5. Cost Estimation and Implementation Schedule

5.1 Project Cost

5.1.1 Condition of Cost Estimation

The project cost is estimated based on the conditions stated below.

- The project cost comprises construction cost, administration cost, engineering cost, contingency (physical and price escalation), interest during construction, commitment charge (front end fee) and relevant taxes.
- The project cost is composed of a local currency potion (L.C.) and a foreign currency portion (F.C.).
- Administration cost in recipient country is assumed to be 5.0 percent of the construction cost.
- Engineering cost is estimated based on man-months of consulting services shown in Table 5.24.
- Physical contingency is considered as 5.0 percent of total of construction cost and engineering cost.
- Price contingency of 6.0 percent per annum for the local currency portion and 1.3 percent per annum for the foreign currency portion are applied based on implementation schedule shown in Table 5.12.
- The base period of cost estimation is December in 2013 and the exchange rate is considered to be 1 UAH=11.93 Yen, 1 Euro=129.64 Yen and 1Euro=10.87 UAH.
- Interest during construction is estimated considering that Project cost is financed by Japanese ODA loan. (Loan condition: Special Terms of Economic Partnership (STEP), Interest rate for main components=0.10%, Interest rate for consulting services=0.01%, Repayment period=40 years, Grace period=10 years)
- Front end fee is imposed by 0.2% of the commitment amount. (The rate of 0.1% is retroactively applied instead of 0.2% in the event that all disbursement is completed within the original disbursement period.)
- Customs rate is 5 % for imported goods taking the Customs tariff of Ukraine into account, and tax rate, i.e. value added tax, in Ukraine is 20 %.
- Construction cost, engineering cost contingency (physical and price escalation), interest during construction and front end fee are portions eligible for ODA loan, while administration cost and relevant taxes are portions non-eligible for ODA loan, considering that the Project cost is to be financed by a Japanese ODA loan.

5.1.2 Condition of Estimating the Construction Cost

The construction cost is estimated based on the conditions listed as follows.

- The materials for civil and building works, labor and construction machinery are basically procured from the local market.
- Mechanical and electrical equipment is procured from Japan, EU countries and the local market. Procurement is decided considering the requirements of STEP and factors such as quality, economic aspects and maintenance.
- The ratio of the goods and services procured from Japan is no less than thirty percent (30%) of the total construction cost under STEP loan conditions.
- Utilization of local contractors is considered for execution of construction works since they have enough experience and ability of local operation.
- The reconstruction of the WWTP is planned to be implemented while the existing facilities are operated to manage the influent sewage during reconstruction period.
- Local physical conditions such as geographical, geological and meteorological conditions and local regulations and customs are taken into consideration to prepare implementation plan of the Project.

5.1.3 Options of the Project Financed by Japanese ODA Loan

All of the activities for reconstructing BAS require a large amount of investment to complete. In general, such a large project becomes feasible for implementation if they are implemented through several projects with appropriate phased development steps. Further, the phased implementation is needed for investment decision by financial or investment institutions.

Hence, KVK has prioritized activities necessary for reconstructing the WWTP and decided the scope of activities for Project Stage 1 considering urgency, improvement of performance, investment efficiency, etc. Then, the prioritized activities are classified into the following five components as shown in Table 5.1 considering functions of facilities and size of investment.

Table 5.1 Components of Prioritized Activities

Component	Main works
Component 0 (C0)	Dismantling of the existing facilities Land preparation of the WWTP site
Component 1 (C1)	Preliminary treatment facilities for Block 2 and Block 3 Primary treatment facilities for Block 2 and Block 3 Rehabilitation of existing secondary treatment for Block 2 Rehabilitation of part of existing secondary treatment for Block 3
Component 2 (C2)	Gravity thickener

Component	Main works
	Mechanical thickening facilities Mechanical dewatering facilities Administration building and laboratory building
Component 3 (C3)	Sludge incineration facilities
Component 4 (C4)	Preliminary treatment facilities for Block 1 Primary treatment facilities for Block 1 Secondary treatment facilities for Block 1 Tertiary treatment and disinfection facilities for Block 1

Source: JICA Study Team

KVK has decided to implement the package of activities listed in Component 0 (C0) using own funds since these preparation works for main construction works do not require highly qualified contractors and are technically and financially manageable by KVK.

However, the remaining activities still require a large amount of investment. Hence, the following options of scope of packages shown in Table 5.2 are proposed in order to allow financial investment institutions to make investment decision considering financial resources.

Table 5.2 Options of the Project Financed by Japanese ODA Loan

Option	Components included in Options
Option 1	Component 1 (C1), Component 2 (C2), Component 3 (C3) and Component 4 (C4)
Option 2	Component 2 (C2), Component 3 (C3) and Component 4 (C4)
Option 3	Component 2 (C2) and Component 3 (C3)

Source: JICA Study Team

5.1.4 Estimated Project Cost

(1) Estimated Construction Cost

Cost estimation of all activities has been carried out and is shown in Table 5.3 and Table 5.4. The estimated construction cost for the Project is 662 million Euro (JPY 85.8 billion). The breakdown of the estimates is presented in Chapter 4 of Appendix.

Table 5.3 Estimated Construction Cost (Euro)

No	Items	L.C. (1,000 Euro)	F.C. (1,000 Euro)	Total (1,000 Euro)
	Component 0			
A-1	Dismantling of the existing facilities	6,417	0	6,417
A-2	Land preparation of the WWTP site	46,849	0	46,849
	Sub-total of A	53,266	0	53,266
B	Component 1			
B-1	Preliminary and primary treatment (Block 2)	15,310	12,952	28,262
B-2	Secondary treatment (Block 2)	8,657	18,336	26,993
B-3	Preliminary and primary treatment (Block 3)	12,042	10,051	22,093
B-4	Secondary treatment (Block 3)	11,707	16,477	28,184
B-5	Piping works	19,058	0	19,058
B-6	Utility buildings, ancillary and landscaping work	8,911	0	8,911
	Sub-total of B	75,685	57,816	133,501
C	Component 2			
C-1	Gravity thickener	3,452	2,298	5,750
C-2	Mechanical thickening and dewatering building	12,790	30,990	43,780
C-3	Administrating building	6,680	6,818	13,498
C-4	Laboratory building	3,403	0	3,403
C-5	Piping works	18,675	0	18,675
C-6	Utility buildings, ancillary and landscaping work	20,029	0	20,029
	Sub-total of C	65,029	40,106	105,135
D	Component 3			
D-1	Sludge incineration	28,856	145,965	174,821
D-2	Piping works	3,584	0	3,584
D-3	Utility buildings, ancillary and landscaping work	4,326	0	4,326
	Sub-total of D	36,766	145,965	182,731
E	Component 4			
E-1	Preliminary and primary treatment (Block 1)	14,116	13,851	27,967
E-2	Secondary treatment (Block 1)	53,877	46,977	100,854
E-3	Tertiary treatment and disinfection (Block 1)	8,008	13,667	21,675
E-4	Piping works	17,213	0	17,213
E-5	Utility buildings, ancillary and landscaping work	19,574	0	19,574
	Sub-total of E	112,788	74,495	187,283
	Total of Construction Cost	**343,534**	**318,382**	**661,916**

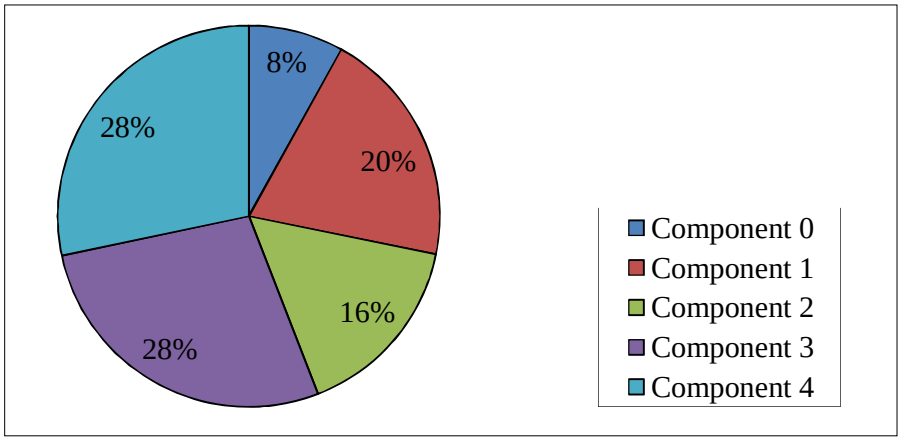
Source: JICA Study Team

Table 5.4 Estimated Construction Cost (JPY)

No	Items	L.C. (million JPY)	F.C. (million JPY)	Total (million JPY)
	Component 0			
A-1	Dismantling of the existing facilities	832	0	832
A-2	Land preparation of the WWTP site	6,074	0	6,074
	Sub-total of A	6,905	0	6,905
B	Component 1			
B-1	Preliminary and primary treatment (Block 2)	1,985	1,679	3,664
B-2	Secondary treatment (Block 2)	1,122	2,377	3,499
B-3	Preliminary and primary treatment (Block 3)	1,561	1,303	2,864
B-4	Secondary treatment (Block 3)	1,518	2,136	3,654
B-5	Piping works	2,471	0	2,471
B-6	Utility buildings, ancillary and landscaping work	1,155	0	1,155
	Sub-total of B	9,812	7,495	17,307
C	Component 2			
C-1	Gravity thickener	448	298	745
C-2	Mechanical thickening and dewatering building	1,658	4,018	5,676
C-3	Administrating building	866	884	1,750
C-4	Laboratory building	441	0	441
C-5	Piping works	2,421	0	2,421
C-6	Utility buildings, ancillary and landscaping work	2,597	0	2,597
	Sub-total of C	8,430	5,199	13,630
D	Component 3			
D-1	Sludge incineration	3,741	18,923	22,664
D-2	Piping works	465	0	465
D-3	Utility buildings, ancillary and landscaping work	561	0	561
	Sub-total of D	4,766	18,923	23,689
E	Component 4			
E-1	Preliminary and primary treatment (Block 1)	1,830	1,796	3,626
E-2	Secondary treatment (Block 1)	6,985	6,090	13,075
E-3	Tertiary treatment and disinfection (Block 1)	1,038	1,772	2,810
E-4	Piping works	2,231	0	2,231
E-5	Utility buildings, ancillary and landscaping work	2,538	0	2,538
	Sub-total of E	14,622	9,658	24,279
	Total of Construction Cost	**44,536**	**41,275**	**85,811**

Source: JICA Study Team

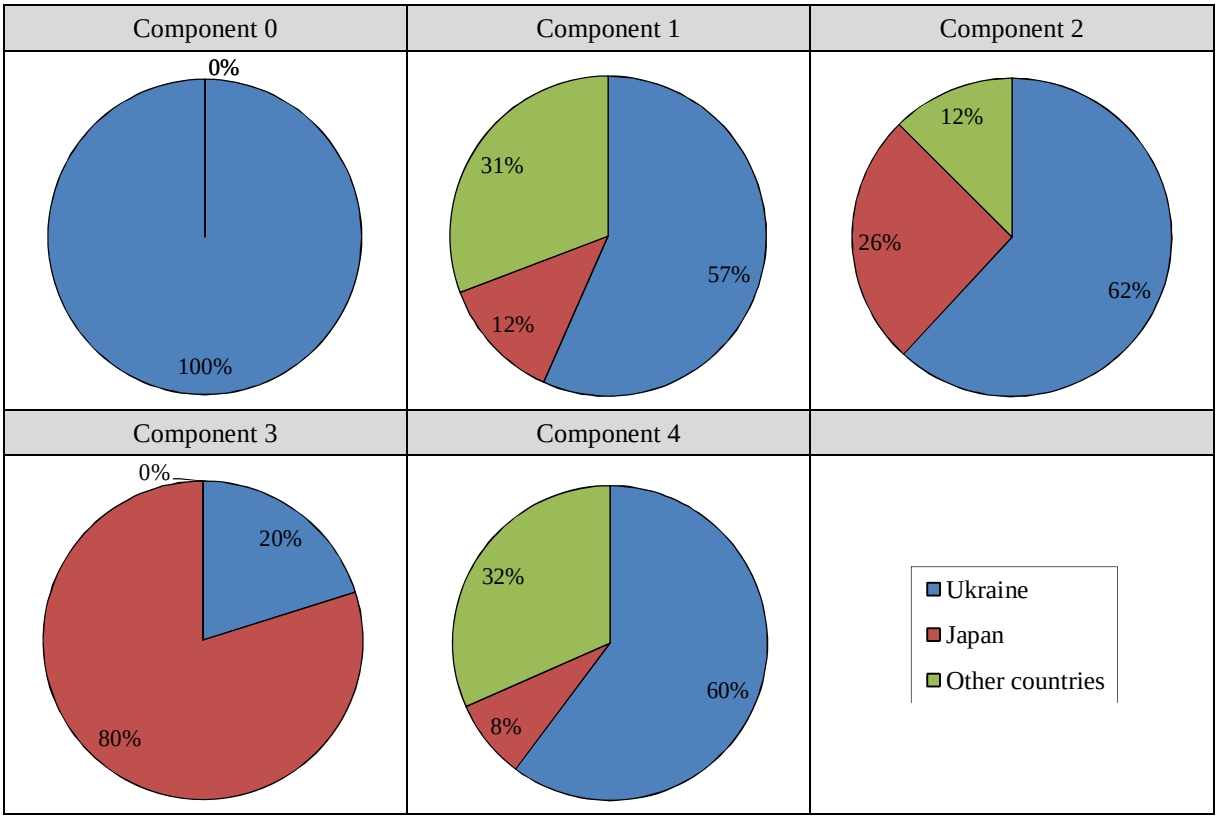
The ratio of the estimated construction cost of components is shown in Figure 5.1. The construction costs of Component 0 (C0), Component 1 (C1), Component 2 (C2), Component 3 (C3) and Component 4 (C4) constitute 8 %, 20 %, 16 %, 28 % and 28 % of the total construction costs, respectively.



Source: JICA Study Team

Figure 5.1 Ratio of the Construction Cost

The ratio of the goods and services procured from Ukraine, Japan and other countries for each component of the construction works is shown in Figure 5.2.



Source: JICA Study Team

Figure 5.2 Ratio of Procurement of Each Component

(2) Estimated Project Cost of Option 1

Cost estimation of Option 1 has been carried out and is shown in Table 5.5 and Table 5.6. The estimated project cost for the Project is 1,123 million Euro (JPY 145.5 billion). The eligible portions of the estimated project cost for the Project is 825 million Euro (JPY 106.9 billion) while non-eligible portions of the estimated project cost for the Project is 298 million Euro (JPY 38.6 billion).

Table 5.5 Estimated Project Cost of Option 1 (Euro)

No	Items	L.C. (1,000 Euro)	F.C. (1,000 Euro)	Total (1,000 Euro)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 1	75,685	57,816	133,501
B	Component 2	65,029	40,106	105,135
C	Component 3	36,766	145,965	182,731
D	Component 4	112,788	74,495	187,283
	Sub-total of 1	**290,268**	**318,382**	**608,650**
2.	Engineering cost	26,970	27,577	54,547
3.	Physical contingency	19,470	16,983	36,453
4.	Price contingency	99,159	21,282	120,441
5.	Interest during construction	0	3,051	3,051
6.	Front end fee	0	1,646	1,646
	Sub-total of (2-6)	**145,599**	**70,539**	**216,138**
	Total of eligible portions	**435,867**	**388,921**	**824,788**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	53,266	0	53,266
	Sub-total of 1	**53,266**	**0**	**53,266**
2.	Administration cost	44,000	0	44,000
3.	Physical contingency	2,860	0	2,860
4.	Price contingency	3,912	0	3,912
5.	Tax and duty	193,824	0	193,824
	Sub-total of (2-5)	**244,596**	**0**	**244,596**
	Total of non-eligible portions	**297,862**	**0**	**297,862**
	Total	**733,729**	**388,921**	**1,122,650**

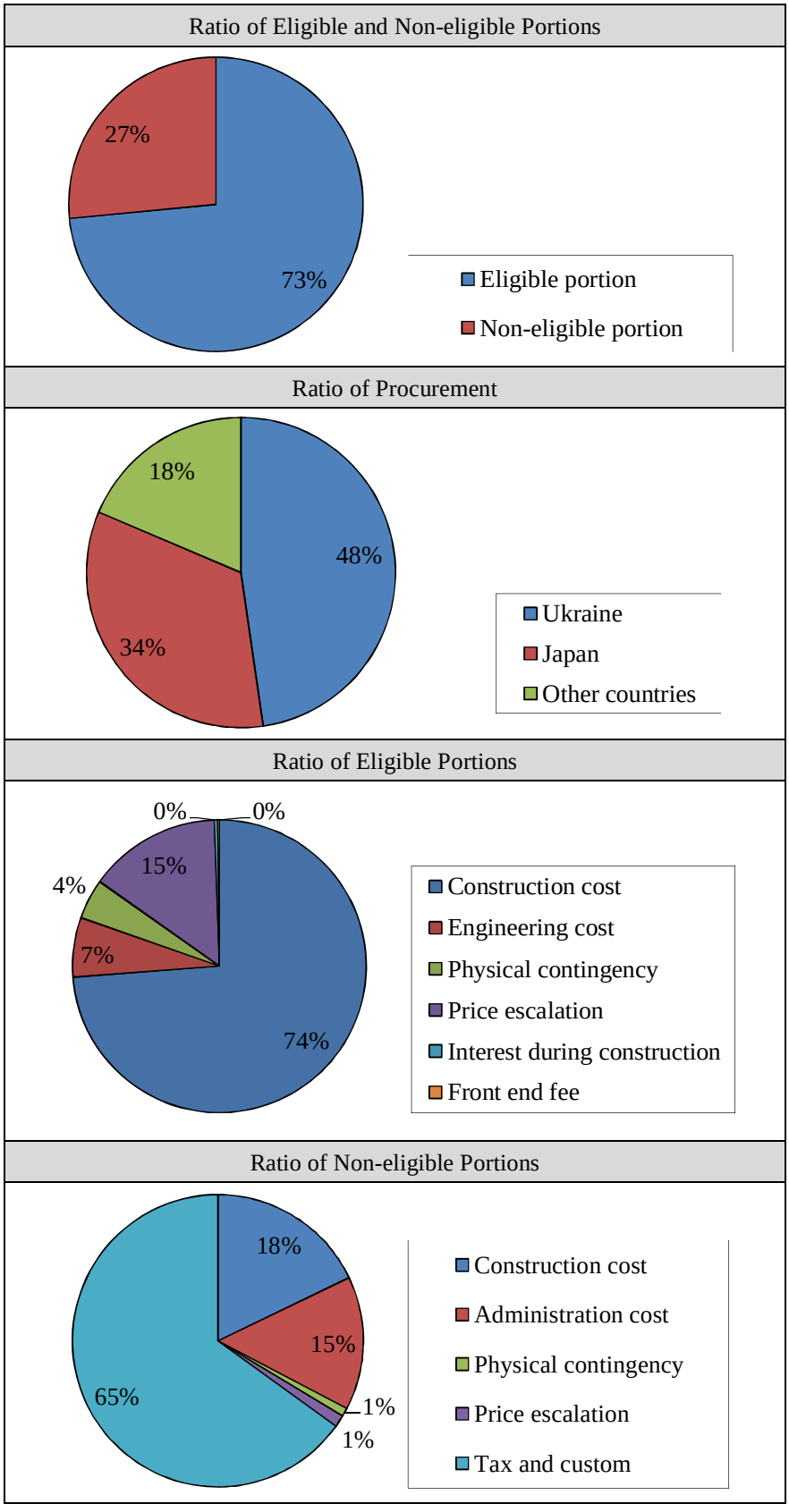
Source: JICA Study Team

Table 5.6 Estimated Project Cost of Option 1 (JPY)

