removed, and the following samples could be adopted.

	202111Gul		202111 Aminbazar		202112Notun		202201India		202202India		202203India		202206NOT		202206gul;		202210India	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C	41.05	18.77	39.74	14.92	40.19	13.79	45.44	13.18	46.62	13.59	43.34	16.46	39.39	13.66	44.20	14.51	40.57	14.06
H	6.11	2.79	5.94	2.23	6.11	2.10	6.64	1.93	7.10	2.07	6.28	2.39	5.81	2.01	6.36	2.09	5.85	2.03
O	34.67	15.85	37.62	14.12	31.93	10.96	30.40	8.82	32.76	9.55	36.10	13.71	42.01	14.57	34.98	11.48	26.03	9.02
N	1.20	0.55	1.44	0.54	1.30	0.45	1.19	0.35	2.11	0.61	1.92	0.73	2.04	0.71	1.73	0.57	1.74	0.60
S	0.10	0.05	0.10	0.04	0.06	0.02	0.32	0.09	0.10	0.03	0.33	0.13	0.38	0.13	0.28	0.09	0.30	0.10
Cl	0.61	0.28	0.83	0.31	0.52	0.18	0.61	0.18	0.13	0.04	0.09	0.03	0.08	0.03	0.08	0.03	0.02	0.01
A	16.26	7.44	14.33	5.38	19.89	6.82	15.40	4.47	11.18	3.26	11.94	4.54	10.29	3.57	12.37	4.06	25.49	8.83
W	0	54.27	0	62.46	0	65.69	0	71	0	70.86	0	62.01	0	65.32	0	67.17	0	65.35
Σ	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	16828	6339	15701	4333	17781	4458	18636	3629	19247	3837	17721	5182	14507	3398	17129	3944	16232	3991
	16441	6162	15500	4257	16444	4000	18965	3725	19557	3927	17262	5007	14800	3500	17752	4149	16974	4248

According to the above analysis, the average calorific value of domestic garbage in North Dhaka is 1044kcal/kg and the water content is 64.9%.

The corresponding average elemental composition analysis is shown in the table below:

	Average
C	14.77
H	2.18
O	12.01
N	0.57
S	0.08
Cl	0.12
A	5.37
W	64.90
Σ	100
Calorific value kJ/kg	4372

### 1.5 Determination of Calorific Value of Incoming Waste in this Project

Waste collection, transportation and condition in waste pond will change the moisture content of the wastes, and then affect the calorific value of actual furnace wastes. On the one hand, the raw wastes is piled in the waste pond and will be extruded due to gravity, the closer to the bottom of the waste pond, the higher the extrusion density will be, and this also makes the leachate (i.e., raw wastes moisture) be physically separated from the raw wastes; On the other hand, the biomass in the raw wastes will convert some organic substances into inorganic substances and biogas under the action of aerobic bacteria, anaerobic bacteria and other bacteria at the appropriate temperature. Although the total energy is reduced at this stage, the humic raw wastes is more likely to further separate itself from the combined moisture, and in fact, the energy per unit weight of furnace wastes is increased.

	Average	
	raw waste	incoming waste
Element composition	%	%
C	14.77	21.04
H	2.18	3.11
O	12.01	17.11
N	0.57	0.81
S	0.08	0.11
Cl	0.12	0.17
A	5.37	7.66
W	64.90	50
Σ	100	100
Calorific value kJ/kg	4371.88	7231

Considering that this project is located in Bangladesh where temperature is relatively high all year round, it is more favorable for the fermentation of raw wastes. According to experience, after 7 to 10 days of fermentation, the moisture content of incoming wastes will generally decrease to about 50%, and according to the above analysis, the average calorific value of incoming waste is 7231kJ/kg.

The operation of refuse incineration plant usually needs to consider the equipment efficiency and the rationality of configuration during the whole operation of the incineration plant to set the refuse characteristics. We generally set 8-year's calorific value of furnace wastes as the design point. According to the data analysis of urban historical waste properties at home and abroad, with the development of economy, the initial calorific value increases rapidly, and when the calorific value increases to a certain value, its growth becomes slow. Assuming that the average annual calorific value of the wastes increases by 0.8%, the calorific value of furnace wastes in the 8th year of operation is taken as the design point, the calorific value of the wastes will reach about 7,706 kJ/kg at this time. Therefore, it is planned to set the waste calorific value of the design point of this project to 7,700 kJ/kg.

## Attached Table 1 (2020-11):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 8-11 November 2020 Date of Testing: 16-30 November 2020

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	65.74	55.10	62.82	70.39	ASTM D 5231
2	Rubber and Plastic		12.25	17.96	13.46	14.24	
3	Wood and Bamboo		12.04	8.92	11.54	5.48	
4	Textile		2.12	5.07	4.13	3.73	
5	Paper		6.81	10.35	5.89	4.95	
6	Bricks/Ash		0.5	2.09	2.10	0.00	
7	Metal		0.68	0.08	0.06	0.00	
8	Others		0.00	0.44	0.00	1.20	

## Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 08 November 2020  
 Sample 2 - STS, Notun Bazar; Sampling date: 09 November, 2020  
 Sample 3 - STS, Indira Road; Sampling date: 10 November 2020  
 Sample 4 - Amin Bazar ; Sampling date: 11 November 2020

Raw life industry analysis, element analysis and calorific value analysis are as follows:

Date of Sampling: 8-11 November 2020 Date of Testing: 16-25 November 2020

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	55.29	54.27	57.52	62.46	ASTM E 871
2	Ash, db	wt%	8.50	16.26	13.38	14.30	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	20135	16828	18063	15701	ASTM E711
4	Carbon (C), db	wt%	39.88	41.05	40.01	39.74	ASTM E777
5	Hydrogen (H), db	wt%	5.95	6.11	5.83	5.94	ASTM E777
6	Nitrogen (N), db	wt%	1.49	1.20	1.33	1.44	ASTM E 778
7	Sulphur (S), db	wt%	0.11	0.10	0.14	0.10	ASTM E 775
8	Oxygen (O), db	wt%	42.06	34.67	38.47	37.62	ASTM E 870
9	Chlorine (Cl), db	wt%	2.01	0.61	0.84	0.83	ASTM E 776

db: dry basis

## Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 08 November 2020  
 Sample 2 - STS, Notun Bazar; Sampling date: 09 November, 2020  
 Sample 3 - STS, Indira Road; Sampling date: 10 November 2020  
 Sample 4 - Amin Bazar ; Sampling date: 11 November 2020

## Attached Table 2 (2020-12):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 27-30 December 2020 Date of Testing: 2-13 January 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	64.33	72.98	80.15	76.75	ASTM D 5231
2	Rubber and Plastic		10.15	14.75	10.89	15.92	
3	Wood and Bamboo		8.05	1.14	4.11	0.72	
4	Textile		1.64	4.58	2.64	1.93	
5	Paper		11.23	4.41	1.50	3.93	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.00	0.35	0.00	0.00	
8	Others		4.60	1.77	0.73	0.75	

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 27 December 2020
- Sample 2 - STS, Notun Bazar; Sampling date: 28 December, 2020
- Sample 3 - STS, Indira Road; Sampling date: 29 December, 2020
- Sample 4 - Amin Bazar ; Sampling date: 30 December, 2020

Raw life industry analysis, element analysis and calorific value analysis are as follows:

Date of Sampling: 27-30 December 2020 Date of Testing: 2-13 January 2021

Table 2. Municipal Solid Waste Composition of DNCC

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	58.29	65.69	70.14	65.48	ASTM E 871
2	Ash, db	wt%	21.03	19.90	8.50	9.67	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	16187	17781	17906	19392	ASTM E711
4	Carbon (C), db	wt%	34.61	40.19	38.17	41.57	ASTM E777
5	Hydrogen (H), db	wt%	5.10	6.11	5.66	6.42	ASTM E777
6	Nitrogen (N), db	wt%	1.30	1.30	1.59	1.46	ASTM E 778
7	Sulphur (S), db	wt%	0.09	0.06	0.11	0.06	ASTM E 775
8	Oxygen (O), db	wt%	37.27	31.93	45.54	40.35	ASTM E 870
9	Chlorine (Cl), db	wt%	0.60	0.52	0.43	0.47	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 27 December 2020
- Sample 2 - STS, Notun Bazar; Sampling date: 28 December, 2020
- Sample 3 - STS, Indira Road; Sampling date: 29 December, 2020
- Sample 4 - Amin Bazar ; Sampling date: 30 December, 2020

Attached Table 3 (2021-01):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 3-6 January 2021 Date of Testing: 9-30 January 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	71.61	73.45	73.73	72.47	ASTM D 5231
2	Rubber and Plastic		10.95	14.31	10.73	18.88	
3	Wood and Bamboo		4.37	1.86	6.44	0.90	
4	Textile		4.41	5.26	3.49	4.59	
5	Paper		8.46	4.73	5.20	1.36	
6	Bricks/Ash		0.00	0.00	0.42	0.00	
7	Metal		0.21	0.23	0.00	0.02	
8	Others		0.00	0.15	0.00	1.78	

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 3 January 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 4 January 2021
- Sample 3 - STS, Indira Road; Sampling date: 5 January 2021
- Sample 4 - Amin Bazar ; Sampling date: 6 January 2021

Raw life industry analysis, element analysis and calorific value analysis are as follows:

Date of Sampling: 3-6 January 2021 Date of Testing: 9-30 January 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	62.93	65.27	71.00	68.67	ASTM E 871
2	Ash, db	wt%	11.78	14.59	15.40	19.10	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	20392	17541	18636	15024	ASTM E711
4	Carbon (C), db	wt%	44.96	46.46	45.44	46.21	ASTM E777
5	Hydrogen (H), db	wt%	6.56	6.94	6.64	7.08	ASTM E777
6	Nitrogen (N), db	wt%	1.16	1.18	1.19	1.17	ASTM E 778
7	Sulphur (S), db	wt%	0.33	0.32	0.32	0.31	ASTM E 775
8	Oxygen (O), db	wt%	34.72	29.94	30.40	25.48	ASTM E 870
9	Chlorine (Cl), db	wt%	0.49	0.57	0.61	0.65	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 3 January 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 4 January 2021
- Sample 3 - STS, Indira Road; Sampling date: 5 January 2021
- Sample 4 - Amin Bazar ; Sampling date: 6 January 2021

Attached Table 4 (2021-02):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 7-10 February 2021 Date of Testing: 7-20 February 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	77.58	74.90	81.80	77.68	ASTM D 5231
2	Rubber and Plastic		11.26	14.81	9.31	10.59	
3	Wood and Bamboo		1.77	2.44	1.47	6.51	
4	Textile		0.87	2.77	3.70	2.89	
5	Paper		5.86	4.79	2.62	1.51	
6	Bricks/Ash		1.72	0.00	0.97	0.00	
7	Metal		0.00	0.05	0.13	0.11	
8	Others		0.94	0.24	0.00	0.72	

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 7 February 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 8 February 2021
- Sample 3 - STS, Indira Road; Sampling date: 9 February 2021
- Sample 4 - Amin Bazar ; Sampling date: 10 February 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 7-10 February 2021 Date of Testing: 7-20 February 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	59.87	59.85	70.86	63.97	ASTM E 871
2	Ash, db	wt%	27.42	12.39	11.18	27.34	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	15873	17549	19247	13166	ASTM E711
4	Carbon (C), db	wt%	46.28	50.05	46.62	47.08	ASTM E777
5	Hydrogen (H), db	wt%	7.12	7.67	7.10	7.08	ASTM E777
6	Nitrogen (N), db	wt%	2.06	1.97	2.11	2.23	ASTM E 778
7	Sulphur (S), db	wt%	0.10	0.10	0.10	0.10	ASTM E 775
8	Oxygen (O), db	wt%	16.96	27.71	32.76	15.86	ASTM E 870
9	Chlorine (Cl), db	wt%	0.06	0.11	0.13	0.31	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 7 February 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 8 February 2021
- Sample 3 - STS, Indira Road; Sampling date: 9 February 2021
- Sample 4 - Amin Bazar ; Sampling date: 10 February 2021

Attached Table 5 (2021-03):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 7-13 March 2021 Date of Testing: 7-21 March 2021

Table 1: Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	78.24	75.70	70.83	83.06	ASTM D 5231
2	Rubber and Plastic		10.36	12.86	17.20	7.93	
3	Wood and Bamboo		3.70	7.51	3.16	0.55	
4	Textile		3.52	0.77	5.40	0.25	
5	Paper		3.06	2.51	2.49	5.69	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.22	0.00	0.14	0.00	
8	Others		0.90	0.65	0.78	2.51	

Sampling Locations and Dates

- Sample 1 - STS, Indira Road; Sampling date: 7 March 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 8 March 2021
- Sample 3 - Amin Bazar; Sampling date: 10 Marchy 2021
- Sample 4 - STS, Gulshan 1 ; Sampling date: 13 March 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 7-13 March 2021 Date of Testing: 7-21 March 2021

Table 2: Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	62.01	71.63	69.59	75.65	ASTM E 871
2	Ash, db	wt%	11.94	11.62	15.92	14.97	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	17721	19013	16889	17813	ASTM E711
4	Carbon (C), db	wt%	43.34	43.12	44.66	37.38	ASTM E777
5	Hydrogen (H), db	wt%	6.28	6.24	6.38	5.54	ASTM E777
6	Nitrogen (N), db	wt%	1.92	1.99	1.73	1.80	ASTM E 778
7	Sulphur (S), db	wt%	0.33	0.33	0.29	0.32	ASTM E 775
8	Oxygen (O), db	wt%	36.10	36.63	30.90	39.94	ASTM E 870
9	Chlorine (Cl), db	wt%	0.09	0.06	0.12	0.05	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Indira Road; Sampling date: 7 March 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 8 March 2021
- Sample 3 - Amin Bazar; Sampling date: 10 Marchy 2021
- Sample 4 - STS, Gulshan 1 ; Sampling date: 13 March 2021

Attached Table 6 (2021-04):

The physical compositions of raw solid waste are as follows:

Date of Sampling: 3-7 April 2021 Date of Testing: 17-29 May 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	69.57	80.96	74.50	72.15	ASTM D 5231
2	Rubber and Plastic		8.72	8.03	11.89	15.45	
3	Wood and Bamboo		3.30	4.78	6.90	5.35	
4	Textile		1.14	2.76	2.25	3.45	
5	Paper		13.50	2.49	3.51	2.85	
6	Bricks/Ash		2.82	0.00	0.00	0.00	
7	Metal		0.07	0.00	0.00	0.10	
8	Others		0.89	0.98	0.95	0.65	