No	Items	L.C. (million JPY)	F.C. (million JPY)	Total (million JPY)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 1	9,812	7,495	17,307
B	Component 2	8,430	5,199	13,630
C	Component 3	4,766	18,923	23,689
D	Component 4	14,622	9,658	24,279
	Sub-total of 1	**37,630**	**41,275**	**78,905**
2.	Engineering cost	3,496	3,575	7,071
3.	Physical contingency	2,524	2,202	4,726
4.	Price contingency	12,855	2,759	15,614
5.	Interest during construction	0	396	396
6.	Front end fee	0	213	213
	Sub-total of (2-6)	**18,875**	**9,145**	**28,020**
	Total of eligible portions	**56,506**	**50,420**	**106,926**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	6,905	0	6,905
	Sub-total of 1	**6,905**	**0**	**6,905**
2.	Administration cost	5,704	0	5,704
3.	Physical contingency	371	0	371
4.	Price contingency	507	0	507
5.	Tax and duty	25,127	0	25,127
	Sub-total of (2-5)	**31,709**	**0**	**31,709**
	Total of non-eligible portions	**38,615**	**0**	**38,615**
	Total	**95,121**	**50,420**	**145,540**

Source: JICA Study Team

The ratio of eligible and non-eligible portions, the ratio of the goods and services procured for the construction works and the ratio of the estimated project cost are shown in Figure 5.3. Eligible portions account for 73 % of the total project cost while non-eligible portions account for 27 %. The procurement from Ukraine, Japan and other countries occupy 48 %, 34 % and 18 % of the total construction costs, respectively. Direct construction cost accounts for 74 % of eligible portions of the project cost and indirect construction cost including remaining costs accounts for 26 %. Direct construction cost accounts for 18 % of non-eligible portions of the project cost and indirect construction cost including remaining costs accounts for 82 %.



Source: JICA Study Team

Figure 5.3 Analysis of Project Cost of Option 1

(3) Estimated Project Cost of Option 2

Cost estimation of Option 2 has been carried out and is shown in Table 5.7 and Table 5.8. The estimated project cost for the Project is 895 million Euro (JPY 116.1 billion). The eligible portions of the estimated project cost for the Project is 645 million Euro (JPY 83.7 billion) while non-eligible portions of the estimated project cost for the Project is 250 million Euro (JPY 32.4 billion).

Table 5.7 Estimated Project Cost of Option 2 (Euro)

No	Items	L.C. (1,000 Euro)	F.C. (1,000 Euro)	Total (1,000 Euro)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 2	65,029	40,106	105,135
B	Component 3	36,766	145,965	182,731
C	Component 4	112,788	74,495	187,283
	Sub-total of 1	**214,583**	**260,566**	**475,149**
2.	Engineering cost	24,568	22,935	47,503
3.	Physical contingency	14,398	13,898	28,296
4.	Price contingency	73,324	17,417	90,741
5.	Interest during construction	0	2,372	2,372
6.	Front end fee	0	1,288	1,288
	Sub-total of (2-6)	**112,290**	**57,910**	**170,200**
	Total of eligible portions	**326,873**	**318,476**	**645,349**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	53,266	0	53,266
	Sub-total of 1	**53,266**	**0**	**53,266**
2.	Administration cost	35,083	0	35,083
3.	Physical contingency	2,859	0	2,859
4.	Price contingency	3,913	0	3,913
5.	Tax and duty	154,921	0	154,921
	Sub-total of (2-5)	**196,776**	**0**	**196,776**
	Total of non-eligible portions	**250,042**	**0**	**250,042**
	Total	**576,915**	**318,476**	**895,391**

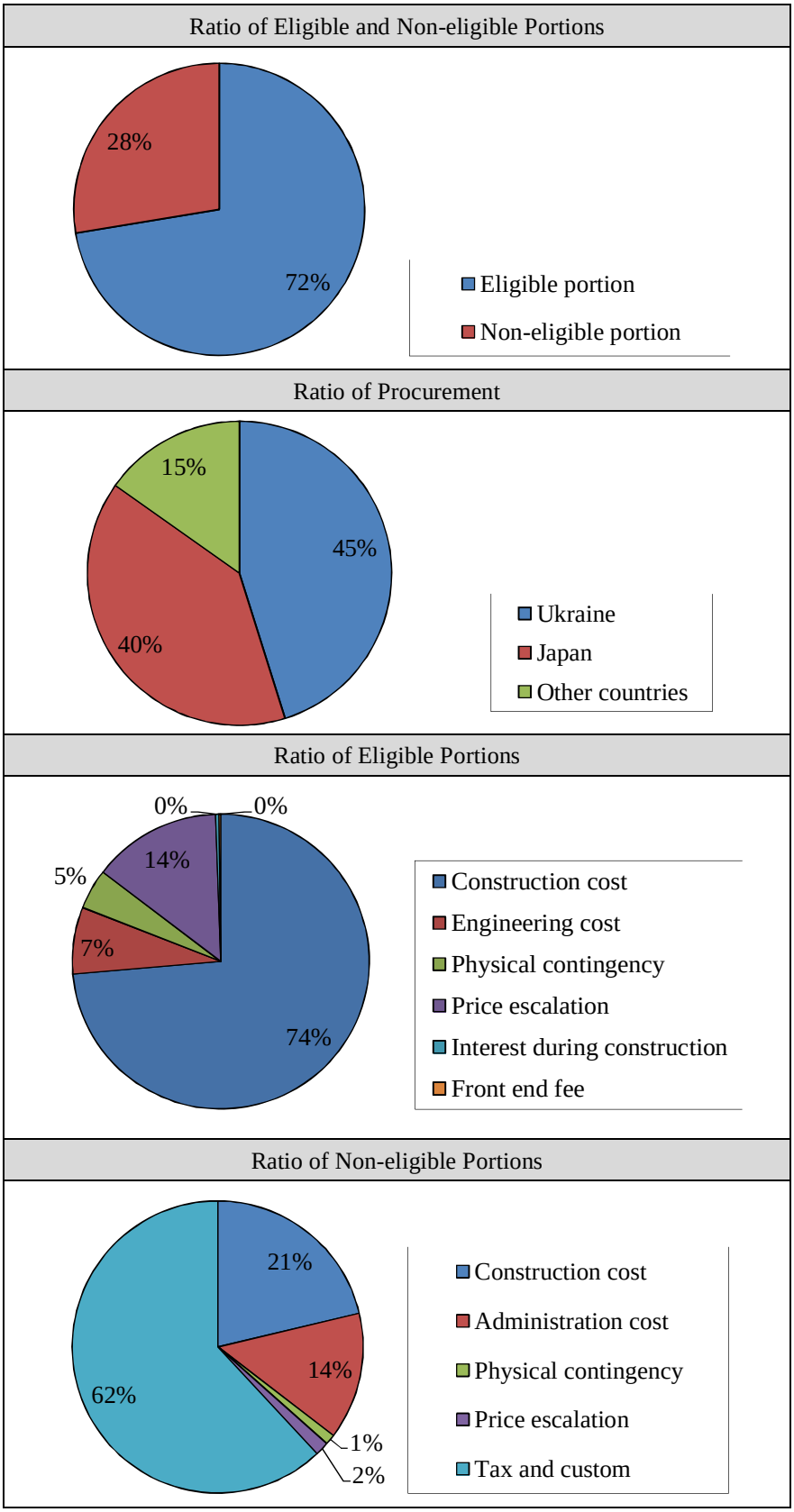
Source: JICA Study Team

Table 5.8 Estimated Project Cost of Option 2 (JPY)

No	Items	L.C. (million JPY)	F.C. (million JPY)	Total (million JPY)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 2	8,430	5,199	13,630
B	Component 3	4,766	18,923	23,689
C	Component 4	14,622	9,658	24,279
	Sub-total of 1	**27,819**	**33,780**	**61,598**
2.	Engineering cost	3,185	2,973	6,158
3.	Physical contingency	1,867	1,802	3,668
4.	Price contingency	9,506	2,258	11,764
5.	Interest during construction	0	308	308
6.	Front end fee	0	167	167
	Sub-total of (2-6)	**14,557**	**7,507**	**22,065**
	Total of eligible portions	**42,376**	**41,287**	**83,663**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	6,905	0	6,905
	Sub-total of 1	**6,905**	**0**	**6,905**
2.	Administration cost	4,548	0	4,548
3.	Physical contingency	371	0	371
4.	Price contingency	507	0	507
5.	Tax and duty	20,084	0	20,084
	Sub-total of (2-5)	**25,510**	**0**	**25,510**
	Total of non-eligible portions	**32,415**	**0**	**32,415**
	Total	**74,791**	**41,287**	**116,078**

Source: JICA Study Team

The ratio of eligible and non-eligible portions, the ratio of the goods and services procured for the construction works and the ratio of the estimated project cost are shown in Figure 5.4. Eligible portions account for 72 % of the total project cost while non-eligible portions account for 28 %. The procurement from Ukraine, Japan and other countries occupy 45 %, 40 % and 15 % of the total construction costs, respectively. Direct construction cost accounts for 74 % of eligible portions of the project cost and indirect construction cost including remaining costs accounts for 26 %. Direct construction cost accounts for 21 % of non-eligible portions of the project cost and indirect construction cost including remaining costs accounts for 79 %.



Source: JICA Study Team

Figure 5.4 Analysis of Project Cost of Option 2

(4) Estimated Project Cost of Option 3

Cost estimation of Option 3 has been carried out and is shown in Table 5.9 and Table 5.10. The estimated project cost for the Project is 572 million Euro (JPY 74.2 billion). The eligible portions of the estimated project cost for the Project is 390 million Euro (JPY 50.5 billion) while non-eligible portions of the estimated project cost for the Project is 182 million Euro (JPY 23.6 billion).

Table 5.9 Estimated Project Cost of Option 3 (Euro)

No	Items	L.C. (1,000 Euro)	F.C. (1,000 Euro)	Total (1,000 Euro)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 2	65,029	40,106	105,135
B	Component 3	36,766	145,965	182,731
	Sub-total of 1	**101,795**	**186,071**	**287,866**
2.	Engineering cost	19,806	15,893	35,699
3.	Physical contingency	6,832	9,925	16,757
4.	Price contingency	34,792	12,438	47,230
5.	Interest during construction	0	1,410	1,410
6.	Front end fee	0	778	778
	Sub-total of (2-6)	**61,430**	**40,444**	**101,874**
	Total of eligible portions	**163,225**	**226,515**	**389,740**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	53,266	0	53,266
	Sub-total of 1	**53,266**	**0**	**53,266**
2.	Administration cost	22,378	0	22,378
3.	Physical contingency	2,859	0	2,859
4.	Price contingency	3,912	0	3,912
5.	Tax and duty	99,931	0	99,931
	Sub-total of (2-5)	**129,080**	**0**	**129,080**
	Total of non-eligible portions	**182,346**	**0**	**182,346**
	Total	**345,571**	**226,515**	**572,086**

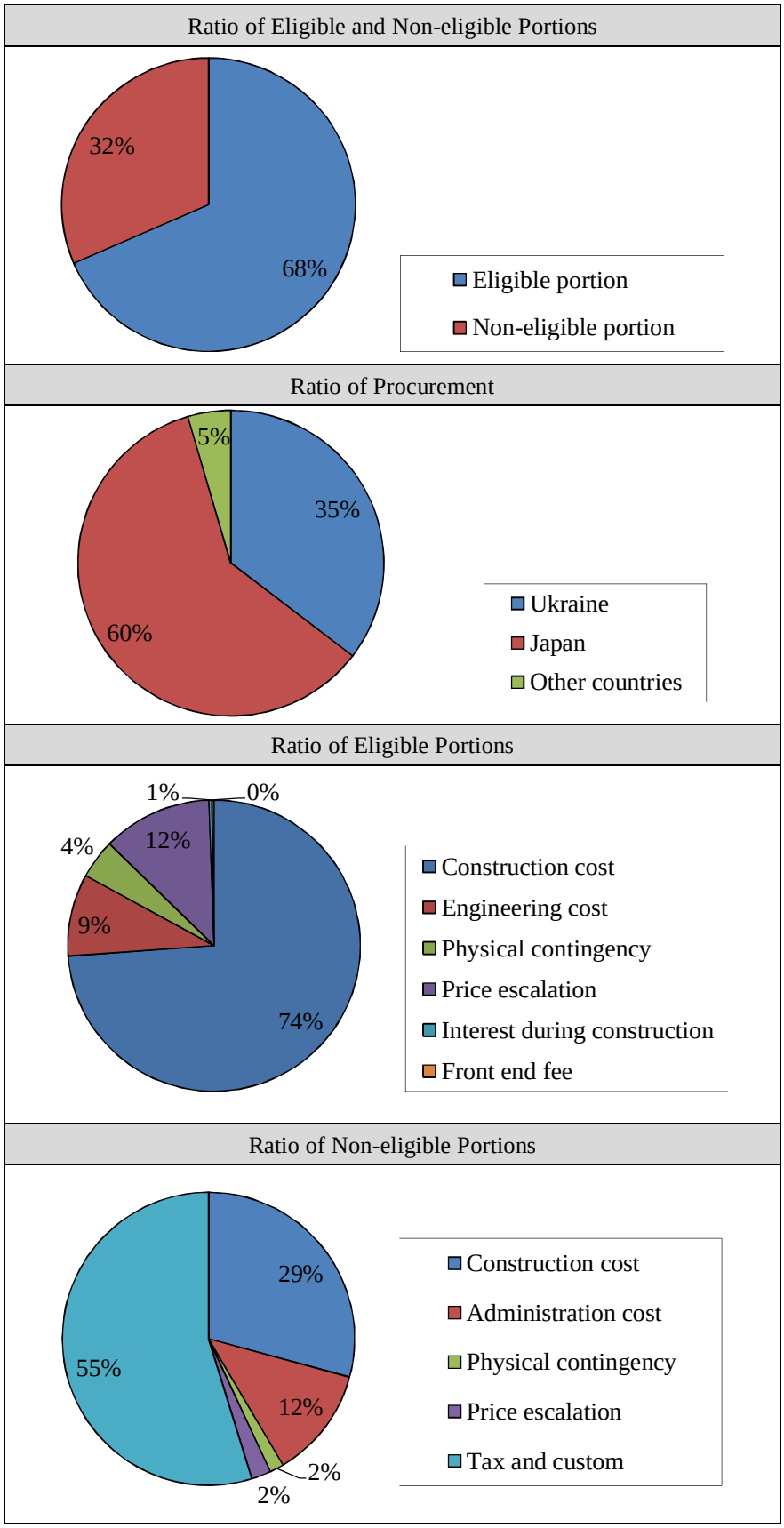
Source: JICA Study Team

Table 5.10 Estimated Project Cost of Option 3 (JPY)

No	Items	L.C. (million JPY)	F.C. (million JPY)	Total (million JPY)
	Eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 2	8,430	5,199	13,630
B	Component 3	4,766	18,923	23,689
	Sub-total of 1	**13,197**	**24,122**	**37,319**
2.	Engineering cost	2,568	2,060	4,628
3.	Physical contingency	886	1,287	2,172
4.	Price contingency	4,510	1,612	6,123
5.	Interest during construction	0	183	183
6.	Front end fee	0	101	101
	Sub-total of (2-6)	**7,964**	**5,243**	**13,207**
	Total of eligible portions	**21,160**	**29,365**	**50,526**
	Non-eligible portions for JICA ODA Loan			
1.	Construction cost			
A	Component 0	6,905	0	6,905
	Sub-total of 1	**6,905**	**0**	**6,905**
2.	Administration cost	2,901	0	2,901
3.	Physical contingency	371	0	371
4.	Price contingency	507	0	507
5.	Tax and duty	12,955	0	12,955
	Sub-total of (2-5)	**16,734**	**0**	**16,734**
	Total of non-eligible portions	**23,639**	**0**	**23,639**
	Total	**44,800**	**29,365**	**74,165**

Source: JICA Study Team

The ratio of eligible and non-eligible portions, the ratio of the goods and services procured for the construction works and the ratio of the estimated project cost are shown in Figure 5.5. Eligible portions account for 68 % of the total project cost while non-eligible portions account for 32 %. The procurement from Ukraine, Japan and other countries occupy 35 %, 60 % and 5 % of the total construction costs, respectively. Direct construction cost accounts for 74 % of eligible portions of the project cost and indirect construction cost including remaining costs accounts for 26 %. Direct construction cost accounts for 29 % of non-eligible portions of the project cost and indirect construction cost including remaining costs accounts for 71 %.