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1 ; Sampling date: 3 April 2021
- Sample 2 - STS, Indra Road; Sampling date: 4 April 2021
- Sample 3 - STS, Notun Bazar; Sampling date: 5 April 2021
- Sample 4 - Amin Bazar; Sampling date: 7 April 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 3-7 April 2021 Date of Testing: 17-29 May 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	63.51	68.85	71.52	70.19	ASTM E 871
2	Ash, db	wt%	19.33	12.49	16.23	7.18	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	16405	18863	16848	19290	ASTM E711
4	Carbon (C), db	wt%	38.30	41.75	43.63	44.22	ASTM E777
5	Hydrogen (H), db	wt%	5.63	6.10	6.30	6.37	ASTM E777
6	Nitrogen (N), db	wt%	1.51	2.11	1.85	1.85	ASTM E 778
7	Sulphur (S), db	wt%	0.26	0.38	0.32	0.32	ASTM E 775
8	Oxygen (O), db	wt%	34.87	37.12	31.57	40.02	ASTM E 870
9	Chlorine (Cl), db	wt%	0.09	0.06	0.12	0.05	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1 ; Sampling date: 3 April 2021
- Sample 2 - STS, Indra Road; Sampling date: 4 April 2021
- Sample 3 - STS, Notun Bazar; Sampling date: 5 April 2021
- Sample 4 - Amin Bazar; Sampling date: 7 April 2021

Attached Table 7 (2021-05) :

The physical compositions of raw solid waste are as follows:

Date of Sampling: 8-14 June 2021 Date of Testing: 15 June - 30 Sep 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	77.01	74.29	73.93	71.71	ASTM D 5231
2	Rubber and Plastic		11.42	10.61	12.28	16.01	
3	Wood and Bamboo		2.90	0.54	7.29	5.45	
4	Textile		3.59	1.67	2.43	3.53	
5	Paper		4.40	12.46	3.75	2.90	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.00	0.00	0.00	0.00	
8	Others		0.67	0.42	0.32	0.41	

Sampling Locations and Dates\*

- Sample 1 - STS, Indira Road ; Sampling date: 8 June 2021
- Sample 2 - STS, Gulshan 1; Sampling date: 9 June 2021
- Sample 3 - Amin Bazar; Sampling date: 12 June 2021
- Sample 4 - STS, Notun Bazar; Sampling date: 14 June 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 8-14 June 2021 Date of Testing: 15 June - 30 Sep 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	72.19	78.19	72.01	63.82	ASTM E 871
2	Ash, db	wt%	10.12	9.26	10.13	9.34	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	18442	17199	16627	14551	ASTM E711
4	Carbon (C), db	wt%	44.31	43.14	45.34	43.93	ASTM E777
5	Hydrogen (H), db	wt%	6.40	6.29	6.45	6.34	ASTM E777
6	Nitrogen (N), db	wt%	1.80	1.75	1.76	1.95	ASTM E 778
7	Sulphur (S), db	wt%	0.31	0.31	0.26	0.33	ASTM E 775
8	Oxygen (O), db	wt%	37.02	39.18	35.97	38.02	ASTM E 870
9	Chlorine (Cl), db	wt%	0.04	0.07	0.07	0.08	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Indira Road ; Sampling date: 8 June 2021
- Sample 2 - STS, Gulshan 1; Sampling date: 9 June 2021
- Sample 3 - Amin Bazar; Sampling date: 12 June 2021
- Sample 4 - STS, Notun Bazar; Sampling date: 14 June 2021

Attached Table 8 (2021-06) :

The physical compositions of raw solid waste are as follows:

Date of Sampling:		19-22 June 2021		Date of Testing:		23 June - 30 Sep 2021	
Table 1. Municipal Solid Waste Composition of DNCC (as received basis)							
Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	82.07	77.40	74.50	72.15	ASTM D 5231
2	Rubber and Plastic		10.19	8.39	11.89	15.45	
3	Wood and Bamboo		2.61	0.51	6.90	5.35	
4	Textile		3.34	1.53	2.25	3.45	
5	Paper		1.23	11.91	3.51	2.85	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.00	0.00	0.00	0.10	
8	Others		0.56	0.25	0.95	0.65	
Sampling Locations and Dates							
Sample 1 - STS, Indira Road ; Sampling date: 19 June 2021							
Sample 2 - STS, Gulshan 1; Sampling date: 20 June 2021							
Sample 3 - Amin Bazar; Sampling date: 21 June 2021							
Sample 4 - STS, Notun Bazar; Sampling date: 22 June 2021							

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling:		19-22 June 2021		Date of Testing:		23 June - 30 Sep 2021	
Table 2. Municipal Solid Waste Composition of DNCC (moist basis)							
Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	73.76	78.97	73.44	65.32	ASTM E 871
2	Ash, db	wt%	9.85	8.48	12.39	10.29	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	18496	17353	16231	14507	ASTM E711
4	Carbon (C), db	wt%	44.27	42.68	44.72	39.39	ASTM E777
5	Hydrogen (H), db	wt%	6.40	6.25	6.39	5.81	ASTM E777
6	Nitrogen (N), db	wt%	1.96	1.85	1.64	2.04	ASTM E 778
7	Sulphur (S), db	wt%	0.34	0.33	0.29	0.38	ASTM E 775
8	Oxygen (O), db	wt%	37.13	40.34	34.50	42.01	ASTM E 870
9	Chlorine (Cl), db	wt%	0.04	0.07	0.07	0.08	ASTM E 776
db: dry basis							
Sampling Locations and Dates							
Sample 1 - STS, Indira Road ; Sampling date: 19 June 2021							
Sample 2 - STS, Gulshan 1; Sampling date: 20 June 2021							
Sample 3 - Amin Bazar; Sampling date: 21 June 2021							
Sample 4 - STS, Notun Bazar; Sampling date: 22 June 2021							

Attached Table 9 (2021-07) :

The physical compositions of raw solid waste are as follows:

Date of Sampling: 14-18 July 2021 Date of Testing: 5 Aug - 30 Sep 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	61.28	72.59	74.50	72.15	ASTM D 5231
2	Rubber and Plastic		20.62	16.15	11.89	15.45	
3	Wood and Bamboo		6.55	3.66	6.90	5.35	
4	Textile		2.72	3.79	2.25	3.45	
5	Paper		6.68	2.94	3.51	2.85	
6	Bricks/Ash		1.39	0.00	0.00	0.00	
7	Metal		0.18	0.00	0.00	0.10	
8	Others		0.60	0.87	0.95	0.65	

Sampling Locations and Dates

- Sample 1 - STS, Notun Bazar; Sampling date: 14 July 2021
- Sample 2 - Amin Bazar; Sampling date: 15 July 2021
- Sample 3 - STS, Indira Road; Sampling date: 17 July 2021
- Sample 4 - STS, Gulshan 1; Sampling date: 18 July 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 14-18 July 2021 Date of Testing: 5 Aug - 30 Sep 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	64.80	70.65	63.27	67.17	ASTM E 871
2	Ash, db	wt%	20.17	16.75	17.20	12.36	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	14964	14715	17770	17129	ASTM E711
4	Carbon (C), db	wt%	43.52	43.26	45.47	44.20	ASTM E777
5	Hydrogen (H), db	wt%	6.26	6.29	6.54	6.36	ASTM E777
6	Nitrogen (N), db	wt%	1.57	1.95	1.84	1.73	ASTM E 778
7	Sulphur (S), db	wt%	0.26	0.35	0.31	0.28	ASTM E 775
8	Oxygen (O), db	wt%	28.09	31.33	28.52	34.98	ASTM E 870
9	Chlorine (Cl), db	wt%	0.13	0.07	0.12	0.08	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Notun Bazar; Sampling date: 14 July 2021
- Sample 2 - Amin Bazar; Sampling date: 15 July 2021
- Sample 3 - STS, Indira Road; Sampling date: 17 July 2021
- Sample 4 - STS, Gulshan 1; Sampling date: 18 July 2021