Source: JICA Study Team

Figure 5.5 Analysis of Project Cost of Option 3

5.1.5 Estimated Operation and Maintenance Cost

The operation and maintenance cost required for operating BAS after implementation of the Project is estimated and summarized in Table 5.11. The operation and maintenance cost is comprised of expenses on salary, electricity, maintenance including spare parts, disposal of ash, consumables including chemicals and others. Annual operation and maintenance cost in the condition of receiving design flow is 50.5 million Euro/year (6.6 billion Yen/year).

Table 5.11 Estimated Annual Operation and Maintenance Cost

No	Items	Total (1,000 Euro)	Total (million JPY)
1.	Salary	5,113	663
2.	Electricity	21,836	2,830
3.	Maintenance	4,135	536
4.	Disposal of ash	969	126
5.	Consumables	13,883	1,800
6.	Others	4,594	596
	Total	**50,530**	**6,551**

Source: JICA Study Team

5.2 Implementation Schedule and Disbursement Schedule of the Project

5.2.1 Implementation Schedule

If the Project is financed through Japanese ODA Loan, the Government of Ukraine must follow JICA procurement guidelines for the selection of the consultants and contractors to implement the Project.

The implementation schedule starting from the signing of Loan Agreement has been developed as shown in Table 5.12 taking into account all necessary steps that would be required. Implementation of the project has been estimated to extend to over 96 months (8 years) in total.

Table 5.12 Implementation Schedule

	Period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Signing of LA	-	▼								
Selection of Consultant	9 months	■	■							
Detailed Design	15 months		■	■						
Land Preparation	30 months	■	■	■	■					
Selection of Contractor	12 months			■	■					
Construction Works	48 months				■	■	■	■	■	
Trial Operation Period	12 months								■	■

Source: JICA Study Team

The duration necessary for selection of the consultant and the contractor has been decided considering JICA's standard procedures and is estimated at 9 months for selection of the consultants and 12 months for selection of the contractor, respectively. Detailed implementation schedules are shown in Table 5.13 and Table 5.14.

Table 5.13 Detailed Implementation Schedule of Selection of Consultant

Month	Period	1	2	3	4	5	6	7	8	9
Preparation of shortlist and RFP	2 months									
Concurrence to RFP by JICA	1 month									
Issuing FRP to consultant	1.5 months									
Evaluation of proposals	1.5 months									
Concurrence to evaluation by JICA	1 month									
Contact negotiation with candidate	1 month									
Concurrence to contract by JICA	1 month									
Contract award	-									

Source: JICA Study Team

Table 5.14 Detailed Implementation Schedule of Selection of Contractor

Month	Period	1	2	3	4	5	6	7	8	9	10	11	12
Concurrence to TD by JICA	1 month												
Tender period	3 months												
Technical evaluation	2 months												
Concurrence to evaluation by JICA	1 month												
Price evaluation	2 months												
Concurrence to evaluation by JICA	1 month												
Contract negotiation with candidate	1 month												
Concurrence to contract by JICA	1 month												
Contract award	-												

Source: JICA Study Team

The duration necessary for land preparation works has been tentatively estimated at 30 months and land preparation should be completed before commencement of main construction works.

The duration necessary for main construction works has been planned to ensure proper execution of the works considering the conditions including ability of contractors, procurement of materials and labor force, manner of construction in Ukraine and construction scale. The construction schedule is mainly estimated according to procedure and working volume of construction such as excavation and concrete casting since there is rarely restriction regarding procurement. Studies on construction

methods including foundation type of the structures, earthwork planning and land formation planning were conducted in order to develop implementation schedule of construction works and the results are presented in Chapter 5 of Appendix. One year of trial operation period including on-job training is planned after the construction so that KVK, which is responsible for operation and maintenance, takes over operation of the constructed facilities smoothly.

(1) Implementation Schedule of Construction Works of Option 1

The implementation schedule of the construction works of Option 1 has been estimated to extend to over 48 months in total and is shown in Table 5.15.

Table 5.15 Detailed Implementation Schedule of Construction Works of Option 1

Year	Year 1		Year 2		Year 3		Year 4	
Component 1								
Preliminary and primary treatment for Block 2								
Rehabilitation of aeration tank for Block 2								
Rehabilitation of secondary setting tank for Block 2								
Rehabilitation of blower buiding for Block 2								
Preliminary and primary treatment for Block 3								
Renovation of aeration tank for Block 3								
Rehabilitation of secondary setting tank for Block 3								
Rehabilitation of blower buiding for Block 3								
Component 2								
Gravity thickener								
Mechanical thickening								
Mechanical dewatering								
Administration building								
Laboratory building								
Component 3								
Sludge incineration								
Component 4								
Preliminary and primary treatment for Block 1								
Aeration tank for Block 1								
Secondary setting tank for Block 1								
Blower buidling for Block 1								
Tertiary treatment for Block 1								
Disinfection for Block 1								
Test								
Testing and commissioning								

Source: JICA Study Team

(2) Implementation Schedule of Construction Works of Option 2

The implementation schedule of the construction works of Option 2 has been estimated to extend to over 48 months in total and is shown in Table 5.16.

Table 5.16 Detailed Implementation Schedule of Construction Works of Option 2

Year	Year 1		Year 2		Year 3		Year 4	
Component 2								
Gravity thickener								
Mechanical thickening								
Mechanical dewatering								
Administration building								
Laboratory building								
Component 3								
Sludge incineration								
Component 4								
Preliminary and primary treatment for Block 1								
Aeration tank for Block 1								
Secondary setting tank for Block 1								
Blower buidling for Block 1								
Tertiary treatment for Block 1								
Disinfection for Block 1								
Test								
Testing and commissioning								

Source: JICA Study Team

(3) Implementation Schedule of Construction Works of Option 3

The implementation schedule of the construction works of Option 3 has been estimated to extend to over 48 months in total and is shown in Table 5.17.

Table 5.17 Detailed Implementation Schedule of Construction Works of Option 3

Year	Year 1		Year 2		Year 3		Year 4	
Component 2								
Gravity thickener	■	■	■					
Mechanical thickening				■	■	■		
Mechanical dewatering	■	■	■	■				
Administration building	■	■	■	■				
Laboratory building					■	■	■	■
Component 3								
Sludge incineration				■	■	■	■	■
Test								
Testing and commissioning								■

Source: JICA Study Team

5.2.2 Disbursement Schedule

(1) Disbursement Schedule of Option 1

The disbursement schedule of Option 1 based on the implementation schedule has been prepared as shown in Table 5.18 and Table 5.19.

Table 5.18 Disbursement Schedule of Option 1 (Euro)

(Million Euro)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	00.0	2.65	2.55	48.14	100.91	107.00	113.45	60.65	0.53	435.87
F.C	1.65	3.66	4.12	46.94	92.41	93.88	95.32	49.52	1.41	388.92
Total	1.65	6.30	6.67	95.08	193.32	200.88	208.77	110.07	1.94	824.79
Non-eligible portions of the project cost										
L.C	13.98	31.22	33.09	25.92	52.65	54.55	56.53	29.63	0.29	297.86
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	13.98	31.22	33.09	25.92	52.65	54.55	56.53	29.63	0.29	297.86
Total project cost										
L.C	13.98	33.87	35.54	74.06	153.56	161.55	169.98	90.28	0.82	733.73
F.C	1.65	3.66	4.12	46.94	92.41	93.88	95.32	49.52	1.41	388.92
Total	15.63	37.53	39.66	121.00	245.97	255.43	265.30	139.80	2.23	1,122.65

Source: JICA Study Team

Table 5.19 Disbursement Schedule of Option 1 (JPY)

(Billion JPY)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	0.00	0.34	0.33	6.24	13.08	13.87	14.71	7.86	0.07	56.51
F.C	0.21	0.47	0.53	6.09	11.98	12.17	12.36	6.42	0.18	50.04
Total	0.21	0.82	0.87	12.33	25.06	26.04	27.07	14.28	0.25	106.93
Non-eligible portions of the project cost										
L.C	1.81	4.05	4.29	3.36	6.83	7.07	7.33	3.84	0.04	38.62
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.81	4.05	4.29	3.36	6.83	7.07	7.33	3.84	0.04	38.62
Total project cost										
L.C	1.81	4.39	4.62	9.60	19.91	20.94	22.04	11.70	0.11	95.12
F.C	0.21	0.47	0.53	6.09	11.98	12.17	12.36	6.42	0.18	50.42
Total	2.03	4.87	5.15	15.69	31.89	33.11	34.39	18.12	0.29	145.54

Source: JICA Study Team

(2) Disbursement Schedule of Option 2

The disbursement schedule of Option 2 based on the implementation schedule has been prepared as shown in Table 5.20 and Table 5.21.

Table 5.20 Disbursement Schedule of Option 2 (Euro)

(Million Euro)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	0.00	2.48	2.42	36.08	75.32	79.88	84.71	45.43	0.55	326.87
F.C	1.29	3.15	3.52	38.45	75.56	76.76	77.94	40.54	1.24	318.48
Total	1.29	5.63	5.94	74.53	150.88	156.64	162.65	85.97	1.79	645.35
Non-eligible portions of the project cost										
L.C	13.98	31.05	32.91	20.39	41.26	42.72	44.23	23.21	0.30	250.04
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	13.98	31.05	32.91	20.39	41.26	42.72	44.23	23.21	0.30	250.04
Total project cost										
L.C	13.98	33.54	35.32	56.47	116.59	122.60	128.93	68.65	0.85	576.92
F.C	1.29	3.15	3.52	38.45	75.56	76.76	77.94	40.54	1.24	318.48
Total	15.27	36.69	38.84	94.92	192.15	199.36	206.87	109.19	2.09	895.39

Source: JICA Study Team

Table 5.21 Disbursement Schedule of Option 2 (JPY)

(Billion JPY)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	0.00	0.32	0.31	4.68	9.76	10.36	10.98	5.89	0.07	42.38
F.C	0.17	0.41	0.46	4.99	9.80	9.95	10.11	5.26	0.16	41.29
Total	0.17	0.73	0.77	9.66	19.56	20.31	21.09	11.15	0.23	83.66
Non-eligible portions of the project cost										
L.C	1.81	4.03	4.27	2.64	5.35	5.54	5.73	3.01	0.04	32.42
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.81	4.03	4.27	2.64	5.35	5.54	5.73	3.01	0.04	32.42
Total project cost										
L.C	1.81	4.35	4.58	7.32	15.11	15.89	16.72	8.90	0.11	74.79
F.C	0.17	0.41	0.46	4.99	9.80	9.95	10.11	5.26	0.16	41.29
Total	1.98	4.76	5.04	12.31	24.91	25.85	26.82	14.15	0.27	116.08

Source: JICA Study Team

(3) Disbursement Schedule of Option 3

The disbursement schedule of Option 3 based on the implementation schedule has been prepared as shown in Table 5.22 and Table 5.23.

Table 5.22 Disbursement Schedule of Option 3 (Euro)

(Million Euro)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	0.00	1.96	1.96	17.97	37.05	39.32	41.72	22.68	0.57	163.23
F.C	0.78	2.14	2.45	27.33	53.80	54.66	55.49	28.93	0.94	226.52
Total	0.78	4.10	4.41	45.30	90.85	93.98	97.21	51.61	1.50	389.74
Non-eligible portions of the project cost										
L.C	13.98	30.67	32.52	12.58	25.25	26.04	26.86	14.15	0.29	182.35
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	13.98	30.67	32.52	12.58	25.25	26.04	26.86	14.15	0.29	182.35
Total project cost										
L.C	13.98	32.63	34.49	30.55	62.30	65.36	68.58	36.83	0.86	345.57
F.C	0.78	2.14	2.45	27.33	53.80	54.66	55.49	28.93	0.94	226.52
Total	14.76	34.77	36.94	57.88	116.10	120.02	124.07	65.76	1.80	572.09

Source: JICA Study Team

Table 5.23 Disbursement Schedule of Option 3 (JPY)

(Million JPY)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Total
Eligible portions of the project cost										
L.C	0.00	0.25	0.25	2.33	4.80	5.10	5.41	2.94	0.07	21.16
F.C	0.10	0.28	0.32	3.54	6.98	7.09	7.19	3.75	0.12	29.37
Total	0.10	0.53	0.57	5.87	11.78	12.18	12.60	6.69	0.20	50.53
Non-eligible portions of the project cost										
L.C	1.81	3.98	4.22	1.63	3.27	3.38	3.48	1.83	0.04	23.64
F.C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.81	3.98	4.22	1.63	3.27	3.38	3.48	1.83	0.04	23.64
Total project cost										
L.C	1.81	4.23	4.47	3.96	8.08	8.47	8.89	4.78	0.11	44.80
F.C	0.10	0.28	0.32	3.54	6.98	7.09	7.19	3.75	0.12	29.37
Total	1.91	4.51	4.79	7.50	15.05	15.56	16.09	8.53	0.23	74.17

Source: JICA Study Team

According to the disbursement schedules, non-eligible portions of the project cost should be timely prepared by Ukrainian government in order to implement the Project smoothly.

5.3 Consulting Services

5.3.1 Required Consulting Services

If this Project is financed through a Japanese ODA Loan, the procurement procedure of Design-Bid-Build contract applying "FIDIC Conditions of Contract for Construction Multilateral Development Bank (MDB) Harmonized Edition for Building and Engineering Works Designed by the Employer" is a common practice for the construction project. In the procurement of Design-Bid-Build contract, detailed design and supervision of the construction works are performed by the consultants. Consulting services including the following will be required for smooth implementation of the Project by assisting KVK, the executing agency.

- Implementation of detailed design
- Preparation of tender documents for the contract
- Assistance in tender/qualification evaluation and contract negotiation
- Supervision of the construction works
- Technical assistance of management, operation and maintenance

The consultant's office should be set up in Kiev for carrying out the consulting services of the Project and executing agency office is proposed to be stationed full time at the consultant Kiev office for smooth implementation of the Project. The consultants are composed of international and local

experts. Local experts should support international experts in all the activities of the Project. The proposed work schedule of the consultants should be in accord with the implementation schedule as shown in Table 5.12.

(1) Consulting Services of Option 1

The required international and local experts along with man-months for consulting services for the implementation of Option 1 are presented in Table 5.24. Based on the estimation of required man-months, 1,043 man-months of international experts and 1,685 man-months of local experts would be required for assisting the executing agency for the Project.

Table 5.24 Consulting Services of Option 1

	International			Local		
	No.	Month	MM	No.	Month	MM
Team leader	1	66	66	0	0	0
Deputy team leader	0	0	0	1	77	77
Process engineer	2	13	26	2	12	24
Civil engineer	4	63	246	4	63	252
Structure engineer	4	7	28	4	7	28
Mechanical engineer	4	61	238	4	61	244
Electrical engineer	2	61	120	2	61	122
Architect	1	59	59	2	61	122
Building service engineer	1	12	12	2	61	122
Cost estimator	4	6	24	4	6	24
Environmental specialist	1	8	8	1	12	12
Institutional expert	1	8	8	1	11	11
Operation expert	1	9	9	1	15	15
M&E maintenance expert	1	9	9	1	15	15
Laboratory expert	1	9	9	1	15	15
Social development expert	1	8	8	1	14	14
Contract engineer	4	16	50	0	0	0
Quantity surveyor	3	41	123	3	48	144
Surveyor	0	0	0	1	60	60
Inspector	0	0	0	8	48	384
Total	36		1,043	43		1,685

Source: JICA Study Team

(2) Consulting Services of Option 2

The required international and local experts along with man-months for consulting services for the implementation of Option 2 are presented in Table 5.25. Based on the estimation of required man-months, 866 man-months of international experts and 1,410 man-months of local experts would be required for assisting the executing agency for the Project.

Table 5.25 Consulting Services of Option 2

	International			Local		
	No.	Month	MM	No.	Month	MM
Team leader	1	66	66	0	0	0
Deputy team leader	0	0	0	1	77	77
Process engineer	2	13	26	2	12	24
Civil engineer	3	63	185	3	63	189
Structure engineer	3	7	21	3	7	21
Mechanical engineer	3	61	179	3	61	183
Electrical engineer	2	61	120	2	61	122
Architect	1	59	59	2	61	122
Building service engineer	1	12	12	2	61	122
Cost estimator	4	6	24	4	6	24
Environmental specialist	1	8	8	1	12	12
Institutional expert	1	8	8	1	11	11
Operation expert	1	9	9	1	15	15
M&E maintenance expert	1	9	9	1	15	15
Laboratory expert	1	9	9	1	15	15
Social development expert	1	8	8	1	14	14
Contract engineer	3	16	41	0	0	0
Quantity surveyor	2	41	82	2	48	96
Surveyor	0	0	0	1	60	60
Inspector	0	0	0	6	48	288
Total	31		866	37		1,410

Source: JICA Study Team

(3) Consulting Services of Option 3

The required international and local experts along with man-months for consulting services for the implementation of Option 3 are presented in Table 5.26. Based on the estimation of required man-months, 598 man-months of international experts and 1,050 man-months of local experts would be required for assisting the executing agency for the Project.

Table 5.26 Consulting Services of Option 3

	International			Local		
	No.	Month	MM	No.	Month	MM
Team leader	1	66	66	0	0	0
Deputy team leader	0	0	0	1	77	77
Process engineer	1	13	13	1	12	12
Civil engineer	2	63	124	2	63	126
Structure engineer	2	7	14	2	7	14
Mechanical engineer	2	61	120	2	61	122
Electrical engineer	1	61	61	1	61	61
Architect	1	59	59	2	61	122
Building service engineer	1	12	12	2	61	122
Cost estimator	2	6	12	2	6	12
Environmental specialist	1	8	8	1	12	12
Institutional expert	1	8	8	1	11	11
Operation expert	1	9	9	1	15	15
M&E maintenance expert	1	9	9	1	15	15
Laboratory expert	1	9	9	1	15	15
Social development expert	1	8	8	1	14	14
Contract engineer	2	16	25	0	0	0
Quantity surveyor	1	41	41	1	48	48
Surveyor	0	0	0	1	60	60
Inspector	0	0	0	4	48	192
Total	22		598	27		1,050

Source: JICA Study Team

5.3.2 Technical Assistance

BAS, which is the largest WWTP in Ukraine, will be the first WWTP to introduce sludge treatment process including incineration in this Project. Hence, it is recommended to include technical assistance shown in Table 5.27 in consulting services to ensure effectiveness of the facilities after implementation of the Project.