Attached Table 10 (2021-08) :

The physical compositions of raw solid waste are as follows:

Date of Sampling: 24-29 August 2021 Date of Testing: 29 Aug - 30 Sep 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	65.11	73.24	74.50	72.15	ASTM D 5231
2	Rubber and Plastic		20.36	11.97	11.89	15.45	
3	Wood and Bamboo		4.46	6.42	6.90	5.35	
4	Textile		6.23	0.72	2.25	3.45	
5	Paper		2.67	6.04	3.51	2.85	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.00	0.00	0.00	0.10	
8	Others		1.18	1.60	0.95	0.65	

Sampling Locations and Dates

- Sample 1 - Amin Bazar; Sampling date:24 August 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 25 August 2021
- Sample 3 - STS, Gulshan 1; Sampling date: 28 August 2021
- Sample 4 - STS, Indira Road; Sampling date: 29 August 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 24-29 August 2021 Date of Testing: 29 Aug - 30 Sep 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	75.78	71.34	77.18	74.08	ASTM E 871
2	Ash, db	wt%	13.29	14.66	17.21	10.75	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	17317	18968	17769	16245	ASTM E711
4	Carbon (C), db	wt%	45.17	43.63	40.05	42.73	ASTM E777
5	Hydrogen (H), db	wt%	6.43	6.30	5.72	6.20	ASTM E777
6	Nitrogen (N), db	wt%	1.56	1.68	1.33	1.75	ASTM E 778
7	Sulphur (S), db	wt%	0.26	0.28	0.21	0.31	ASTM E 775
8	Oxygen (O), db	wt%	33.23	33.36	35.39	38.18	ASTM E 870
9	Chlorine (Cl), db	wt%	0.07	0.08	0.09	0.08	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - Amin Bazar; Sampling date:24 August 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 25 August 2021
- Sample 3 - STS, Gulshan 1; Sampling date: 28 August 2021
- Sample 4 - STS, Indira Road; Sampling date: 29 August 2021

Attached Table 11 (2021-09) :

The physical compositions of raw solid waste are as follows:

Date of Sampling: 12-15 Sep 2021 Date of Testing: 15- 30 Sep 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	65.20	74.57	62.67	76.22	ASTM D 5231
2	Rubber and Plastic		12.44	10.97	21.66	13.98	
3	Wood and Bamboo		6.19	7.26	3.49	3.26	
4	Textile		1.33	0.95	3.23	2.81	
5	Paper		11.75	5.76	6.04	3.31	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.28	0.09	0.00	0.42	
8	Others		2.82	0.39	2.91	0.00	

Sampling Locations and Dates

Sample 1 - STS, Notun Bazar; Sampling date:12 September 2021

Sample 2 - STS, Gulshan 1; Sampling date: 13 September 2021

Sample 3 - Amin Bazar; Sampling date: 14 September 2021

Sample 4 - STS, Indira Road; Sampling date: 15 September 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 12-15 Sep 2021 Date of Testing: 15- 30 Sep 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	68.51	72.53	71.31	78.40	ASTM E 871
2	Ash, db	wt%	17.08	8.57	21.91	12.39	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	15096	19457	16232	18146	ASTM E711
4	Carbon (C), db	wt%	40.26	44.13	43.10	45.62	ASTM E777
5	Hydrogen (H), db	wt%	5.76	6.36	6.15	6.50	ASTM E777
6	Nitrogen (N), db	wt%	1.21	1.88	1.39	1.65	ASTM E 778
7	Sulphur (S), db	wt%	0.15	0.30	0.23	0.27	ASTM E 775
8	Oxygen (O), db	wt%	35.53	38.75	27.22	33.55	ASTM E 870
9	Chlorine (Cl), db	wt%	0.01	0.01	0.01	0.02	ASTM E 776

db: dry basis

Sampling Locations and Dates

Sample 1 - STS, Notun Bazar; Sampling date:12 September 2021

Sample 2 - STS, Gulshan 1; Sampling date: 13 September 2021

Sample 3 - Amin Bazar; Sampling date: 14 September 2021

Sample 4 - STS, Indira Road; Sampling date: 15 September 2021

Attached Table 12 (2021-10) :

The physical compositions of raw solid waste are as follows:

Date of Sampling: 2-5 October 2021 Date of Testing: 3-24 October 2021

Table 1. Municipal Solid Waste Composition of DNCC (as received basis)

Sl. No.	Components	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Kitchen Waste	wt%	71.22	75.67	67.97	68.22	ASTM D 5231
2	Rubber and Plastic		14.56	11.44	15.69	18.50	
3	Wood and Bamboo		6.40	4.65	4.68	3.88	
4	Textile		2.91	3.81	5.05	7.38	
5	Paper		4.64	3.54	3.24	1.89	
6	Bricks/Ash		0.00	0.00	0.00	0.00	
7	Metal		0.02	0.02	0.08	0.00	
8	Others		0.24	0.86	3.29	0.13	

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 02 October 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 03 October 2021
- Sample 3 - STS, Indira Road; Sampling date: 04 October 2021
- Sample 4 - Amin Bazar; Sampling date: 05 October 2021

Raw life industry analysis, element analysis elements and calorific value analysis are as follows:

Date of Sampling: 2-5 October 2021 Date of Testing: 3-24 October 2021

Table 2. Municipal Solid Waste Composition of DNCC (moist basis)

Sl. No.	Test Parameters	Unit	Results				Method of Analysis
			Sample 1	Sample 2	Sample 3	Sample 4	
1	Moisture	wt%	65.57	63.79	65.35	71.59	ASTM E 871
2	Ash, db	wt%	5.43	15.68	25.49	17.83	ASTM D 1102
3	Net Calorific Value, db	kJ/kg	20067	15792	18129	19068	ASTM E711
4	Carbon (C), db	wt%	44.91	44.34	40.57	45.89	ASTM E777
5	Hydrogen (H), db	wt%	6.48	6.41	5.85	6.59	ASTM E777
6	Nitrogen (N), db	wt%	1.82	1.83	1.74	1.83	ASTM E 778
7	Sulphur (S), db	wt%	0.31	0.32	0.30	0.31	ASTM E 775
8	Oxygen (O), db	wt%	41.05	31.40	26.03	27.52	ASTM E 870
9	Chlorine (Cl), db	wt%	0.01	0.02	0.02	0.03	ASTM E 776

db: dry basis

Sampling Locations and Dates

- Sample 1 - STS, Gulshan 1; Sampling date: 02 October 2021
- Sample 2 - STS, Notun Bazar; Sampling date: 03 October 2021
- Sample 3 - STS, Indira Road; Sampling date: 04 October 2021
- Sample 4 - Amin Bazar; Sampling date: 05 October 2021

## **Appendix R: Waste management during the downtime for repairing and maintenance of the incineration plant**

The maintenance of domestic waste incineration power plant units is divided into four maintenance levels: A, B, C, and D based on the principle of scale and downtime. Among them, the A level maintenance period is about 20 days with an interval of 5 years, the B level maintenance period is about 15 days with an interval of 5 years, the C maintenance period is about 7 days with an interval of 1 year, and the D level maintenance period is about 5 days with an interval of half a year. The combination of power plant maintenance is to arrange one B-level maintenance between the two A-level maintenances, except for the A and B maintenance years, arrange one C-level maintenance every year, and add one D-level maintenance as appropriate. Therefore, according to rich operating experience, the operating time of each incineration line is not less than 333 days, that is, 8000h.

Considering that the project has a 4x750t incineration line and 2 steam turbines, and the design capacity of the pit can store all 4 lines for at least 10 days. During operation, each incineration line is overhauled one by one, so during the maintenance of one incineration line, the other 3 lines will run at full capacity, and the rich capacity of the garbage pit is sufficient to meet the temporary storage and dumping of garbage; When a single steam turbine is overhauled, at least 2 incineration lines are in operation, and the capacity of the pit can also meet the storage and dumping of garbage for 30 days.

Therefore, a good operational maintenance plan and redundant pit design are guarantees that the waste is accepted and stored during the maintenance period of the incineration plant.

## **Appendix S: Detail about the compliance with the operating, monitoring and emission standards in the schedule 5, serial no. 14 of the Air Pollution (Control) Rules, 2022.**

The proponent will comply all the rules and regulations of Bangladesh. In this case, we have already given EU standard along with Emission Concentration Standard (Daily average) Air Emission (Control) Rules, 2022. **Please see section 7.2.3.1.1 and Table 7-12**

Please see Appendix E-7: Incinerator Operation Standard. It has been incorporated this in the report. Please see Appendix E-8: Stack Emission Standard. It has also been incorporated this in the report. This standard will be maintained by the project developer.

Please see section 7.2.3.1.1 and Table 7-12:

The waste-to-energy project will use 3000 t/d waste. The project consists of four sets of 750 t/d incinerators and waste heat boilers and two sets of 35 MW turbine generator sets with an annual operation time of not less than 8,000 hours.

Pollutants of concern released by the power station, Sulfur dioxide (SO<sub>2</sub>), and Carbon Monoxide (CO). The waste-to-energy power station will also emit Hydrogen Fluoride (HF), Hydrochloric Acid (HCl), Dioxin & Furan, and Heavy Metals (Cadmium, Mercury, Titanium). The resulting ground level concentration (GLC) from air quality modeling will be referred to the applicable limits of ambient air quality from schedule 1 of Bangladesh air pollution control rules 2022. Substances not specified in the Government of Bangladesh regulation and WHO global air quality guidelines; environmental standard criteria are taken from UK Environmental Agency's air emission risk assessment guidance.

The project will have different flue gas treatment systems. The flue gas treatment process is to remove pollutants such as soot, acidic gases (HCl, HF, SO<sub>2</sub> as well as NO<sub>2</sub>, etc.), heavy metals (Hg, Pb, Cr, etc.) and dioxins from the flue gas emission according to flue gas standards to meet the emission standards of the project.

To improve the removal efficiency of acid gas from the flue gas treatment system, firstly the flue gas will be cooled. The water component evaporates rapidly by spraying the atomized droplet reaction agent into the flue gas and mixing it with the flue gas, which will make the flue gas temperature drop to the appropriate reaction temperature. The reactant components as well as the hydrated lime powder will be sprayed into the flue and are neutralized with acidic gases such as hydrogen chloride, sulfur oxide, and hydrogen fluoride in the flue gas to generate salts.

Heavy metals such as dioxin and mercury in the flue gas will be adsorbed by activated carbon sprayed into the flue, and the acidic substances continue to react with hydrated lime sprayed into the flue. Salt particles generated by the acid-base neutralization reaction and activated carbon particles adsorbed with dioxin and heavy metals will be removed in the subsequent bag filter and mixed into the fly ash, which will be sent to the fly ash stabilization system by the fly ash delivery equipment for stabilization treatment. The bag filter that passes through the flue gas enters the chimney and is then excreted into the atmosphere.

Emission concentration control of acidic gas---according to the flue gas from the top of the chimney, monitor the acid gas content online and adjust the deacidification dose.

Control of removal of dioxin and heavy metals — according to the measured flue gas quantity, the feed quantity will be adjusted by the way of quantitative feed of activated carbon.

Emission control of nitrogen dioxide gas - the operating conditions of the Selective Non-catalytic Reduction (SNCR) system will be regulated based on online monitoring of nitrogen dioxide concentrations by the chimney on flue gas.

The emission inventory has been presented based on the guaranteed emission concentration from equipment. The emission inventory of the power plant is presented in **Table 7-12**. As per the IFC-WB guideline for thermal power plants running on solid fuel, the lowest guaranteed emission concentration for NO<sub>2</sub> is 200 mg/Nm<sup>3</sup>.

**Table 11-1: Emission Inventory of Waste to Energy Power Plant**

Pollutant	Unit	Average Time	Emission Concentration (Daily average) EU standard DIRECTIVE 2010/75/EU	Emission Concentration (Daily average) Air Pollution Control Rules, 2022
Particulate Matter (PM)	mg/Nm <sup>3</sup>	24 hr	10	20
Nitrogen Dioxide (NO <sub>2</sub> )	mg/Nm <sup>3</sup>	24 hr	200	250
Sulfur Dioxide (SO <sub>2</sub> )	mg/Nm <sup>3</sup>	24 hr	50	80
Carbon Monoxide (CO)	mg/Nm <sup>3</sup>	24 hr	50	80
Mercury (Hg)	mg/Nm <sup>3</sup>	0.5-8 hr	0.05	0.05
Hydrogen Chloride (HCl)	mg/Nm <sup>3</sup>	24 hr	10	50

Pollutant	Unit	Average Time	Emission Concentration (Daily average) EU standard DIRECTIVE 2010/75/EU	Emission Concentration (Daily average) Air Pollution Control Rules, 2022
Hydrogen Fluoride (HF)	mg/Nm <sup>3</sup>	0.5 hr	1	1.0
Cd+Ti	mg/Nm <sup>3</sup>	0.5-8 hr	0.05	0.1
Pb+Cr and other heavy metals	mg/Nm <sup>3</sup>	0.5-8 hr	0.5	0.5
Dioxins and Furans	ng-TEQ/Nm <sup>3</sup>	6-8 hr	0.1	0.1

Source: EU standard DIRECTIVE 2010/75/EU

Source: Air Pollution (control) Rules, 2022

The following mitigation measures should be followed to reduce the air pollution.

- The flue gas is to be exhausted at 100m stack height.
- Ensuring the standard of Bangladesh (MoEF) where emissions always should be lower due to nearly presence of any sensitive area.
- The plant equipment must be performance tested during the commissioning phase to ensure the standard has been maintained.
- A continuous Emission Monitoring System (CEMS) will be installed to detect the emission of pollutants from the flue gas.
- Automatic monitoring processes and presentation on real-time Web Pages should be implemented.
- Ambient air quality monitoring stations are to be installed within the project site to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers is to be conducted at other locations.
- Install instruments to record meteorological data such as wind speed, direction, solar radiation, relative humidity, and temperature shall be established so that the operating power plant can record these parameters at regular intervals.
- Regular maintenance and overhauling as per design specification.
- Regular inspection and maintenance of boiler, pressure parts, FD and ID fans bag filter and ash separation and handling system, and other ancillaries.
- Particulate Matter emission concentration will be controlled by a bag filter.
- Selective Non-Catalytic Reduction-SNCR (urea water injection in the furnace) will be adopted for nitrogen oxides control and space for Selective Catalytic Reduction (SCR) will be reserved to cope with the possible improvement of denitrification standards in the future since the airshed is already degraded.
- Combination mode of "SNCR (urea water injection in the furnace) + semi-dry method (lime pulp solution) + dry method (Ca (OH)<sub>2</sub> dry powder) + activated carbon injection + bag filter + (reserved SCR) will be adopted to control acidic gases (HCl, SO<sub>2</sub>, and HF).
- Control the residence time of flue gas in the furnace above 850°C to ensure adequate decomposition of dioxins.