Table 5.27 Technical Assistance

Program	Contents
Training program for institutional setup	Since new treatment facilities such as sludge thickening, dewatering, and incineration are introduced, a reorganization of relevant sections for O&M needs to be carried out. An appropriate institutional arrangement for O&M and definition of roles and duties of new sections will be advised. Additionally, guidance will be provided on the overall staffing of the BAS considering a future organizational transition.
Training program for operation	The theories and technologies of sludge treatment process including thickening, dewatering and incineration shall be lectured. Following the lectures, on-job trainings for operation of these facilities, emergency handling and troubleshooting are to be conducted. Currently, the existing facilities are manually operated. A SCADA system will be introduced to make automatic operation possible. Hence, operation utilizing SCADA system is to be trained. Initial operation, optimization of treatment processes and adjustment according to seasonal changes are also to be trained. Preparation of operation records in digital data form is encouraged.
Training program for M&E equipment maintenance	It is important to maintain equipment in proper condition so that the facilities perform effectively. Maintenance of newly installed equipment for sludge treatment is to be trained. Ex-post/reactive maintenance, in which maintenance and repairs are conducted after problems, are common practice in Kiev. Hence, the concept of planned/proactive maintenance is introduced. Planned/proactive maintenance contributes to reduction of life cycle cost by early detection of abnormalities, prevention of major breakdown and extension of equipment life. Preparation of maintenance records in digital data form is encouraged.
Training program for laboratory analysis	Operating agencies are obligated to ensure water quality of effluent and exhaust control of incineration by conducting necessary analysis at regular intervals. It is necessary to monitor water quality during treatment processes in order to keep records and improve performance of the plant. It is also necessary to monitor content of toxic substances in sewage/sludge, as well as exhaust gas composition from incinerators. On-the job training for laboratory analysis is implemented since the results of these analyses are basic indicators of plant performance. Preparation of records of laboratory analysis in digital data form is encouraged.
Public relation and customer management	A sewage sludge incineration plant will be newly introduced by the Project. It is necessary to promote public relations activities regarding this plant by explaining the functions and the influence for securing accountability and sufficient public opinion before starting the operation. Also customer-focus activities such as assistance of customer policy, strategy and guidelines, and customer research to understand basic needs and awareness will be encouraged.

Source: JICA Study Team

Trainee, timing of implementation and required consultant man-months of these training programs are summarized as shown in Table 5.28.

Table 5.28 Implementation Plan of the Training Programs

Program	Trainee	Timing	Consultant MM
Training program for institutional setup	Dept. of human resources in HQ Directors of BAS Total: 10 trainee	Design and tender phase : 3 month Construction phase : 8 month	International: 8 MM Local: 11 MM
Training program for operation	Process engineers of BAS Chiefs of operator of BAS Total: 20 trainee	Construction phase : 3 month Post construction phase : 12 month	International: 9 MM Local: 15 MM
Training program for M&E equipment maintenance	Mechanical engineers of BAS Electrical engineers of BAS Chief maintenance staff of BAS Total: 20 trainee	Construction phase : 3 month Post construction phase : 12 month	International: 9 MM Local: 15 MM
Training program for laboratory analysis	Chemists of BAS Assistants of chemist of BAS Process engineers of BAS Total: 10 trainee	Construction phase : 3 month Post construction phase : 12 month	International: 9 MM Local: 15 MM
Public relation and customer management	Dept. of information and communication in HQ Directors of BAS Total: 10 trainee	Design and tender phase : 5 month Construction phase : 9 month	International: 8 MM Local: 14 MM

Source: JICA Study Team

6. Financial and Economic Analysis

6.1 Results of Willingness to Pay Survey

6.1.1 Outline of the Survey

(1) Area Surveyed

The survey target areas covered 10 districts in Kiev City and the surrounding areas in Kiev Region where sewerage service has been provided by KVK.

(2) Sampling

The size of the sample from the districts and the surrounding areas was determined in accordance with the size of the population in each administrative area in principle. The residential households with sewerage connections living either in private houses or communal housings were selected at random. The total number of valid samples interviewed was 201 which were spread across the target areas.

(3) Survey Period

October – November, 2013

6.1.2 Methodology of the Survey

(1) Interview Survey

All information on socio-economic conditions of the households, WTP and other items was collected by means of a direct interview to the respondents.

(2) Double Bound Form

With regard to the question on the WTP survey, there were four main techniques for contingent valuation methods such as open-ended, bidding game, payment card and dichotomous choice. In this survey, double bound form[7] of dichotomous choice type is applied since it is easy for respondents to answer the question and it could provide comparatively reliable estimation results with less bias despite a small number of samples. The results was analyzed by using the estimation model[8].

[7] The respondent is presented with a price option twice. In case that the respondents agree the first price, a higher price option is presented in the second question. In case of disagreement, a lower price option is proposed in the second question.
[8] Kouichi Kuriyama, "Contingent Valuation Methods by Excel, ver.4"

(3) Results of the Survey

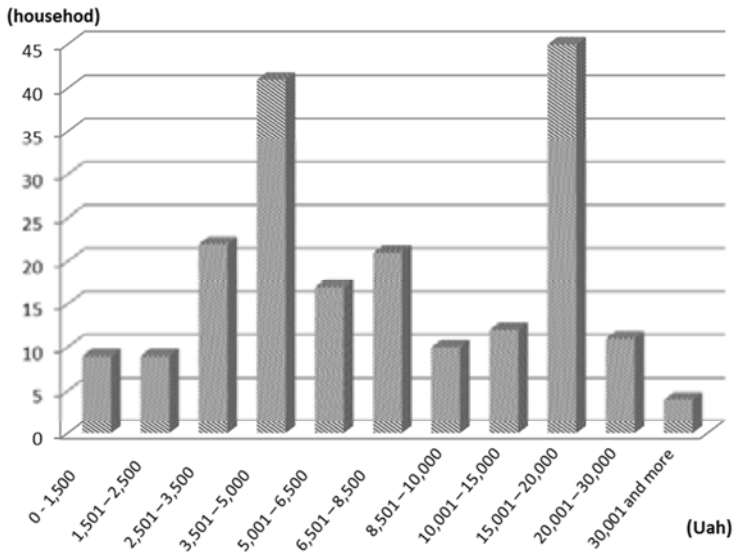
Main results of the survey are described in follows. The answer of respondents and the questionnaire sheet are attached in the Chapter 6.1 of Appendix.

(A) Monthly Household Consumption

Monthly average consumption volume of cold water and sewerage and hot water volume per household are amounted for 10.8 m^3/hh/month and 5.1 m^3/hh/month respectively. The average consumption volume is calculated based on the amount value from household's answer. The consumption volume for wastewater is acknowledged same as water supply volume in this estimation in accordance with the actual collection practice of KVK.

(B) Monthly Household Income

Monthly median household income as a median value is amounted for 7,500 UAH (690 Euro)/hh/month.



Source: JICA Study Team

Figure 6.1 Distribution of Monthly Household Income

(C) Monthly Expenditure for Hot Water, and Cold and Sewerage

Monthly expenditure for hot water, and cold and sewerage per household are indicated as 79.3 UAH (7.3 Euro) and 33.9 UAH (3.1 Euro) respectively. In accordance with the ratio of cost composition of cold and sewerage, monthly expenditure of only sewerage is estimated to be 14.9 UAH (1.4 Euro).

(D) Estimation of Affordability to Pay (ATP)

For reference, the affordability to pay (ATP) prospectively estimated as 75 UAH (6.9 Euro) calculated by using the median value of aforementioned monthly household income, if assumed that the level of ATP is 1% of monthly average household income. If this benchmark is applied, it could be thought that the current sewerage tariff rate remains at a relatively low level.

(E) Willingness-to-Pay

The medium value of the incremental amount of willingness-to-pay (WTP) for Project was calculated by using the Weibull model of CVM estimation model. The incremental WTP amount was 20 UAH (1.8 Euro)/hh/month, thereby the incremental WTP per cubic meter is presumably estimated to be 10.8 UAH (1.0 Euro)/ hh/m^3.

The estimated expenditure for sewerage is amounted for 34.9 UAH (3.2 Euro) combined existing spending with incremental WTP amount. It is equivalent to 0.5% of the monthly average household income, so that it is still less than 1% of the income which is considered as a typical benchmark parameter.

6.2 Financial and Economic Evaluation of the Project

6.2.1 Methodology of Financial and Economic Evaluation

(1) Indicators of Financial and Economic Evaluation

The financial and economic viability of the project is analyzed on the basis of incremental analysis to measure the difference between with-project and without project situation in principle. Discount cash flow method also applied to clarify the anticipated net cash flows of the project. In order to assess the project's feasibility, three indicators were calculated. These are the Internal Rate of Return (IRR), Net Present Value (NPV), and Benefit and Cost Ratio (B/C).

(2) Options for Financial and Economic Evaluations

As mentioned in Chapter 4 "Cost Estimation and Implementation Schedule", three options have been proposed in accordance with the scope of packages for the project. Financial and economic analysis herein focuses on the analysis of Option 1, Option 2 and Option 3.
The type of options is indicated in the following table.

Table 6.1 Composition of the Project Option

Type	Component				
	Component 0 (C0)	Component 1 (C1)	Component 2 (C2)	Component 3 (C3)	Component 4 (C4)
Option 1	O	O	O	O	O
Option 2	O		O	O	O
Option 3	O		O	O	

Source: JICA Study Team

6.2.2 Financial Evaluation of Priority Project for Water Supply

(1) Condition for Financial Analysis

Financial analysis of the project is conducted according to the following conditions.

(a) Base year : Year 2014
(b) Evaluation period : 2014-2062
(c) Project life : 2023-2062 (40 years from star of the service)
(d) Social discount rate : 10%
(e) Wastewater volume treated : 1,009,000 m^3/day (2021), 1,101,000 m^3/day (2030) based on the Project design wastewater volume to BAS
(f) Sewerage tariff rates : 1.392 UAH (0.13 Euro)/m^3 for domestic, 2.490 UAH (0.23 Euro) /m^3 for non-domestic, based on current rates,
(g) Exchange rate : 1 Euro = 129.63 Yen, 1 Euro = 10.87 UAH

(A) Project Life

The total project life has been set to 40 years from the commencement of service, during 2023 – 2062

(B) Social Discount Rate

In the analysis, 10% of social discount rate is in place for this analysis taking into account the interest rate as 10.57% of 10-years foreign bond issued by the government on December 2013. This rate could be considered as the cut-off rate of opportunity cost of capital.

(C) Physical Contingencies

5% of physical contingency has been set for both the foreign and local cost portions of the Project costs.

(2) Identification of Financial Cost

Financial costs of the proposed project consist of initial construction costs, replacement and rehabilitation costs and O&M costs.

(A) Initial Construction Cost

Initial construction costs are composed of construction costs (base costs), price escalation and physical contingency as indicated in Chapter 4.

(B) Replacement and Rehabilitation Costs

Replacement and rehabilitation costs of infrastructure are calculated in accordance with the following conditions.

- The lifetime of civil engineering infrastructure is expected to be 50 years. The lifetime of electrical and mechanical equipment is expected to be 15 years
- Electrical and mechanical equipment is replaced every 15 years with the costs of 100%
- The residual value of infrastructure is calculated according to age of service in 2062, the end of the evaluation period, and then it is accounted as benefits.

(C) Operation and Maintenance (O&M) Costs

Estimations of incremental O&M costs are summarized as follows.

Table 6.2 O&M Costs

Options	Annual Amount
Option 1	40 million Euro
Option 2	18 million Euro
Option 3	31 million Euro

Source: JICA Study Team

(D) Summary of Financial Costs

Financial cost of the Project with NPV 0% up to 2062 are accounted as indicated below.

Table 6.3 Breakdown of Financial Cost

Options	Initial construction costs	Replacement and rehabilitation cost	O&M costs
Option 1	1,122 million Euro	1,394 million Euro	1,676 million Euro
Option 2	895 million Euro	1,121million Euro	1,297million Euro
Option 3	572 million Euro	783million Euro	759million Euro

Source: JICA Study Team

(3) Identification of Financial Benefit

Financial benefits are calculated from incremental sewerage tariff revenue as borne out by providing incremental wastewater treatment service attributed to preconstruction and rehabilitation of treatment facilities of Block 1, Block 2, Block 3, which are included in Component 1 and Component 4 of the Project. With the Project, the treatment volume of wastewater is expected to be increased from 868,789 m^3/day to 1,101,000 m^3/day in 2030, hence this difference can be regarded as incremental benefits of the Project.

For the estimation, current unit price of sewerage service as 1.392 UAH (0.13 Euro)/m^3 is adopted.

(4) Financial Evaluation

The results of financial indicators for Options 1 - 3 are shown in the following table.

In case of Option 1 and Option 2, the results is not able to indicate financial soundness of the Project. It is noted that the Project is not a new construction project of wastewater treatment plant but a reconstruction and rehabilitation project for that, therefore it can be considered that the low viability likely attribute to the nature of project components with small incremental benefits.

Table 6.4 Results of Financial Evaluation of Project

	NPV (mil Euro)	B/C ratio	FIRR (%)
Option 1	- 917	0.13	N.A.
Option 2	-724	0.12	N.A.
Option 3	- 500	-	-

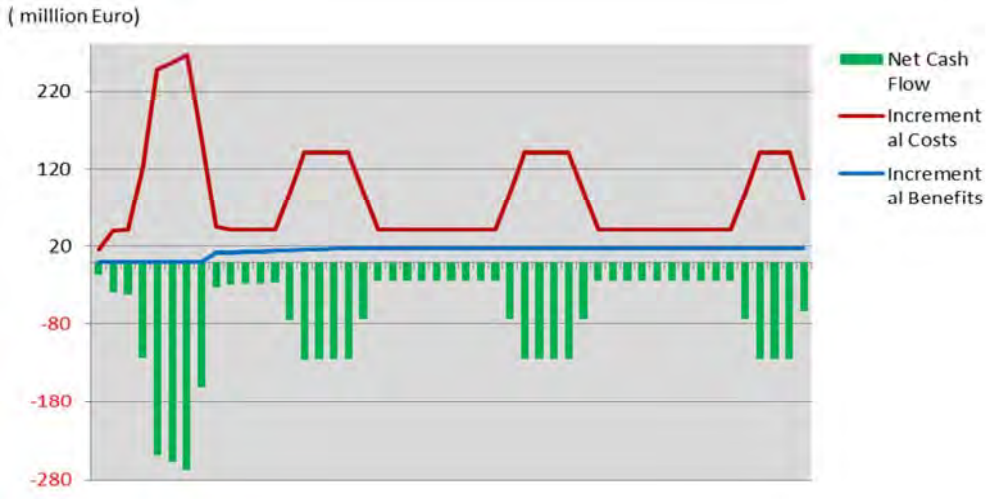
[Note]
N.A. ---Not accountable
- --- Estimation is not available due to a lack of incremental benefits
Source: JICA Study Team

(A) Financial Evaluation of the Project (Option 1)

The aggregate capital investment costs between 2014 and 2022 and annual O&M cost of the Project are worked out to 1,122 million Euro and 40 million Euro respectively. The incremental financial benefits incurred are to reach 17 million Euro per annum.

The viability indicators for Option 1 shows far negative work with minus 917 million Euro with 10% NPV and uncountable FIRR. The B/C ratio is turned out to be 0.13 at low level. Thereby this result is not able to indicate financial soundness of the Project.

The financial cash flow for Option 1 of the Project is presented in the following table and figure.



Source: JICA Study Team

Figure 6.2 Financial Cash Flow for Option 1

Table 6.5 Financial Cost and Benefit Flow of Project (Option 1)

Unit: 1,000 Euro

Year in order	Financial Cost					Financial Benefit		Cash Balance
	Capital cost		Incremental O&M Costs	Replacement Cost	Total	Incremental Benefits	Total	
	F/C portion	L/C portion						
1	1,646	13,982			15,629			-15,629
2	3,658	33,863			37,522			-37,522
3	4,120	35,637			39,757			-39,757
4	46,944	74,058			121,001			-121,001
5	92,414	153,554			245,968			-245,968
6	93,881	161,542			255,424			-255,424
7	95,325	169,978			265,303			-265,303
8	49,517	90,274	20,187		159,978			-159,978
9	1,407	819	40,374		42,599	11,674	11,674	-30,925
10			40,374		40,374	12,314	12,314	-28,060
11			40,374		40,374	12,953	12,953	-27,421
12			40,374		40,374	13,592	13,592	-26,781
13			40,374		40,374	14,231	14,231	-26,142
14			40,374	50,138	90,512	14,871	14,871	-75,641
15			40,374	100,276	140,649	15,510	15,510	-125,139
16			40,374	100,276	140,649	16,149	16,149	-124,500
17			40,374	100,276	140,649	16,789	16,789	-123,861
18			40,374	100,276	140,649	16,789	16,789	-123,861
19			40,374	50,138	90,512	16,789	16,789	-73,723
20			40,374		40,374	16,789	16,789	-23,585
21			40,374		40,374	16,789	16,789	-23,585
22			40,374		40,374	16,789	16,789	-23,585
23			40,374		40,374	16,789	16,789	-23,585
24			40,374		40,374	16,789	16,789	-23,585
25			40,374		40,374	16,789	16,789	-23,585
26			40,374		40,374	16,789	16,789	-23,585
27			40,374		40,374	16,789	16,789	-23,585
28			40,374		40,374	16,789	16,789	-23,585
29			40,374	50,138	90,512	16,789	16,789	-73,723
30			40,374	100,276	140,649	16,789	16,789	-123,861
31			40,374	100,276	140,649	16,789	16,789	-123,861
32			40,374	100,276	140,649	16,789	16,789	-123,861
33			40,374	100,276	140,649	16,789	16,789	-123,861
34			40,374	50,138	90,512	16,789	16,789	-73,723
35			40,374		40,374	16,789	16,789	-23,585
36			40,374		40,374	16,789	16,789	-23,585
37			40,374		40,374	16,789	16,789	-23,585
38			40,374		40,374	16,789	16,789	-23,585
39			40,374		40,374	16,789	16,789	-23,585
40			40,374		40,374	16,789	16,789	-23,585
41			40,374		40,374	16,789	16,789	-23,585
42			40,374		40,374	16,789	16,789	-23,585
43			40,374		40,374	16,789	16,789	-23,585
44			40,374		40,374	16,789	16,789	-23,585
45			40,374	50,138	90,512	16,789	16,789	-73,723
46			40,374	100,276	140,649	16,789	16,789	-123,861
47			40,374	100,276	140,649	16,789	16,789	-123,861
48			40,374	100,276	140,649	16,789	16,789	-123,861
49			40,374	39,847	80,221	16,789	16,789	-63,432
Total	**388,913**	**733,708**	**1,675,504**	**1,393,572**	**4,191,696**	**665,318**	**665,318**	**-3,526,378**
NPV 3%	326,543	621,751	762,119	603,586	2,313,999	372,172	293,796	-2,020,203
NPV10%	222,668	434,272	193,980	134,747	985,667	147,476	68,799	-916,868
							B/C (NPV 10%)	0.13
							FIRR (NPV 10%)	#NUM!

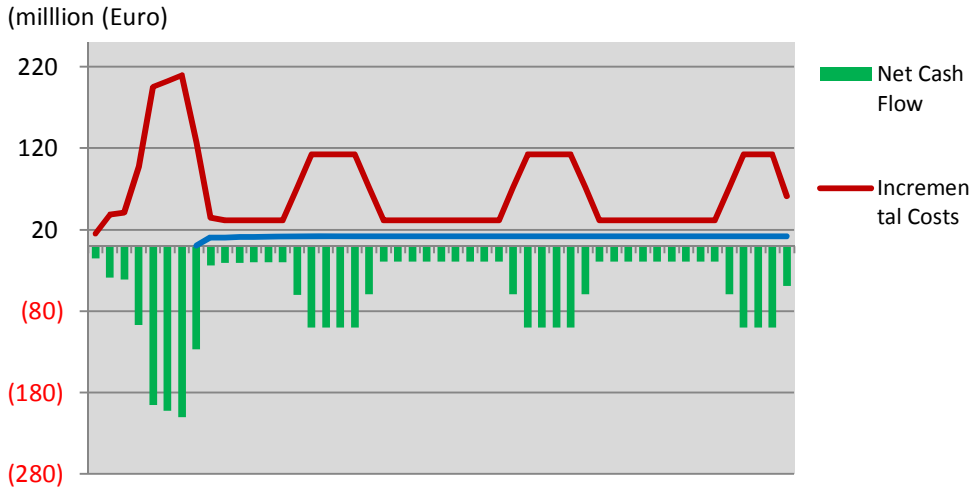
Source: JICA Study Team

(B) Financial Evaluation of the Project (Option 2)

The aggregate capital investment costs between 2014 and 2022 and annual O&M cost of the Project are worked out to 895 million Euro and 31 million Euro respectively. The incremental financial benefits incurred are to reach 12 million Euro per annum.

The viability indicators for Option 2 also show far negative work with minus 724 million Euro with 10% NPV and uncountable FIRR. The B/C ratio is turned out to be 0.12 at low level. Thereby this result is not able to indicate financial soundness of the Project.

The financial cash flow for Option 1 of the Project is presented in the following table and figure.



Source: JICA Study Team

Figure 6.3 Financial Cash Flow for Option 2

Table 6.6 Financial Cost and Benefit Flow of Project (Option 2)

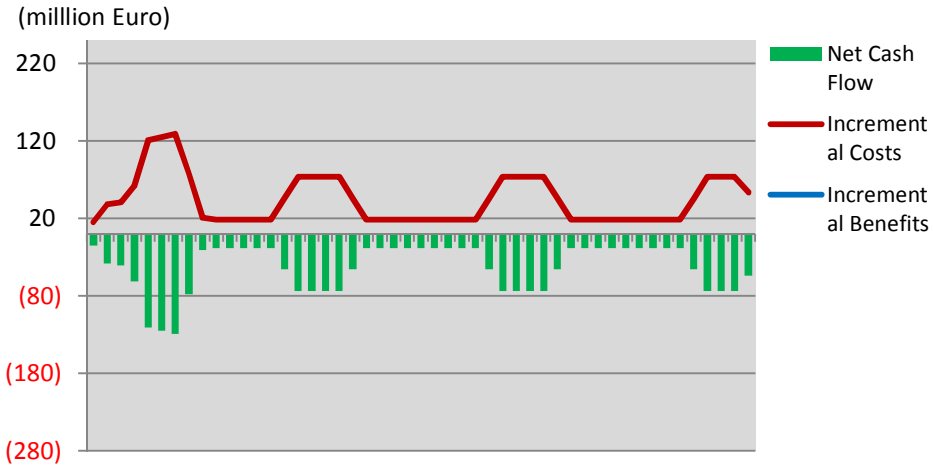
Unit: 1,000 Euro

Yearin order	Financial Cost					Financial Benefit		Cash Balance
	Capital cost		Replacement Cost	Incremental O&M Costs	Total	Incremental Benefits	Total	
	F/C portion	L/C portion						
1	1,288	13,982			15,271			-15,271
2	3,151	33,535			36,686			-36,686
3	3,522	35,321			38,843			-38,843
4	38,450	56,477			94,927			-94,927
5	75,561	116,595			192,156			-192,156
6	76,767	122,604			199,371			-199,371
7	77,945	128,944			206,889			-206,889
8	40,544	68,653		15,632	124,830	72	72	-124,758
9	1,235	847		31,265	33,346	10,359	10,359	-22,987
10				31,265	31,265	10,594	10,594	-20,671
11				31,265	31,265	10,828	10,828	-20,437
12				31,265	31,265	11,063	11,063	-20,202
13				31,265	31,265	11,297	11,297	-19,968
14				31,265	31,265	11,532	11,532	-19,733
15			40,414	31,265	71,679	11,766	11,766	-59,913
16			80,828	31,265	112,093	12,001	12,001	-100,092
17			80,828	31,265	112,093	12,235	12,235	-99,858
18			80,828	31,265	112,093	12,235	12,235	-99,858
19			80,828	31,265	112,093	12,235	12,235	-99,858
20			40,414	31,265	71,679	12,235	12,235	-59,444
21				31,265	31,265	12,235	12,235	-19,030
22				31,265	31,265	12,235	12,235	-19,030
23				31,265	31,265	12,235	12,235	-19,030
24				31,265	31,265	12,235	12,235	-19,030
25				31,265	31,265	12,235	12,235	-19,030
26				31,265	31,265	12,235	12,235	-19,030
27				31,265	31,265	12,235	12,235	-19,030
28				31,265	31,265	12,235	12,235	-19,030
29				31,265	31,265	12,235	12,235	-19,030
30			40,414	31,265	71,679	12,235	12,235	-59,444
31			80,828	31,265	112,093	12,235	12,235	-99,858
32			80,828	31,265	112,093	12,235	12,235	-99,858
33			80,828	31,265	112,093	12,235	12,235	-99,858
34			80,828	31,265	112,093	12,235	12,235	-99,858
35			40,414	31,265	71,679	12,235	12,235	-59,444
36				31,265	31,265	12,235	12,235	-19,030
37				31,265	31,265	12,235	12,235	-19,030
38				31,265	31,265	12,235	12,235	-19,030
39				31,265	31,265	12,235	12,235	-19,030
40				31,265	31,265	12,235	12,235	-19,030
41				31,265	31,265	12,235	12,235	-19,030
42				31,265	31,265	12,235	12,235	-19,030
43				31,265	31,265	12,235	12,235	-19,030
44				31,265	31,265	12,235	12,235	-19,030
45			40,414	31,265	71,679	12,235	12,235	-59,444
46			80,828	31,265	112,093	12,235	12,235	-99,858
47			80,828	31,265	112,093	12,235	12,235	-99,858
48			80,828	31,265	112,093	12,235	12,235	-99,858
49			30,040	31,265	61,305	12,235	12,235	-49,069
50								
Total	**318,463**	**576,958**	**1,121,220**	**1,297,488**	**3,314,129**	**493,270**	**493,270**	**-2,820,859**
NPV3%	267,405	490,630	474,158	590,175	1,822,368	270,741	220,137	-1,602,231
NPV10%	182,369	345,696	99,049	150,216	777,329	103,379	53,050	-724,280
							B/C (NPV 10%)	0.12
							FIRR (NPV 10%)	#NUM!

Source: JICA Study Team

(C) Financial Evaluation of the Project (Option 3)

In case of Option 3, incremental benefits are not able to be identified due to a lack of wastewater treatment works which generate incremental treatment volume by component 1 and component 4. Hence, the financial indicators such as NPV, B/C ratio and FIRR are not able to be appeared.



Source: JICA Study Team

Figure 6.4 Financial Cash Flow for Option 3

Table 6.7 Financial Cost and Benefit Flow of Project (Option 3)

Unit: 1,000 Euro

Yearin order	Financial Cost					Financial Benefit		Cash Balance
	Capital cost		Replacement Cost	Incremental O&M Costs	Total	Incremental Benefits	Total	
	F/C portion	L/C portion						
1	778	13,982			14,760			-14,760
2	2,138	32,627			34,765			-34,765
3	2,447	34,488			36,935			-36,935
4	27,325	30,554			57,878			-57,878
5	53,800	62,314			116,114			-116,114
6	54,663	65,373			120,036			-120,036
7	55,492	68,588			124,079			-124,079
8	28,933	36,833		9,151	74,917			-74,917
9	938	857		18,301	20,096			-20,096
10				18,301	18,301			-18,301
11				18,301	18,301			-18,301
12				18,301	18,301			-18,301
13				18,301	18,301			-18,301
14				18,301	18,301			-18,301
15			27,676	18,301	45,977			-45,977
16			55,352	18,301	73,653			-73,653
17			55,352	18,301	73,653			-73,653
18			55,352	18,301	73,653			-73,653
19			55,352	18,301	73,653			-73,653
20			27,676	18,301	45,977			-45,977
21				18,301	18,301			-18,301
22				18,301	18,301			-18,301
23				18,301	18,301			-18,301
24				18,301	18,301			-18,301
25				18,301	18,301			-18,301
26				18,301	18,301			-18,301
27				18,301	18,301			-18,301
28				18,301	18,301			-18,301
29				18,301	18,301			-18,301
30			27,676	18,301	45,977			-45,977
31			55,352	18,301	73,653			-73,653
32			55,352	18,301	73,653			-73,653
33			55,352	18,301	73,653			-73,653
34			55,352	18,301	73,653			-73,653
35			27,676	18,301	45,977			-45,977
36				18,301	18,301			-18,301
37				18,301	18,301			-18,301
38				18,301	18,301			-18,301
39				18,301	18,301			-18,301
40				18,301	18,301			-18,301
41				18,301	18,301			-18,301
42				18,301	18,301			-18,301
43				18,301	18,301			-18,301
44				18,301	18,301			-18,301
45			27,676	18,301	45,977			-45,977
46			55,352	18,301	73,653			-73,653
47			55,352	18,301	73,653			-73,653
48			55,352	18,301	73,653			-73,653
49			35,268	18,301	53,570			-53,570
50								
Total	**226,514**	**345,615**	**782,515**	**759,494**	**2,114,138**			**-2,114,138**
NPV3%	190,154	297,039	328,159	345,463	1,160,816			-1,160,816
NPV10%	129,609	214,791	67,967	87,930	500,297			-500,297
							B/C (NPV 10%)	0.00
							FIRR (NPV 10%)	#NUM!

Source: JICA Study Team

(5) Analysis of Repayment Ability

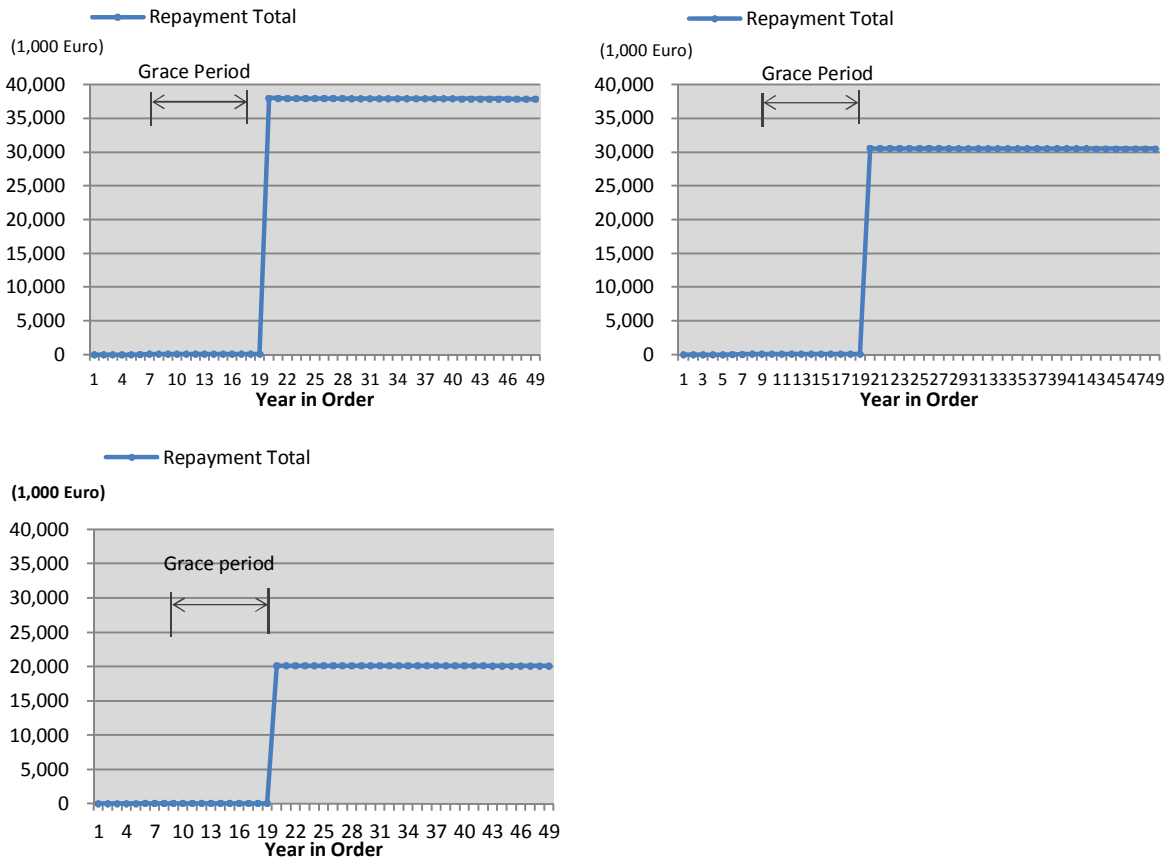
The financial burden of the Project cost as an initial capital investment costs is a very large amount, so that it would be a realistic and effective way for a project executing agency/project implementing agency to utilize outside financing sources including international and bi-lateral financing agencies.

(A) Financial Terms and Conditions of Loans

If a Japanese ODA STEP Loan is assumed to be utilized, the repayment period and the interest rate are respectively 30 years including 10 years grace period and 0.01% per annum as a very soft rate. In this Project, the price escalation rates are applied as 1.3% per annum for FC portion and 6.0 % per annum for LC portion.

(B) Repayment Schedule of Loans

In the case that the PEA/PIA bears the financial burden of the loan, prospective repayment schedule for Option 1- Option 3 is shown in the following figure and table.



Source: JICA Study Team

Figure 6.5 Repayment Schedule of Loans

Option 1 (top-left), Option 2 (top-right), Option 3 (bottom-left)

Table 6.8 Repayment Schedule of Project (Japanese ODA STEP Loan, Option 1)

Unit: 1,000 Euro

Year in order	Outflow							
	Disbursement		Repayment			Operation and Maintenance	Replacement Cost	Outflow total
	F/C portion	L/C portion	Interest	Principal	Amortization Total			
1	1,646	13,982						15,629
2	3,658	33,863	2		2			37,524
3	4,120	35,637	5		5			39,762
4	46,944	74,058	9		9			121,010
5	92,414	153,554	21		21			245,989
6	93,881	161,542	46		46			255,470
7	95,325	169,978	72		72			265,375
8	49,517	90,274	98		98	20,187		160,076
9	1,407	819	112		112	40,374		42,711
10			112		112	40,374		40,486
11			112		112	40,374		40,486
12			112		112	40,374		40,486
13			112		112	40,374		40,486
14			112		112	40,374	50,138	90,624
15			112		112	40,374	100,276	140,761
16			112		112	40,374	100,276	140,761
17			112		112	40,374	100,276	140,761
18			112		112	40,374	100,276	140,761
19			112		112	40,374	50,138	90,624
20			112	37,421	37,533	40,374		77,906
21			109	37,421	37,530	40,374		77,903
22			105	37,421	37,526	40,374		77,899
23			101	37,421	37,522	40,374		77,895
24			97	37,421	37,518	40,374		77,891
25			94	37,421	37,515	40,374		77,888
26			90	37,421	37,511	40,374		77,884
27			86	37,421	37,507	40,374		77,880
28			82	37,421	37,503	40,374		77,876
29			79	37,421	37,500	40,374	50,138	128,011
30			75	37,421	37,496	40,374	100,276	178,145
31			71	37,421	37,492	40,374	100,276	178,141
32			67	37,421	37,488	40,374	100,276	178,137
33			64	37,421	37,485	40,374	100,276	178,134
34			60	37,421	37,481	40,374	50,138	127,992
35			56	37,421	37,477	40,374		77,850
36			52	37,421	37,473	40,374		77,846
37			49	37,421	37,470	40,374		77,843
38			45	37,421	37,466	40,374		77,839
39			41	37,421	37,462	40,374		77,835
40			37	37,421	37,458	40,374		77,831
41			34	37,421	37,455	40,374		77,828
42			30	37,421	37,451	40,374		77,824
43			26	37,421	37,447	40,374		77,820
44			22	37,421	37,443	40,374		77,816
45			19	37,421	37,440	40,374	50,138	127,951
46			15	37,421	37,436	40,374	100,276	178,085
47			11	37,421	37,432	40,374	100,276	178,081
48			7	37,421	37,428	40,374	100,276	178,077
49			4	37,421	37,425	40,374	39,847	117,646
Total	**388,913**	**733,708**	**3,225**	**1,122,620**	**1,125,845**	**1,675,504**	**1,393,572**	**5,317,542**
	326,543	621,751	1,818	733,462	420,048	762,119	603,586	2,734,047
	222,668	434,272	658	352,762	58,278	193,980	134,747	1,043,945