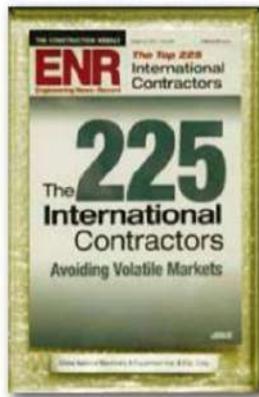
- Maintain the more stringent emission standard of the European Union Pollutant Emission Standard (European Union 2010/75/EU) since the project location airshed already degraded and
- It is highly recommended to conduct a validation run after 1 to 3 months during the operations stage using actual CEMS, stack testing, and ambient air monitoring results.
- All the parameters of the Air Quality/Emission Standard must have to comply with the Air Pollution Control Rules-2022
- The following air quality monitoring system and air pollution control equipment will be considered for this Waste to Energy Project.

Monitoring	Continuous emission monitoring	Particulate Matter, CO, SO <sub>2</sub> , HF, HCl, NO <sub>x</sub> and other parameters might be added based on clearance certificate condition
	Continuous process parameters monitoring	Furnace Temperature, Flue Gas outlet temperature, pressure, Water vapor or other parameters will be monitored as per clearance certificate condition
	Regular Emission Monitoring (2-4 times in a year)	Heavy Metal, Dioxin and Furan
Air Pollution Control Equipment	Air pollution control device setup	Fabric Filter Dry

## Appendix T: Qualification and Experience of CMEC Group in Waste to Energy Project

### Qualification Certificates

#### Qualification Certificates



CMEC連續多年入選美國《工程新聞記錄》(ENR)雜誌“世界最大225家國際承包商” CMEC has successively been selected as one of the Top 225 International Contractors by *Engineering News-Record* of the USA



企業法人營業執照  
License of Business Corporation



對外貿易經營者備案登記表  
Record Registration Form of Foreign Trade Dealers



中華人民共和國國際招標機構甲級資格證書 (商務部)  
Certificate (Grade A) for International Tendering Organization of China, issued by the Ministry of Commerce of China to CMEC



工程招標代理機構資格證書 (住建部)  
Certificate of Project Tendering Agency of China, issued by the Ministry of Housing and Urban-Rural Development of China to CMEC



中華人民共和國對外承包工程資格證書  
Certificate of Qualification for Contract Engineering Projects of China, issued by Beijing Municipal Bureau of Commerce to CMEC



ISO 9001:2008 質量管理體系認證證書  
Certificate of ISO 9001:2008



ISO 14001:2004 環境管理體系認證證書  
Certificate of ISO 14001:2004



OHSAS 18001:2007 職業健康安全管理体系认证證書  
Certificate of OHSAS 18001:2007



**工程咨询单位甲级资格證書**  
 專業：機械、電子、市政工程、有色冶金、火電、建築、生態建設和環境工程  
 Qualifications for Engineering Consulting Services (Grade A)  
 Specialties: machinery, electronics, municipal engineering, non-ferrous metallurgy, thermal power, construction, ecological construction and environmental engineering



**工程監理資質證書**  
 資質等級：房屋建築工程監理甲級、市政公用工程監理甲級  
 Qualifications for Project Supervision  
 Grade A qualification for building construction project supervision and municipal utilities project supervision



**工程勘察綜合類甲級資質（住建部發）**  
 Class A Certification of Comprehensive Engineering Investigation (by MOHURD)



**工程諮詢單位甲級資格證書**  
 專業：火力、其他（新能源）  
 Qualification for engineering tendering agencies (Grade A)  
 Specialties: thermal power and other (new energy)



中華人民共和國中央投資項目招標代理機構  
甲級資格證書(發改委)  
Certificate (Grade A) of Tendering Agency for the Central Investment Projects, issued by National Development and Reform Commission of China to CMEC



工程設計資格證書  
資質等級：甲級（冶金行業；軍工行業；機械行業；輕紡行業；市政行業；建築行業；風景園林工程設計；環境工程；）乙級：電子通訊廣播電行業  
Qualifications for Engineering Design  
Specialties and Grades: Grade A for metallurgy, military industry, machinery, light textile, municipal utilities, construction, landscaping engineering, environmental engineering, Grade B for telecommunications, radio and television



工程設計資格證書  
資質等級：乙級：電力行業（火力發電）；農林行業；輕紡行業；化工石化醫藥行業；環境工程專項；市政行業  
Qualifications for Engineering Design  
Grade B for power (thermal power), agriculture and forestry, light textiles, chemical, petrochemical, medical and pharmaceutical industries, environmental engineering, municipal utilities, etc.



工程諮詢單位甲級資格證書（工程項目管理資格）  
專業：機械  
Qualifications for Engineering Consulting Services (Qualifications for project management)  
Specialty: Machinery, Grade A

## Representative Experiences

### Project Name: Reppie Waste-to-Energy Project, Ethiopia

#### 1. Project Overview

Project Location: Addis Ababa, Ethiopia

Project Scale: A waste-to-energy plant with disposal capacity of 1,000 tons/day (approx 400 000 tons per annum)

Employer: Ethiopia Electric Power Corporation (EEP)

Waste: Municipal Solid Waste (MSW)

Furnace/boiler: 2 grate fired lines, vertical economizer section

Energy production: 20 MW power

Steam parameters: 60 bar/420°C

Flue gas treatment: SNCR, dry FGT system (lime milk in reaction tower), baghouse filter

Start Date: 24 September, 2014

Commissioning: 2018

#### 2. Project Profile



Aerial View of waste-to-energy project

Reppie Waste-to-Energy Project is the construction of waste-to-energy power plant with waste disposal capacity of 1000t/d. This Project is the first waste-to-energy project in Ethiopia and even in Sub-Saharan African. It is also one of two key green energy projects in Ethiopia participating in International Emission Trading Association. Located in Addis Ababa, Reppie will adhere to the strict EU200 standard.