Japanese ODA Loan (STEP)

Amortization period	40 years
Interest rate	0.01%
Grace period	10 years

Source: JICA Study Team

Table 6.9 Repayment Schedule of Project (Japanese ODA STEP Loan, Option 2)

Unit: 1,000 Euro

Year	Outflow							
	Disbursement		Repayment			Operation and Maintenance	Replacement Cost	Outflow total
	F/C portion	L/C portion	Interest	Principal	Amortization Total			
1	1,288							15,271
2	3,151	33,535						36,686
3	3,522	35,321						38,843
4	38,450	56,477						94,927
5	75,561	116,595						192,156
6	76,767	122,604						199,371
7	77,945	128,944						206,889
8	40,544	68,653				15,632		124,830
9	1,235	847				31,265		33,346
10						31,265		31,265
11						31,265		31,265
12						31,265		31,265
13						31,265		31,265
14						31,265		31,265
15						31,265	40,414	71,679
16						31,265	80,828	112,093
17						31,265	80,828	112,093
18						31,265	80,828	112,093
19						31,265	80,828	112,093
20				29,847	29,847	31,265	40,414	101,526
21				29,847	29,847	31,265		61,112
22				29,847	29,847	31,265		61,112
23				29,847	29,847	31,265		61,112
24				29,847	29,847	31,265		61,112
25				29,847	29,847	31,265		61,112
26				29,847	29,847	31,265		61,112
27				29,847	29,847	31,265		61,112
28				29,847	29,847	31,265		61,112
29				29,847	29,847	31,265		61,112
30				29,847	29,847	31,265	40,414	101,526
31				29,847	29,847	31,265	80,828	141,940
32				29,847	29,847	31,265	80,828	141,940
33				29,847	29,847	31,265	80,828	141,940
34				29,847	29,847	31,265	80,828	141,940
35				29,847	29,847	31,265	40,414	101,526
36				29,847	29,847	31,265		61,112
37				29,847	29,847	31,265		61,112
38				29,847	29,847	31,265		61,112
39				29,847	29,847	31,265		61,112
40				29,847	29,847	31,265		61,112
41				29,847	29,847	31,265		61,112
42				29,847	29,847	31,265		61,112
43				29,847	29,847	31,265		61,112
44				29,847	29,847	31,265		61,112
45				29,847	29,847	31,265	40,414	101,526
46				29,847	29,847	31,265	80,828	141,940
47				29,847	29,847	31,265	80,828	141,940
48				29,847	29,847	31,265	80,828	141,940
49				29,847	29,847	31,265	30,040	91,152
50								
Total	**318,463**	**576,958**		**895,421**	**895,421**	**1,297,488**	**1,121,220**	**4,209,550**
NPV3%	267,405	490,630		585,021	333,629	590,175	474,158	2,155,998
NPV10%	182,369	345,696		281,368	46,006	150,216	99,049	823,335

Japanese ODA Loan (STEP)

Amortization period	40 years
Interest rate	0.01%
Grace period	10 years

Source: JICA Study Team

Table 6.10 Repayment Schedule of Project (Japanese ODA STEP Loan, Option 3)

Unit: 1,000 Euro

Year	Outflow							
	Disbursement		Repayment			Operation and Maintenance	Replacement Cost	Outflow total
	F/C portion	L/C portion	Interest	Principal	Amortization Total			
1	778							14,760
2	2,138	32,627						34,765
3	2,447	34,488						36,935
4	27,325	30,554						57,878
5	53,800	62,314						116,114
6	54,663	65,373						120,036
7	55,492	68,588						124,079
8	28,933	36,833				9,151		74,917
9	938	857				18,301		20,096
10						18,301		18,301
11						18,301		18,301
12						18,301		18,301
13						18,301		18,301
14						18,301		18,301
15						18,301	27,676	45,977
16						18,301	55,352	73,653
17						18,301	55,352	73,653
18						18,301	55,352	73,653
19						18,301	55,352	73,653
20				19,071	19,071	18,301	27,676	65,048
21				19,071	19,071	18,301		37,372
22				19,071	19,071	18,301		37,372
23				19,071	19,071	18,301		37,372
24				19,071	19,071	18,301		37,372
25				19,071	19,071	18,301		37,372
26				19,071	19,071	18,301		37,372
27				19,071	19,071	18,301		37,372
28				19,071	19,071	18,301		37,372
29				19,071	19,071	18,301		37,372
30				19,071	19,071	18,301	27,676	65,048
31				19,071	19,071	18,301	55,352	92,724
32				19,071	19,071	18,301	55,352	92,724
33				19,071	19,071	18,301	55,352	92,724
34				19,071	19,071	18,301	55,352	92,724
35				19,071	19,071	18,301	27,676	65,048
36				19,071	19,071	18,301		37,372
37				19,071	19,071	18,301		37,372
38				19,071	19,071	18,301		37,372
39				19,071	19,071	18,301		37,372
40				19,071	19,071	18,301		37,372
41				19,071	19,071	18,301		37,372
42				19,071	19,071	18,301		37,372
43				19,071	19,071	18,301		37,372
44				19,071	19,071	18,301		37,372
45				19,071	19,071	18,301	27,676	65,048
46				19,071	19,071	18,301	55,352	92,724
47				19,071	19,071	18,301	55,352	92,724
48				19,071	19,071	18,301	55,352	92,724
49				19,071	19,071	18,301	35,268	72,641
50								
Total	**226,514**	**345,615**		**572,129**	**572,129**	**759,494**	**782,515**	**2,686,267**
NPV3%	190,154	297,039		373,799	213,173	345,463	328,159	1,373,988
NPV10%	129,609	214,791		179,780	29,396	87,930	67,967	529,692

Japanese ODA Loan (STEP)

Amortization period	40 years
Interest rate	0.01%
Grace period	10 years

Source: JICA Study Team

6.2.3 Economic Evaluation

(1) Identification of Economic Benefit

Economic benefit of the Project is calculated by subtracting aggregate benefit of "with project case" from aggregate benefit of "without project case". Economic benefit can be divided into quantitative and non-quantitative. This analysis targets quantitative benefits.

(A) Types of Economic Benefit

Economic benefits are mainly categorized into 2 types, ① Benefits from cost reduction effect and ② Willingness to pay, as indicated in the following table.

Table 6.11 Economic Benefit of Projects

Type of economic benefit	
1. Cost reduction effect	- Saving cost of raw sludge treatment
2. Willingness to pay	- People's willingness to pay for the Project

Source: JICA Study Team

(B) Saving Cost of Raw Sludge Treatment

In current conditions of operation of BAS, the generated sewerage sludge is transported and accumulated in the outside sludge field sites No.1 - No.3. Considering the "Without Project" case, sewerage sludge has to be accumulated in the sludge fields in accordance with the current practice. Considering the "With Project" case, the sludge volume generated will be overwhelmingly reduced by installation of thickeners, dewatering machines and improvement of sludge treatment process. The dewatered sludge will be expected to be 1,080 m^3/day as dewatered sludge compared to 12,317 m^3/day by the current operational basis. This difference is considered as incremental economic benefits.

(C) Willingness to Pay

The medium value of willingness to pay (WTP) amount for sewerage service is calculated as 20 UAH (1.84 Euro)/hh/month by using CVM estimation model, based on the interview results. This amount of willingness to pay is the incremental value given by people to the current sewerage tariff charge, expecting for (1) increase of effectiveness and station's operational reliability, (2) decrease in pollution emission such as offensive odor, (3) improvement of water treatment quality.

(D) Other Benefits

a) Saving Effect of Medical Expenditure for Waterborne Disease

Occurrence of waterborne diseases such as diarrhoea, dysentery, malaria and so on can be seen in Ukraine, however these diseases are brought from outside of the country according to the interview survey.

b) Recycling of Sludge Ash

There is a possibility to utilize sludge ash containing polymer after incineration as raw materials of concrete products and calcination products. According to the information from a cement manufacturer, sludge ash to be generated from BAS will be acceptable in terms of the chemical components of ash. However, actual market needs, scale of market, manufacturer's willingness to pay for purchasing are not sure in Ukraine and there is also no sufficient information on that. It is judged that it is premature to estimate economic benefits from the utilization of sludge ash.

Thus the above benefits are passed over and not accounted for economic benefits in this analysis.

c) Agricultural Use of Final Sludge

The agricultural use of final sludge is generally not a new practice in the world, however the sludge material produced by BAS has been prohibited to use in such way by the government due to high heavy metal concentration in the sludge exceeding the permissible level. Thus, there is no possibility to use final sludge produced for agricultural use.

(2) Identification of Economic Cost

The economic costs of the Project are estimated by converting the financial costs with a standard conversion factor (SCF) as 0.93. SCF is multiplied to financial costs of local currency portion. The detail estimation of SCF is attached in Appendix-6.2.

(3) Economic Evaluation

The results of economic indicators during the project evaluation period are indicated in the following table.

Table 6.12 Results of Economic Evaluation of Project

	NPV (mil. Euro)	B/C Ratio	FIRR
Option 1	218	1.24	13.0%
Option 2	61	1.07	11.0%
Option 3	225	1.39	14.9%

Source: JICA Study Team

(A) Economic Evaluation of the Project (Option 1)

As a result of the economic analysis for Option 1, the Project feasibility turned out to be 13.0%. NPV and B/C ratio is estimated at respective of 218 million Euro and 1.24 as above.

With current opportunity cost of capital standing at 10% per year, the result of EIRR for the Project exceeds the applied discount rate as an opportunity cost of capital. Hence, it could be said that the project is considered worthy for implementation as economically viable. The positive figure of NPV reveals the financial soundness of the Project.

In addition, international institutions such as World Bank, WHO and UNDP suggest that 5% is a benchmark criteria of IRR for basic human needs project as a public works in developing countries. From this perspective, the results of economic analysis for Option 1 cleared the defined benchmark.

The economic cash flow for Option 1 is presented in the following table.

Table 6.13 Economic Cost and Benefits Flow of the Project (Option 1)

Unit: 1,000 Euro

Year in order	Economic Cost					Economic Benefit			Cash Balance
	Capital Cost		Incremental O&M Costs	Replacement Cost	Total	WTP	Cost Reduction of Raw Sludge Treatment	Total	
	F/C portion	L/C portion							
0									
1	1,646	13,004	0	0	14,650		0	0	-14,650
2	3,658	31,493	0	0	35,151		0	0	-35,151
3	4,120	33,143	0	0	37,262		0	0	-37,262
4	46,944	68,874	0	0	115,817		0	0	-115,817
5	92,414	142,805	0	0	235,219		0	0	-235,219
6	93,881	150,234	0	0	244,116		0	0	-244,116
7	95,325	158,079	0	0	253,405		0	0	-253,405
8	49,517	83,955	18,774	0	152,246	32,555	79,664	112,218	-40,028
9	1,407	761	37,547	0	39,715	65,110	159,327	224,437	184,722
10			37,547	0	37,547	65,852	161,143	226,995	189,447
11			37,547	0	37,547	66,594	162,959	229,553	192,005
12			37,547	0	37,547	67,336	164,775	232,111	194,563
13			37,547	0	37,547	68,078	166,591	234,669	197,122
14			37,547	0	37,547	68,820	168,407	237,227	199,680
15			37,547	46,628	84,176	69,562	170,223	239,785	155,609
16			37,547	93,257	130,804	70,304	172,039	242,343	111,539
17			37,547	93,257	130,804	71,046	173,855	244,901	114,097
18			37,547	93,257	130,804	71,046	173,855	244,901	114,097
19			37,547	93,257	130,804	71,046	173,855	244,901	114,097
20			37,547	46,628	84,176	71,046	173,855	244,901	160,725
21			37,547	0	37,547	71,046	173,855	244,901	207,354
22			37,547	0	37,547	71,046	173,855	244,901	207,354
23			37,547	0	37,547	71,046	173,855	244,901	207,354
24			37,547	0	37,547	71,046	173,855	244,901	207,354
25			37,547	0	37,547	71,046	173,855	244,901	207,354
26			37,547	0	37,547	71,046	173,855	244,901	207,354
27			37,547	0	37,547	71,046	173,855	244,901	207,354
28			37,547	0	37,547	71,046	173,855	244,901	207,354
29			37,547	0	37,547	71,046	173,855	244,901	207,354
30			37,547	46,628	84,176	71,046	173,855	244,901	160,725
31			37,547	93,257	130,804	71,046	173,855	244,901	114,097
32			37,547	93,257	130,804	71,046	173,855	244,901	114,097
33			37,547	93,257	130,804	71,046	173,855	244,901	114,097
34			37,547	93,257	130,804	71,046	173,855	244,901	114,097
35			37,547	46,628	84,176	71,046	173,855	244,901	160,725
36			37,547	0	37,547	71,046	173,855	244,901	207,354
37			37,547	0	37,547	71,046	173,855	244,901	207,354
38			37,547	0	37,547	71,046	173,855	244,901	207,354
39			37,547	0	37,547	71,046	173,855	244,901	207,354
40			37,547	0	37,547	71,046	173,855	244,901	207,354
41			37,547	0	37,547	71,046	173,855	244,901	207,354
42			37,547	0	37,547	71,046	173,855	244,901	207,354
43			37,547	0	37,547	71,046	173,855	244,901	207,354
44			37,547	0	37,547	71,046	173,855	244,901	207,354
45			37,547	46,628	84,176	71,046	173,855	244,901	160,725
46			37,547	93,257	130,804	71,046	173,855	244,901	114,097
47			37,547	93,257	130,804	71,046	173,855	244,901	114,097
48			37,547	93,257	130,804	71,046	173,855	244,901	114,097
49			37,547	93,257	130,804	71,046	173,855	244,901	114,097
Total	**388,913**	**682,348**	**1,558,219**	**1,352,220**	**3,981,700**	**2,918,735**	**7,142,335**	**10,061,069**	**6,079,369**
NPV 3%	326,543	578,229	708,771	560,834	2,174,376	1,622,979	3,229,222	4,548,852	2,374,476
NPV10%	222,668	403,873	180,401	114,828	921,770	644,518	809,341	1,140,080	218,310

B/C (NPV 10%)	1.24
EIRR (NPV 10%)	13.0%

Source: JICA Study Team

(B) Economic Evaluation of the Project (Option 2)

As a result of the economic analysis for Option 2, the Project feasibility turned out to be 11.0%. NPV and B/C ratio is estimated at respective of 61 million Euro and 1.07 as above.

With current opportunity cost of capital standing at 10% per year, the result of EIRR for the Project exceeds the applied discount rate as an opportunity cost of capital. Hence, it could be said that the project is considered worthy for implementation as economically viable. The positive figure of NPV reveals the financial soundness of the Project.

In addition, international institutions such as World Bank, WHO and UNDP suggest that 5% is a benchmark criteria of IRR for basic human needs project as a public works in developing countries. From this perspective, the results of economic analysis for Option 2 cleared the defined benchmark.

The economic cash flow for Option 2 is presented in the following table.

Table 6.14 Economic Costs and Benefits Flow of the Project (Option 2)

Unit: 1,000 Euro

Year in order	Economic Cost					Economic Benefit			Cash Balance
	Capital Cost		Replacement Cost	Incremental O&M Costs	Total	WTP	Cost Reduction of Raw Sludge Treatment	Total	
	F/C portion	L/C portion							
0									
1	1,288	13,004	0	0	14,292		0	0	-14,292
2	3,151	31,187	0	0	34,338		0	0	-34,338
3	3,522	32,849	0	0	36,370		0	0	-36,370
4	38,450	52,524	0	0	90,973		0	0	-90,973
5	75,561	108,434	0	0	183,995		0	0	-183,995
6	76,767	114,022	0	0	190,789		0	0	-190,789
7	77,945	119,918	0	0	197,863		0	0	-197,863
8	40,544	63,848	0	14,538	118,930	96	79,664	79,760	-39,170
9	1,235	787	0	29,076	31,098	13,769	159,327	173,096	141,998
10			51,714	29,076	80,790	14,080	161,143	175,224	94,434
11			51,714	29,076	80,790	14,392	162,959	177,351	96,561
12			51,714	29,076	80,790	14,704	164,775	179,479	98,689
13			51,714	29,076	80,790	15,015	166,591	181,606	100,816
14			51,714	29,076	80,790	15,327	168,407	183,734	102,944
15			37,585	29,076	66,661	15,639	170,223	185,862	119,200
16			75,170	29,076	104,246	15,950	172,039	187,989	83,743
17			75,170	29,076	104,246	16,262	173,855	190,117	85,870
18			75,170	29,076	104,246	16,262	173,855	190,117	85,870
19			75,170	29,076	104,246	16,262	173,855	190,117	85,870
20			37,585	29,076	66,661	16,262	173,855	190,117	123,455
21			0	29,076	29,076	16,262	173,855	190,117	161,041
22			0	29,076	29,076	16,262	173,855	190,117	161,041
23			0	29,076	29,076	16,262	173,855	190,117	161,041
24			0	29,076	29,076	16,262	173,855	190,117	161,041
25			0	29,076	29,076	16,262	173,855	190,117	161,041
26			0	29,076	29,076	16,262	173,855	190,117	161,041
27			0	29,076	29,076	16,262	173,855	190,117	161,041
28			0	29,076	29,076	16,262	173,855	190,117	161,041
29			0	29,076	29,076	16,262	173,855	190,117	161,041
30			37,585	29,076	66,661	16,262	173,855	190,117	123,455
31			75,170	29,076	104,246	16,262	173,855	190,117	85,870
32			75,170	29,076	104,246	16,262	173,855	190,117	85,870
33			75,170	29,076	104,246	16,262	173,855	190,117	85,870
34			75,170	29,076	104,246	16,262	173,855	190,117	85,870
35			37,585	29,076	66,661	16,262	173,855	190,117	123,455
36			0	29,076	29,076	16,262	173,855	190,117	161,041
37			0	29,076	29,076	16,262	173,855	190,117	161,041
38			0	29,076	29,076	16,262	173,855	190,117	161,041
39			0	29,076	29,076	16,262	173,855	190,117	161,041
40			0	29,076	29,076	16,262	173,855	190,117	161,041
41			0	29,076	29,076	16,262	173,855	190,117	161,041
42			0	29,076	29,076	16,262	173,855	190,117	161,041
43			0	29,076	29,076	16,262	173,855	190,117	161,041
44			0	29,076	29,076	16,262	173,855	190,117	161,041
45			37,585	29,076	66,661	16,262	173,855	190,117	123,455
46			75,170	29,076	104,246	16,262	173,855	190,117	85,870
47			75,170	29,076	104,246	16,262	173,855	190,117	85,870
48			75,170	29,076	104,246	16,262	173,855	190,117	85,870
49			27,937	29,076	57,013	16,262	173,855	190,117	133,104
Total	**318,463**	**536,571**	**1,301,304**	**1,206,664**	**3,363,002**	**655,620**	**7,142,335**	**7,797,955**	**4,434,953**
NPV3%	267,405	456,286	622,481	548,863	1,895,034	359,850	3,229,222	3,521,813	1,626,778
NPV10%	182,369	321,497	175,254	139,700	818,820	137,403	809,341	879,851	61,030

B/C (NPV 10%)	1.07
EIRR (NPV 10%)	11.0%

Source: JICA Study Team

(C) Economic Evaluation of the Project (Option 3)

As a result of the economic analysis for Option 3, the Project feasibility turned out to be 14.9%. NPV and B/C ratio is estimated at respective of 225 million Euro and 1.39 as above.