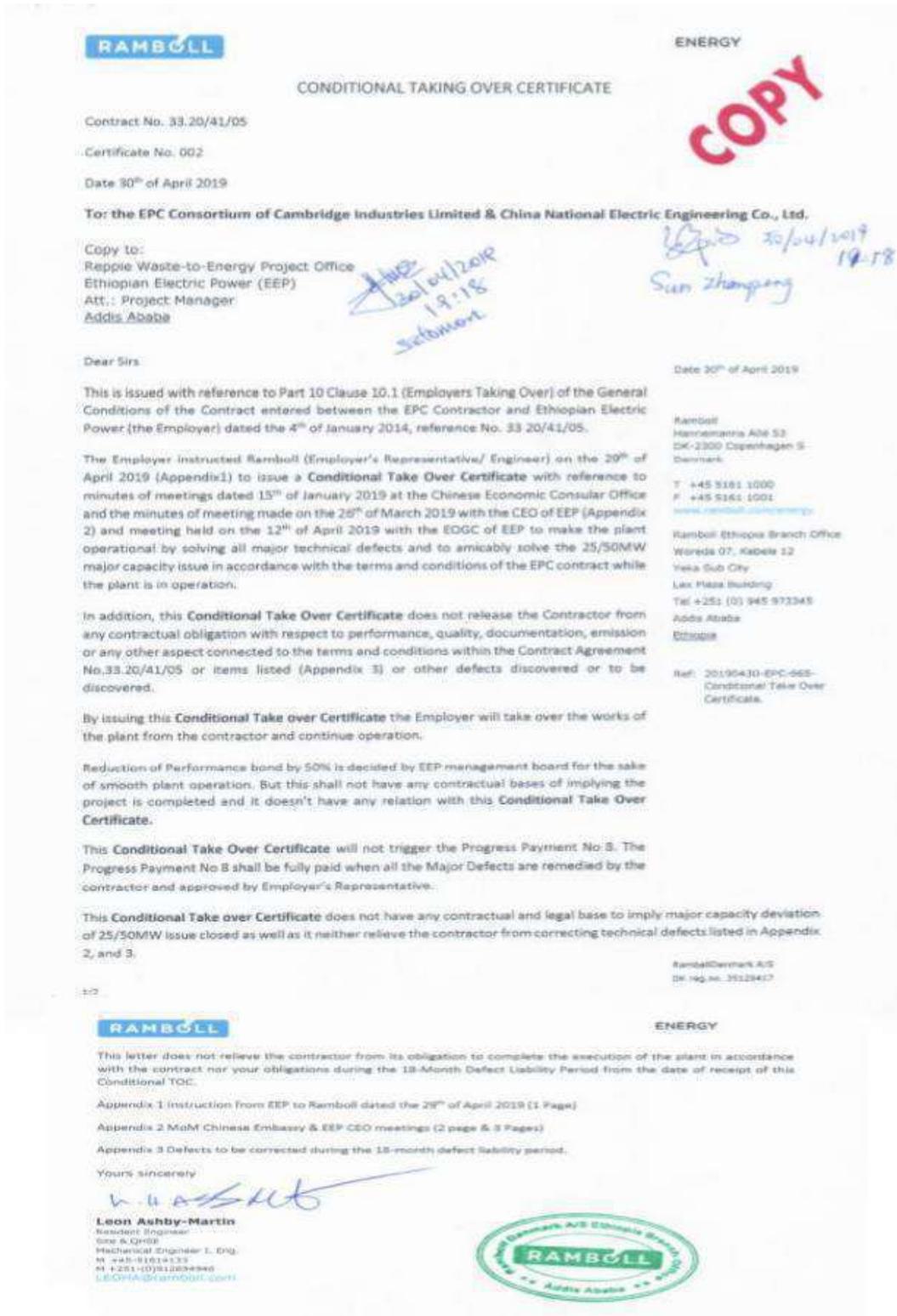
Main plant diagram

### 3. Major Scope of Works undertaken by CMEC Group

The project is constructed on an EPC basis. The scope of works include: final site selection, geological exploration, water resource investigation, overall concept design, project design, equipment and materials supply, shipment, erection, debugging, commissioning and trial operation, maintenance and defect elimination after commercial operation date, and other work.

The major civil work includes: the construction of main building consisting of tipping hall, waste bunker, main control building, turbine deaerator bay, etc; water area at west side consisting of water pond, cooling tower, water pump room, etc; leachate treatment station at east side consisting of leachate collection pond, membrane treatment workshop, reaction tower, etc; and auxiliary construction consisting of permanent fence, weighbridge room, oil tank and oil pump room, maintenance room, etc.

The major erection work includes: supply and erection of two sets of waste combustion boiler with capacity of 500 t/d; supply and erection of two sets of flu gas treatment facilities; supply and erection of two sets 25MW turbine and generator; supply and erection of two sets of waste crane and one set of slag crane; supply and erection of 132 kV switch yard facility; supply and erection of electric primary and secondary devices; supply and erection auxiliary equipment.



Photocopy of Taking Over Certificate

## Project Name: TPI PP 60 MW WTE & 30 MW WHR Power Plant, Thailand

### 1. Project Overview

Project Location: Saraburi, Thailand  
Project Scale: 90 MW  
Contract Amount: 106,560,000 USD  
Employer: TPI Polene Power Public Co., Ltd  
Start Date: 11 July, 2013  
Completion date: 11 Dec, 2015

### 2. Project Profile



Main Plant Location Map

The project consists of two parts: refused-derived fuel (RDF) electricity generation with two sets of 130T/H circulating fluidized bed boiler (CFBB) combined with one set of 60 MW steam turbine generator, and wasted heat recovery (WHR) electricity generation with two sets of waste heat boiler combined with one set of 30 MW steam turbine generator.

On the benefit of this project, the land used for burying garbage will decrease. On the other hand, the project will improve the comprehensive utilization in cement production of incineration ash from garbage burning by collecting the waste heat from the process of cement production. It will bring a profound significance in energy saving and environmental protection to the local area and cultivate considerable value both on economy and on society as well as TPI PP, the project Owner.



Main Plant Interior View

Combined refuse-derived fuel (RDF) and wasted heat recovery (WHR) , this project is not only the first energy saving and environmental protection power plant in the world, but also the worldwide biggest power plant in unit power output with above mentioned configuration. It has multiple technical breakthroughs and it is the first time using a 130 T/H circulating fluidized bed boiler taking refuse-derived fuel and scrap tire as its fuel. Moreover, it is also the first time combining waste incineration boiler with cement kiln waste heat boiler, and the output of waste heat part can reach 30 MW on the base of a 10,000 T/D cement kiln line.

### 3. Major Scope of Works Undertaken by CMEC Group

Responsible for engineering, purchasing, construction, trial operation and commissioning, maintenance and defect elimination after commercial operation date and performance guarantee test of the whole plant.

PLANT ACCEPTANCE CERTIFICATE	
(B2,B3 and TG5)	
Dear Sirs,	
According to the Main Contract, by Dec 30 2016, CNEEC has completed all EPC services of TPI PP 60MW RDF & 30MW WHR Power Plant Project (PG.16327E), B2 and B3 Boilers and TG5 (60MW) plant have been in commercial operation for two years.	
During operation, TPI requested to increase the usage of RDF from 75% to 100% and to reduce the usage of coal as less as possible, the particle size of RDF from sorting line is bigger than original design parameters, so it caused the fuel feeding system and slag drainage systems could not perfectly meet additional requirements.	
After two years' operation and execution many tests and modifications, on Jan 11 2017, TPI and CNEEC agreed and signed an agreement (Meeting Summary) to finalize the modification of B2, B3, TG5 and associated systems. All modification work shall be completed by June 30 2017, due to TPI maintenance plan and requests.	
Excluding the modification work mentioned above, CNEEC would apply for TPI's ACCEPTANCE of B2, B3 and TG5, including all associated equipments and systems.	
After the plant is accepted, all systems are taken over by TPI, and obligations for operation and maintenance are transferred to TPI as well.	
CNEEC shall continue the modification work and service until all modification works listed in the Meeting Summary are completed, so the project is finally closed out.	
Applied by	Approved by
	Mr. Somkiet Teeratrakulpisan
Mr. Fu Wen	Mr. Worawit Leat
Vice Department Manager of China National Electric Engineering Co., Ltd.	Department Manager
	21/09/2017
	Vice President
	TPI Polene Power Public Co., Ltd.
	Mr. Pakkapot Leepairat
	Mr. Panchai Leepairat
	
	
	President
	CEO
	TPI Polene Power Public Co., Ltd.
	TPI Polene Power Public Co., Ltd.

Photocopy of Plant Acceptance Certificate

## **Introduction of the Design Institute**

### **1. Profile of China United Engineering Corporation Limited (CUC)**

China United Engineering Corporation Limited is a large-scale, technology-intensive and state-owned engineering company, which is also a member enterprise belonging to CMEC Group.