With current opportunity cost of capital standing at 10% per year, the result of EIRR for the Project exceeds the applied discount rate as an opportunity cost of capital. Hence, it could be said that the project is considered worthy for implementation as economically viable. The positive figure of NPV reveals the financial soundness of the Project.

In addition, international institutions such as World Bank, WHO and UNDP suggest that 5% is a benchmark criteria of IRR for basic human needs project as a public works in developing countries. From this perspective, the results of economic analysis for Option 1 cleared the defined benchmark.

The economic cash flow for Option 3 is presented in the following table.

Table 6.15 Economic Costs and Benefits Flow of the Project (Option 3)

Unit: 1,000 Euro

Year in order	Economic Cost					Economic Benefit			Cash Balance
	Capital Cost		Replacement Cost	Incremental O&M Costs	Total	WTP	Cost Reduction of Raw Sludge Treatment	Total	
	F/C portion	L/C portion							
1	778	13,004			13,782				-13,782
2	2,138	30,343			32,481				-32,481
3	2,447	32,074			34,521				-34,521
4	27,325	28,415			55,740				-55,740
5	53,800	57,952			111,752				-111,752
6	54,663	60,797			115,460				-115,460
7	55,492	63,787			119,278				-119,278
8	28,933	34,255		8,510	71,698		79,664	79,664	7,966
9	938	797		17,020	18,755		159,327	159,327	140,572
10			68,105	17,020	85,125		161,143	161,143	76,018
11			68,105	17,020	85,125		162,959	162,959	77,834
12			68,105	17,020	85,125		164,775	164,775	79,650
13			68,105	17,020	85,125		166,591	166,591	81,466
14			68,105	17,020	85,125		168,407	168,407	83,282
15			25,738	17,020	42,758		170,223	170,223	127,464
16			51,477	17,020	68,497		172,039	172,039	103,542
17			51,477	17,020	68,497		173,855	173,855	105,358
18			51,477	17,020	68,497		173,855	173,855	105,358
19			51,477	17,020	68,497		173,855	173,855	105,358
20			25,738	17,020	42,758		173,855	173,855	131,096
21				17,020	17,020		173,855	173,855	156,835
22				17,020	17,020		173,855	173,855	156,835
23				17,020	17,020		173,855	173,855	156,835
24				17,020	17,020		173,855	173,855	156,835
25				17,020	17,020		173,855	173,855	156,835
26				17,020	17,020		173,855	173,855	156,835
27				17,020	17,020		173,855	173,855	156,835
28				17,020	17,020		173,855	173,855	156,835
29				17,020	17,020		173,855	173,855	156,835
30			25,738	17,020	42,758		173,855	173,855	131,096
31			51,477	17,020	68,497		173,855	173,855	105,358
32			51,477	17,020	68,497		173,855	173,855	105,358
33			51,477	17,020	68,497		173,855	173,855	105,358
34			51,477	17,020	68,497		173,855	173,855	105,358
35			25,738	17,020	42,758		173,855	173,855	131,096
36				17,020	17,020		173,855	173,855	156,835
37				17,020	17,020		173,855	173,855	156,835
38				17,020	17,020		173,855	173,855	156,835
39				17,020	17,020		173,855	173,855	156,835
40				17,020	17,020		173,855	173,855	156,835
41				17,020	17,020		173,855	173,855	156,835
42				17,020	17,020		173,855	173,855	156,835
43				17,020	17,020		173,855	173,855	156,835
44				17,020	17,020		173,855	173,855	156,835
45			25,738	17,020	42,758		173,855	173,855	131,096
46			51,477	17,020	68,497		173,855	173,855	105,358
47			51,477	17,020	68,497		173,855	173,855	105,358
48			51,477	17,020	68,497		173,855	173,855	105,358
49			32,800	17,020	49,820		173,855	173,855	124,035
Total	**226,514**	**321,422**	**1,068,263**	**706,329**	**2,322,528**		**7,142,335**	**7,142,335**	**4,819,806**
NPV3%	190,154	276,247	544,234	321,281	1,331,915		3,229,222	3,229,222	1,897,307
NPV10%	129,609	199,756	172,699	81,775	583,838		809,341	809,341	225,503

B/C (NPV 10%)	1.39
EIRR (NPV 10%)	14.9%

Source: JICA Study Team

(4) Sensitivity Analysis in Economic Aspect

The major financial risks associated with the Project include lower Project benefits and larger Project cost. In this context, the sensitivity analysis is conducted for the variation of the economic cost and benefits change in plus minus 10% respectively for Option 1-3.

(A) Sensitivity Analysis for Option 1

The results of sensitivity analysis of Option 1 are indicated by project in the following table.

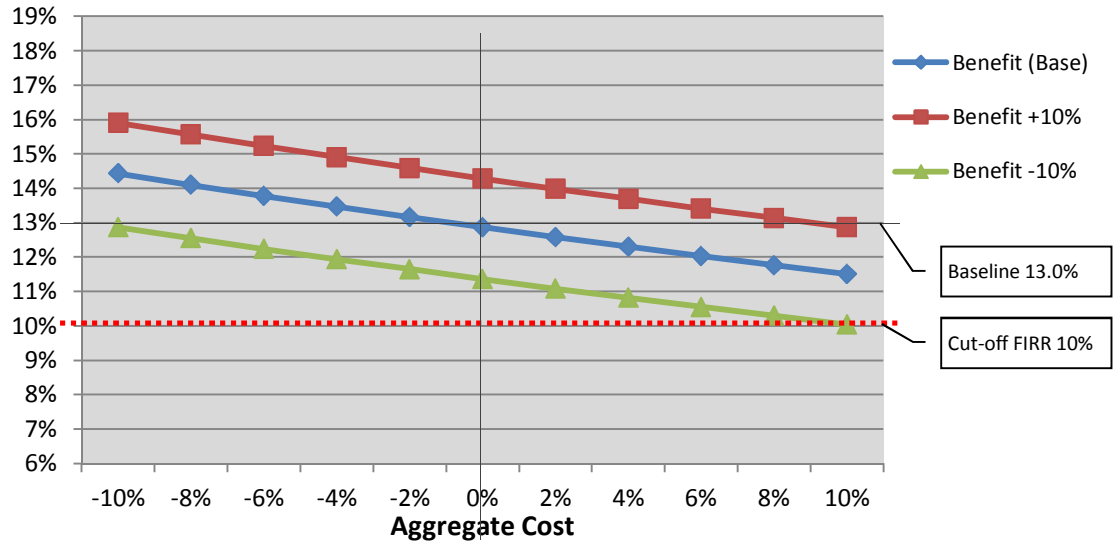
Table 6.16 Results of EIRR Sensitivity Analysis (Option 1)

		Economic benefits		
		-10%	Base	+10%
Economic costs	-10%	13.0%	14.6%	16.1%
	Base	11.5%	13.0%	14.4%
	+10%	10.2%	11.6%	13.0%

Source: JICA Study Team

In the all cases colored in gray above out of 9 cases, EIRR remains satisfactory with more than 10%. Only in the case of 10% cost plus and 10% benefit minus, EIRR and NPV are estimated to be just equivalent to 10.2% and 3 million Euro respectively.

The results of sensitivity analysis for Option 1indicate that marginal resiliency can be seen in the all cases.



Source: JICA Study Team

Figure 6.6 EIRR Sensitivity of Project (Option 1)

(B) Sensitivity Analysis for Option 2

The results of sensitivity analysis of Option 2 are indicated by project in the following table.

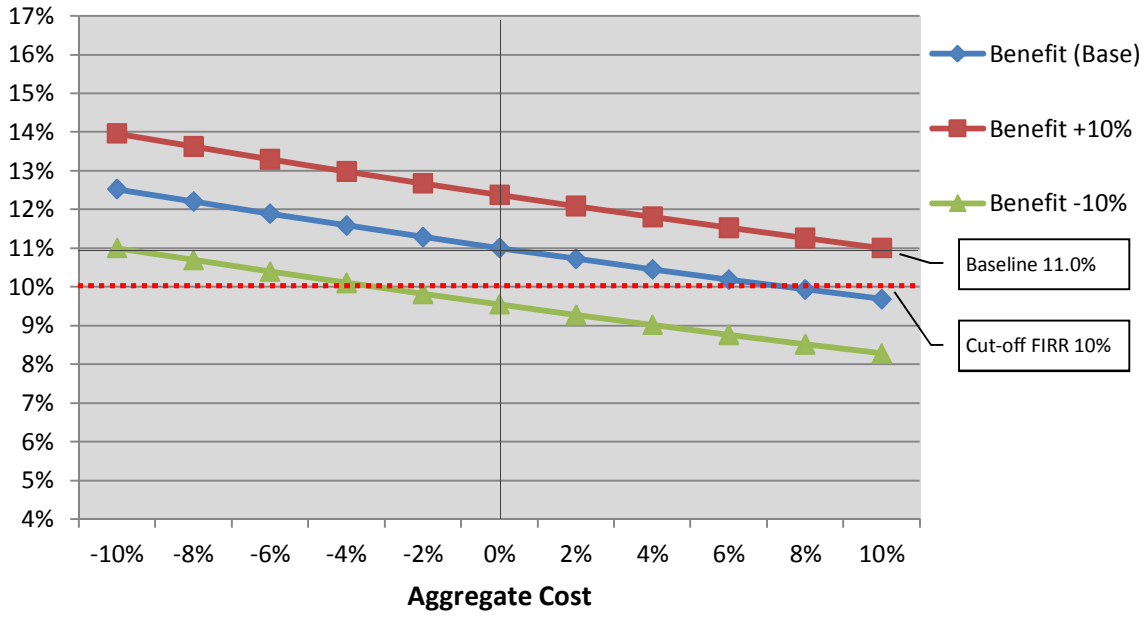
Table 6.17 Results of EIRR Sensitivity Analysis (Option 2)

		Economic benefits		
		-10%	Base	+10%
Economic costs	-10%	11.0%	12.5%	14.0%
	Base	9.5%	11.0%	12.4%
	+10%	8.3%	9.7%	11.0%

Source: JICA Study Team

In the cases colored in gray above out of 9 cases, EIRR remains satisfactory with more than 10%. In the three cases, EIRR is estimated to be less than 10.0%.

The results of sensitivity analysis for Option 2 indicate that marginal resiliency can be seen in the eight cases.



Source: JICA Study Team

Figure 6.7 EIRR Sensitivity of Project (Option 2)

(C) Sensitivity Analysis for Option 3

The results of sensitivity analysis of Option 3 are indicated by project in the following table.

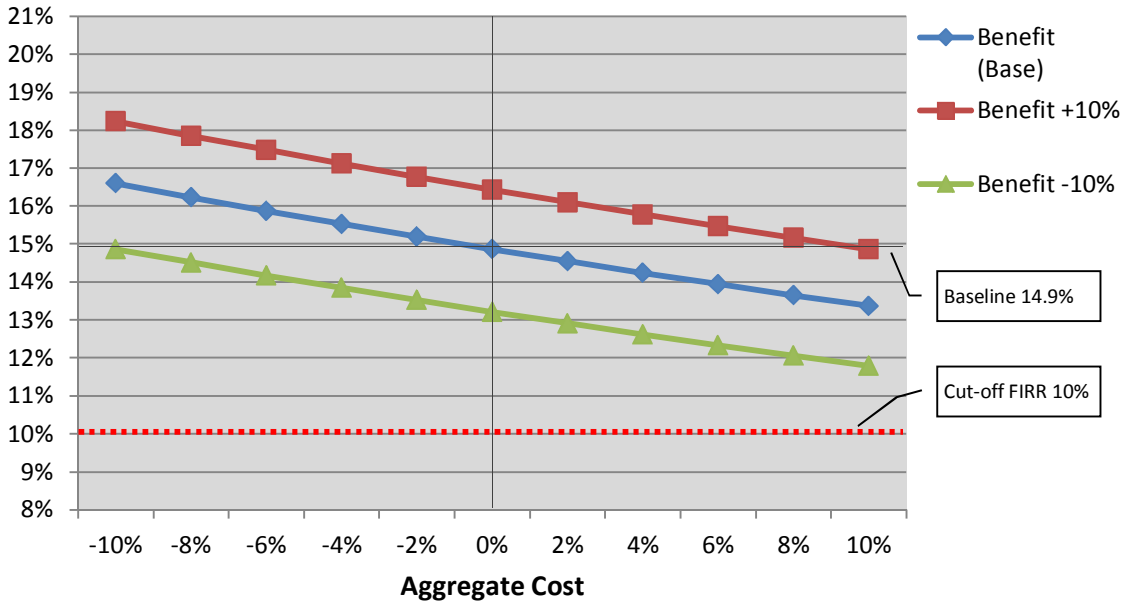
Table 6.18 Results of EIRR Sensitivity Analysis (Option 3)

		Economic benefits		
		-10%	Base	+10%
Economic costs	-10%	14.9%	16.6%	18.2%
	Base	13.2%	14.9%	16.4%
	+10%	11.8%	13.4%	14.9%

Source: JICA Study Team

In the all cases colored in gray above out of 9 cases, EIRR remains satisfactory with more than 10%.

The results of sensitivity analysis for Option 3 indicate that marginal resiliency can be seen in the all cases.



Source: JICA Study Team

Figure 6.8 EIRR Sensitivity of Project (Option 1)

6.2.4 Accounting Projection of KVK

The projection of profit and loss and fund flow of KVK until 2033 for Option 1-3 are conducted based on the current accounting information shown as follows.

In all cases of Option 1-3, the results do not indicate a sound accounting. It envisages a large financial deficit especially after starting the new operation of facilities constructed by the Project. The prospective annual net loss is estimated at 63–178 million Euro for Option 1, 63–156 million Euro for Option 2 and 63 – 149 million Euro for Option 3. Furthermore, according to the prospective balance sheet, it is presumed that the net loss is not covered by the accumulated available cash if the central and/or municipal government does not provide financial subsidies.

Even though this estimation is carried out based on various assumptions, it would be said that KVK has to face severe financial shortage. The unsound financial situation could be considered to primarily attribute to lower tariff rates than actual unit production and service costs and to the project nature which does not contribute to increase new sewerage service connections. Without the revision of sewerage tariff rates, projection results would not be expected to be improved very much.

The serious deadlock is seemed that KVK does not have an authority over revision of sewerage tariff rates, which is given to NCSPUR. Hence NCSPUR and other relevant governmental agencies have to acknowledge the urgent need for revising the sewerage tariff rates for sustainable sewerage works management.

6.2.5 Debt Service and Financial Soundness

Debt Service Coverage Ratio[9] is a popular benchmark used in the measurement of an entity's ability to produce enough cash to cover its debt payments. This indicator indicates on how much cash is available for debt servicing to interest, principal.

Associated debt service values are calculated in the three cases as A – C according to the percentage of financial burden by KVK. The results of DSCR are shown as below.

(1) Option 1

The Estimated debt services coverage ratio of Case A - Case C during the whole loan period presumably turn to be 40%, 79% and 158% in that order. In the view point of financial soundness borne out by DSCR, it would be noteworthy that Case C is within the liable level and considered as financially soundness. In Case A and Case B, heavy obligation of debt service will be projected during the repayment period.

[9] Net cash flow (net operating income + net investment income) / (Repayment of loan + interest payment)

Table 6.19 Associated Debt Service Value (Option 1)

Case	Case A	Case B	Case C
KVK's financial burden against initial investment costs (%)	100%	50%	25%
Principal repayment (million UAH) (million Euro)	1,122.6 (103.3)	561.3 (51.6)	280.6 (25.8)
Interest repayment (million UAH) (million Euro)	3.2 (0.3)	1.6 (0.15)	0.8 (0.07)
Aggregate repayment (million UAH) (million Euro)	1,125.8 (103.6)	562.9 (51.8)	281.4 (25.9)
Debt Service Coverage Ratio (%)	40%	79%	158%

Source: JICA Study Team

(2) Option 2

The Estimated debt services coverage ratio of Case A - Case C during the whole loan period presumably turn to be 50%, 99% and 199% in that order. In the view point of financial soundness borne out by DSCR, it would be noteworthy that Case C and Case B is within the liable level or is almost the criteria level and considered as financially soundness. In Case A, heavy obligation of debt service will be projected during the repayment period.

Table 6.20 Associated Debt Service Value (Option 2)

Case	Case A	Case B	Case C
KVK's financial burden against initial investment costs (%)	100%	50%	25%
Principal repayment (million UAH) (million Euro)	895.4 (82.4)	447.8 (41.2)	238.9 (22.0)
Interest repayment (million UAH) (million Euro)	2.6 (2.4)	1.3 (0.1)	0.7 (0.6)
Aggregate repayment (million UAH) (million Euro)	898.0 (82.6)	449.0 (41.3)	223.8 (20.5)
Debt Service Coverage Ratio (%)	50%	99%	199%

Source: JICA Study Team

(3) Option 3

The Estimated debt services coverage ratio of Case A - Case C during the whole loan period presumably turn to be 78%, 155% and 311% in that order. In the view point of financial soundness borne out by DSCR, it would be noteworthy that Case B and Case C are within the liable level and considered as financially soundness. In Case A, heavy obligation of debt service will be projected during the repayment period.