CUC has been awarded more than 100 Outstanding Engineering Technology Awards at the national level, and more than 1000 such awards at the provincial level. CUC has also consistently ranked 10th among the Top 60 Design Firms in China, an industrial ranking list issued annually by the Engineering News-Record (ENR) Magazine of the U.S. CUC presently employs over 6000 people, of which more than 95% belong to the technical staff.

CUC is one of the earliest company to carry out waste incineration power generation project design. In 2012, it got second place in China best tender of waste incineration power plant design. So far, CUC has designed nearly one hundred waste incineration power plants, which is in the leading position in the field in China. In these projects, the furnace type involves grate furnace, circulating fluidized bed furnace and pyrolysis gasifier; the largest waste throughput of waste incineration power plant completed at once is 5200 t/d and the largest waste handling capacity of single incineration line is 1000 t/d. At the same time, CUC has investigated about waste integrated treatment and found out the integrated treatments about waste separation, anaerobic fermentation and gasification power generation.

### **2. Qualifications**

- Qualification certificate of General Project contracting of Engineering Project (Grade A)
- Qualification Certificate of construction Cost Consulting (Grade A)
- Qualification certificate of Urban Planning (Grade A)
- Qualification Certificate of construction Supervision (Grade A)
- Qualification certificate of Engineering Survey (Grade B)
- Qualification of direct foreign business operation



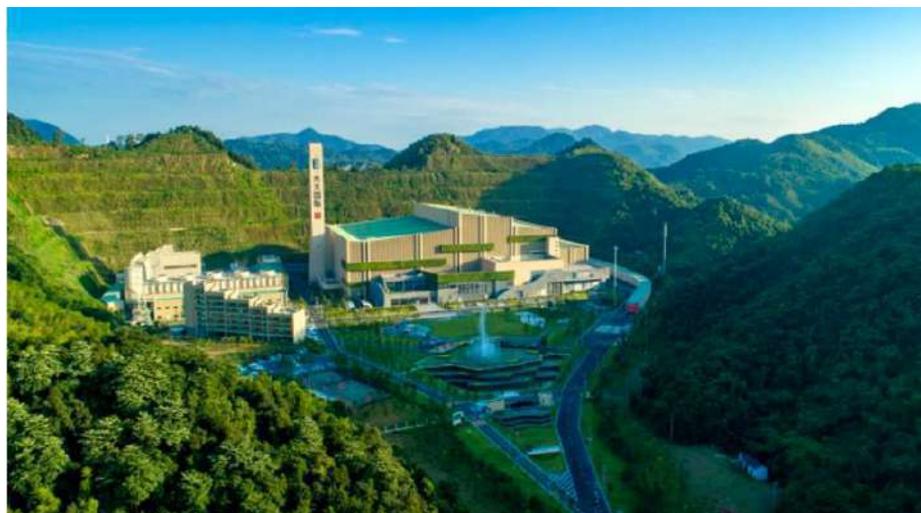
Qualification Certificate of Comprehensive Engineering Design Grade A



Certificates on Quality Management System, Environmental Management System and Occupational Health & Safety Management System



### 3. Representative Experiences



Hangzhou Jiufeng Waste Incineration Power Plant 4X750 t/d

Hangzhou Jiufeng Waste-to-energy Plant is located in Jiufeng stone mine of Nanfeng village, Zhongtai street, Yuhang District, Hangzhou. It is designed to treat 3000 tons of domestic waste per day, with 4 sets of 750 t/d mechanical grate furnaces and 2 sets of 45MW turbine. The advanced technology of "SNCR + Semi-dry scrubber + Dry process + Activated carbon adsorption + Bag filter + SCR + Wet scrubber + GGH" is adopted for flue gas purification. From the start of construction to the completion of the courtyard-style waste-to-energy project, the project serves as a good example of quelling the "Not in My Back Yard" effect and having a positive impact on the neighboring communities, making the project a world-class benchmark.



Hangzhou Linjiang Waste Incineration Power Plant 6X870t/d

Located in Hangzhou dajiangdong circular economy (vein) Industrial Park. The project is equipped with 6 sets of Hitachi shipbuilding machinery grate furnaces, which a single processing capacity of 870 t/d, and 3 sets of 45MW condensing steam turbine generator units, with a daily domestic waste treatment capacity of 5200t, the second largest in Asia. The project is the key project of Hangzhou 2022 Asian Games guarantee project. It is a benchmark project of Zhejiang waste incineration industry.



Xuchang Waste-to-Energy Power Plant 3X750 t/d

Xuchang Waste-to-Energy Plant is located in the south of Xiangshan Park (the original landfill). The project is equipped with 3×750 t/d mechanical grate waste incinerator + 3 medium temperature and medium pressure waste heat boiler + 1×N25MW condensing turbine generator + 1 × B15mw back pressure turbine generator. The project covers an area of about 203 mu. The project won the "Zhongzhou Cup" high quality project award in 2020.

#### **Other China Domestic Experiences (part)**

- Guangdong Foshan Municipal Solid Waste Recycling Treatment Quality Improvement Project (4X750 t/d)
- Hebei Gaobeidian Municipal household garbage resource treatment project (2X600 t/d)
- Hangzhou Fuyang District circular economy Industrial Park household waste incineration disposal project (2X750 t/d)
- Wuhan Municipal waste incineration power generation environmental protection upgrading project (2X600 t/d)
- Bayannur household waste incineration power generation project (1X700 t/d)
- Guangxi Liuzhou Municipal solid waste incineration treatment PPP project (3X750 t/d)

**Other International Experiences (part)**

- Iran Tehran waste incineration power generation project (2X350 t/d)
- Thailand Phuket Island household waste incineration power generation project (2X300 t/d)
- Thailand TPI PP household waste incineration power generation project (2X750 t/d)
- Singapore Mechanical Biological MBT Treatment facility pilot project (1X500 t/d)
- India Mumbai household waste incineration power generation project (2X500 t/d)
- Indonesia Surabaya waste incineration power generation project (2×500t/d+750t/d pyrolytic gasification)

## Certificates of the Incinerator Design

We attach the certificates of the Incinerator Supplier and operation & maintenance experiences of the Supplier, ensuring that the Supplier is also available for main equipment after commercial operation date.



Quality management system certification



The First Prize of the Science and Technology Progress Award issued by the Ministry of Education of China, the awarded project is: Key Technologies and Applications of Domestic Waste Energy and Recycling



National Science and Technology Progress Award issued by the State Council





Hangzhou Linjiang Environment Energy Project (6X870 t/d), which is also designed by CUC as mentioned above, is the second largest domestic waste incineration power plant in Asia built at one time. The project was completed and put into operation at the end of 2020. The project adopts advanced process equipment, supporting 6 sets of mechanical grate incinerators that process 870 tons of domestic waste per day, using medium temperature sub-high pressure steam parameters, and equipped with 3 sets of 45MW condensing steam turbines and 3 sets of 50MW generator sets. The flue gas purification process adopts "SNCR (selective non-catalytic reduction

denitrification) + rotary spray semi-dry method + dry deacidification + activated carbon jet adsorption + bag filter + 1# GGH + wet deacidification + SGH+SCR (selective catalytic reduction denitrification) + 2# GGH". The design scale of the leachate treatment station is 2000t/d, and the leachate advanced treatment adopts the "pretreatment + anaerobic + A/O+ MBR+NF" process, and the site of the advanced treatment system is reserved. After the completion of the project, it will become an important environmental protection education and industrial tourism demonstration base in Hangzhou, fully showing the demonstration function of science and education.