Table 6.21 Associated Debt Service Value (Option 3)

Case	Case A	Case B	Case C
KVK's financial burden against initial investment costs (%)	100%	50%	25%
Principal repayment (million UAH) (million Euro)	572.1 (52.6)	285.6 (26.3)	142.8 (13.1)
Interest repayment (million UAH) (million Euro)	1.7 (0.2)	0.8 (0.1)	0.4 (0.04)
Aggregate repayment (million UAH) (million Euro)	573.8 (52.8)	286.9 (26.3)	143.5 (1.3)
Debt Service Coverage Ratio (%)	78%	155%	311%

(4) Remarks

In the case that the DSCR is less than 100%, a partial financing for initial investment costs by the government is fundamentally desirable, if the government recognizes an urgent social needs and the present deteriorated situation of the facilities. Furthermore, as mentioned before, the improvement of tariff rates needs to be seriously taken into account by NCSPUR and the relevant governmental agencies.

Table 6.22 Projection of Profit and Loss of KVK

[Option 1] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Revenue income	88,408	89,683	90,958	92,233	93,508	94,782	96,057	97,332	98,322	99,320
	Water & Sewerage Service	80,371	81,530	82,689	83,848	85,007	86,166	87,325	88,484	89,384	90,291
	Other revenue	8,037	8,153	8,269	8,385	8,501	8,617	8,732	8,848	8,938	9,029
2	O&M Cost	136,415	138,515	140,615	142,715	144,815	146,915	149,015	151,115	152,028	156,737
3	Replacement Cost	0	0	0	0	0	0	0	0	0	0
4	Profit/Loss before Tax	-48,007	-48,832	-49,657	-50,482	-51,307	-52,132	-52,958	-53,783	-53,417	-57,417
5	Value Added tax	14,735	14,947	15,160	15,372	15,585	15,797	16,010	16,222	16,387	16,553
Net Profit/Loss		**-62,742**	**-63,779**	**-64,817**	**-65,854**	**-66,892**	**-67,930**	**-68,967**	**-70,005**	**-70,093**	**-73,970**
Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	Revenue income	100,314	101,307	102,301	103,295	104,289	105,283	106,276	107,233	108,189	109,146
	Water & Sewerage Service	91,194	92,098	93,001	93,905	94,808	95,711	96,615	97,484	98,354	99,224
	Other revenue	9,119	9,210	9,300	9,390	9,481	9,571	9,661	9,748	9,835	9,922
2	O&M Cost	157,907	159,074	160,242	161,409	212,714	264,019	265,186	266,353	267,484	218,478
3	Replacement Cost	0	0	0	0	50,138	100,276	100,276	100,276	100,276	50,138
4	Profit/Loss before Tax	-57,594	-57,767	-57,940	-58,114	-158,563	-259,012	-259,185	-259,396	-259,571	-159,470
5	Value Added tax	16,719	16,885	17,050	17,216	17,381	17,547	17,713	17,872	18,032	18,191
Net Profit/Loss		**-74,313**	**-74,652**	**-74,991**	**-75,329**	**-175,944**	**-276,559**	**-276,898**	**-277,268**	**-277,602**	**-177,661**

[Option 2] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Revenue income	88,408	89,683	90,958	92,233	93,508	94,782	96,057	97,332	98,322	99,320
	Water & Sewerage Service	80,371	81,530	82,689	83,848	85,007	86,166	87,325	88,484	89,384	90,291
	Other revenue	8,037	8,153	8,269	8,385	8,501	8,617	8,732	8,848	8,938	9,029
2	O&M Cost	136,415	138,515	140,615	142,715	144,815	146,915	149,015	151,115	149,206	150,712
3	Replacement Cost	0	0	0	0	0	0	0	0	0	0
4	Profit/Loss before Tax	-48,007	-48,832	-49,657	-50,482	-51,307	-52,132	-52,958	-53,783	-50,884	-51,392
5	Value Added tax	14,735	14,947	15,160	15,372	15,585	15,797	16,010	16,222	16,387	16,553
Net Profit/Loss		**-62,742**	**-63,779**	**-64,817**	**-65,854**	**-66,892**	**-67,930**	**-68,967**	**-70,005**	**-67,271**	**-67,945**
Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	Revenue income	100,314	101,307	102,301	103,295	104,289	105,283	106,276	107,233	108,189	109,146
	Water & Sewerage Service	91,194	92,098	93,001	93,905	94,808	95,711	96,615	97,484	98,354	99,224
	Other revenue	9,119	9,210	9,300	9,390	9,481	9,571	9,661	9,748	9,835	9,922
2	O&M Cost	152,225	153,734	155,243	156,752	198,676	240,599	242,108	243,610	245,073	206,121
3	Replacement Cost	0	0	0	0	40,414	80,828	80,828	80,828	80,828	40,414
4	Profit/Loss before Tax	-51,911	-52,427	-52,942	-53,457	-134,801	-216,144	-216,660	-217,205	-217,711	-137,390
5	Value Added tax	16,719	16,885	17,050	17,216	17,381	17,547	17,713	17,872	18,032	18,191
Net Profit/Loss		**-68,630**	**-69,311**	**-69,992**	**-70,673**	**-152,182**	**-233,691**	**-234,372**	**-235,077**	**-235,743**	**-155,581**

[Option 3] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Revenue income	88,408	89,683	90,958	92,233	93,508	94,782	96,057	97,332	98,322	99,320
	Water & Sewerage Service	80,371	81,530	82,689	83,848	85,007	86,166	87,325	88,484	89,384	90,291
	Other revenue	8,037	8,153	8,269	8,385	8,501	8,617	8,732	8,848	8,938	9,029
2	O&M Cost	136,415	138,515	140,615	142,715	144,815	146,915	149,015	151,115	**166,209**	**167,886**
3	Replacement Cost	0	0	0	0	0	0	0	0	0	0
4	Profit/Loss before Tax	-48,007	-48,832	-49,657	-50,482	-51,307	-52,132	-52,958	-53,783	-67,887	-68,566
5	Value Added tax	14,735	14,947	15,160	15,372	15,585	15,797	16,010	16,222	16,387	16,553
Net Profit/Loss		**-62,742**	**-63,779**	**-64,817**	**-65,854**	**-66,892**	**-67,930**	**-68,967**	**-70,005**	**-84,274**	**-85,120**
Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	Revenue income	**100,314**	**101,307**	**102,301**	**103,295**	**104,289**	**105,283**	**106,276**	**107,233**	**108,189**	**109,146**
	Water & Sewerage Service	91,194	92,098	93,001	93,905	94,808	95,711	96,615	97,484	98,354	99,224
	Other revenue	9,119	9,210	9,300	9,390	9,481	9,571	9,661	9,748	9,835	9,922
2	O&M Cost	339,141	342,501	345,861	349,222	380,258	411,294	414,655	417,993	421,250	396,832
3	Replacement Cost	0	0	0	0	27,676	55,352	55,352	55,352	55,352	27,676
4	Profit/Loss before Tax	-69,257	-69,943	-70,630	-71,316	-127,354	-183,392	-184,078	-184,791	-185,463	-130,784
5	Value Added tax	16,719	16,885	17,050	17,216	17,381	17,547	17,713	17,872	18,032	18,191
Net Profit/Loss		**-85,976**	**-86,828**	**-87,680**	**-88,532**	**-144,735**	**-200,939**	**-201,791**	**-202,663**	**-203,495**	**-148,975**

Source: KVK

[Conditions]

- Population served for domestic users: 639,000 in 2021 and 697,000 in 2030, designed in the Study Report.
- Sewerage water consumption: Designed at 200L/person/day. Water supply amount is assumed as same as wastewater volume.
- Industrial wastewater amount: Assumed as 21.5% of domestic wastewater flow.
- Collection ratio: 95% of the total
- Price escalation: Not considered.
- Exchange rate: 1 UAH = 0.0920 Euro

Table 6.23 Projection of Fund Flow of KVK

[Option 1] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	**Fund Source**	**-61,095**	**-55,829**	**-56,501**	**30,877**	**128,070**	**134,590**	**141,450**	**41,804**	**-218,540**	**-202,904**
a.	Internal fund generation (b+c)	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-222,121	-202,904
b.	Depreciation	0	0	0	0	0	0	0	0	0	27,803
c.	Net profit	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-222,121	-230,707
d.	JICA Loan to the Project (FC)	1,646	5,305	5,766	48,590	94,061	95,528	96,972	51,164	3,053	0
e.	JICA Loan to the Project (LC)	0	2,645	2,550	48,142	100,902	106,992	113,445	60,644	528	0
2	**Application of Fund**	**-61,095**	**-55,829**	**-56,501**	**30,877**	**128,070**	**134,590**	**141,450**	**41,804**	**-218,540**	**-202,904**
f.	Investment for the Project	1,646	7,950	8,316	96,732	194,962	202,520	210,417	111,808	3,581	0
g.	Debt repayment (h+i)										
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	0
i.	Repayment of interest	0	2	5	10	22	47	72	99	113	114
3	**Working Capital**	**-62,742**	**-63,781**	**-64,822**	**-65,864**	**-66,914**	**-67,977**	**-69,039**	**-70,104**	**-222,234**	**-203,018**
Accumulated Available Cash		**-62,742**	**-126,523**	**-191,345**	**-257,209**	**-324,123**	**-392,100**	**-461,139**	**-531,242**	**-753,476**	**-956,494**

Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	**Fund Source**	**-61,095**	**-55,829**	**-56,501**	**30,877**	**128,070**	**134,590**	**141,450**	**41,804**	**-218,540**	**-202,904**
a.	Internal fund generation (b+c)	-204,417	-205,923	-207,429	-208,935	-310,717	-412,499	-414,005	-415,542	-417,007	-318,197
b.	Depreciation	-204,417	-205,923	-207,429	-208,935	-310,717	-412,499	-414,005	-415,542	-417,007	-318,197
c.	Net profit	27,803	27,803	27,803	27,803	27,803	27,803	27,803	27,803	27,803	27,803
d.	JICA Loan to the Project (FC)	-232,220	-233,726	-235,232	-236,738	-338,520	-440,302	-441,808	-443,345	-444,811	-346,000
e.	JICA Loan to the Project (LC)	0	0	0	0	0	0	0	0	0	0
2	**Application of Fund**	**-204,417**	**-205,923**	**-207,429**	**-208,935**	**-310,717**	**-412,499**	**-414,005**	**-415,542**	**-417,007**	**-318,197**
f.	Investment for the Project	0	0	0	0	0	0	0	0	0	0
g.	Debt repayment (h+i)	114	114	114	114	114	114	114	114	114	37,974
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	37,860
i.	Repayment of interest	114	114	114	114	114	114	114	114	114	114
3	**Working Capital**	**-204,531**	**-206,037**	**-207,543**	**-209,049**	**-310,831**	**-412,613**	**-414,119**	**-415,656**	**-417,121**	**-356,171**
Accumulated Available Cash		**-1,161,025**	**-1,367,062**	**-1,574,605**	**-1,783,654**	**-2,094,485**	**-2,507,097**	**-2,921,216**	**-3,336,872**	**-3,753,993**	**-4,110,164**

[Option 2] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	**Fund Source**	**-61,439**	**-56,173**	**-56,845**	**10,803**	**86,622**	**91,388**	**96,398**	**18,057**	**-213,411**	**-196,524**
a.	Internal fund generation (b+c)	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-216,476	-196,524
b.	Depreciation	0	0	0	0	0	0	0	0	0	22,134
c.	Net profit	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-216,476	-218,657
d.	JICA Loan to the Project (FC)	1,302	4,961	5,422	40,337	77,673	78,889	80,078	42,341	2,537	0
e.	JICA Loan to the Project (LC)	0	2,645	2,550	36,320	75,841	80,428	85,287	45,721	528	0
2	**Application of Fund**	**-61,439**	**-56,173**	**-56,845**	**10,803**	**86,622**	**91,388**	**96,398**	**18,057**	**-213,411**	**-196,524**
f.	Investment for the Project	1,302	7,606	7,972	76,658	153,514	159,317	165,365	88,061	3,066	0
g.	Debt repayment (h+i)	0	2	5	10	19	39	59	80	91	91
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	0
i.	Repayment of interest	0	2	5	10	19	39	59	80	91	91
3	**Working Capital**	**-62,742**	**-63,781**	**-64,822**	**-65,864**	**-66,911**	**-67,969**	**-69,026**	**-70,085**	**-216,567**	**-196,615**
Accumulated Available Cash		**-62,742**	**-126,523**	**-191,345**	**-257,209**	**-324,120**	**-392,089**	**-461,115**	**-531,199**	**-747,767**	**-944,381**

Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	**Fund Source**	**-198,721**	**-200,912**	**-203,102**	**-205,292**	**-288,310**	**-371,329**	**-373,519**	**-375,725**	**-377,854**	**-299,154**
a.	Internal fund generation (b+c)	-198,721	-200,912	-203,102	-205,292	-288,310	-371,329	-373,519	-375,725	-377,854	-299,154
b.	Depreciation	22,134	22,134	22,134	22,134	22,134	22,134	22,134	22,134	22,134	22,134
c.	Net profit	-220,855	-223,045	-225,235	-227,425	-310,444	-393,462	-395,652	-397,859	-399,987	-321,288
d.	JICA Loan to the Project (FC)	0	0	0	0	0	0	0	0	0	0
e.	JICA Loan to the Project (LC)	0	0	0	0	0	0	0	0	0	0
2	**Application of Fund**	**-198,721**	**-200,912**	**-203,102**	**-205,292**	**-288,310**	**-371,329**	**-373,519**	**-375,725**	**-377,854**	**-299,154**
f.	Investment for the Project	0	0	0	0	0	0	0	0	0	0
g.	Debt repayment (h+i)	91	91	91	91	91	91	91	91	91	30,580
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	30,489
i.	Repayment of interest	91	91	91	91	91	91	91	91	91	91
3	**Working Capital**	**-198,812**	**-201,003**	**-203,193**	**-205,383**	**-288,401**	**-371,420**	**-373,610**	**-375,816**	**-377,945**	**-329,734**
Accumulated Available Cash		**-1,143,194**	**-1,344,197**	**-1,547,389**	**-1,752,772**	**-2,041,173**	**-2,412,593**	**-2,786,203**	**-3,162,019**	**-3,539,963**	**-3,869,698**

[Option 3] (1,000 Euro)

Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	**Fund Source**	**-61,926**	**-56,660**	**-57,332**	**-17,504**	**28,083**	**30,278**	**32,577**	**-15,633**	**-248,147**	**-238,524**
a.	Internal fund generation (b+c)	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-250,483	-238,524
b.	Depreciation	0	0	0	0	0	0	0	0	0	14,482
c.	Net profit	-62,742	-63,779	-64,817	-65,854	-66,892	-67,930	-68,967	-70,005	-250,483	-253,006
d.	JICA Loan to the Project (FC)	816	4,474	4,936	29,661	56,512	57,400	58,254	30,910	1,808	0
e.	JICA Loan to the Project (LC)	0	2,645	2,550	18,689	38,463	40,807	43,289	23,462	528	0
2	**Application of Fund**	**-61,926**	**-56,660**	**-57,332**	**-17,504**	**28,083**	**30,278**	**32,577**	**-15,633**	**-248,147**	**-238,524**
f.	Investment for the Project	816	7,119	7,485	48,350	94,975	98,207	101,544	54,372	2,336	0
g.	Debt repayment (h+i)	0	1	5	9	16	28	40	53	60	60
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	0
i.	Repayment of interest	0	1	5	9	16	28	40	53	60	60
3	**Working Capital**	-62,742	-63,780	-64,822	-65,863	-66,908	-67,958	-69,007	-70,058	-250,543	-238,584
Accumulated Available Cash		-62,742	-126,522	-191,344	-257,207	-324,115	-392,073	-461,080	-531,137	-781,680	-1,020,264
Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	**Fund Source**	**-241,064**	**-243,596**	**-246,129**	**-248,661**	**-306,545**	**-364,428**	**-366,961**	**-369,502**	**-371,962**	**-319,071**
a.	Internal fund generation (b+c)	-241,064	-243,596	-246,129	-248,661	-306,545	-364,428	-366,961	-369,502	-371,962	-319,071
b.	Depreciation	14,482	14,482	14,482	14,482	14,482	14,482	14,482	14,482	14,482	14,482
c.	Net profit	-255,546	-258,078	-260,611	-263,143	-321,027	-378,910	-381,442	-383,984	-386,444	-333,553
d.	JICA Loan to the Project (FC)	0	0	0	0	0	0	0	0	0	0
e.	JICA Loan to the Project (LC)	0	0	0	0	0	0	0	0	0	0
2	**Application of Fund**	**-241,064**	**-243,596**	**-246,129**	**-248,661**	**-306,545**	**-364,428**	**-366,961**	**-369,502**	**-371,962**	**-319,071**
f.	Investment for the Project	0	0	0	0	0	0	0	0	0	0
g.	Debt repayment (h+i)	60	60	60	60	60	60	60	60	60	20,135
h.	Repayment of principal	0	0	0	0	0	0	0	0	0	20,075
i.	Repayment of interest	60	60	60	60	60	60	60	60	60	60
3	**Working Capital**	-241,124	-243,656	-246,189	-248,721	-306,605	-364,488	-367,021	-369,562	-372,022	-339,206
Accumulated Available Cash		-1,261,388	-1,505,044	-1,751,233	-1,999,954	-2,306,558	-2,671,046	-3,038,067	-3,407,629	-3,779,650	-4,118,856

Source: KVK

[Conditions]

- Population served for domestic users: 639,000 in 2021 and 697,000 in 2030, designed in the Study Report.
- Sewerage water consumption: Designed at 200L/person/day. Water supply amount is assumed as same as wastewater
- Depreciation: Fixed assets for sewerage facilities planned by the Project are depreciated by KVK over 15 years for electric and mechanical works and 50 years for civil and architecture works
- Price escalation: Not considered.
- Exchange rate: 1 UAH = 0.0920 Euro

7. Operation and Management System

7.1 Institutional Framework for Implementing the Project

An institutional framework for the Project consists of Project Executing Agency (PEA), Project Implementation Agency (PIA), Project Implementation Unit (PIU), and Project Coordination Committee (PCC). Project stakeholders will be involved in the PCC. Since KVK as PIA is one private entity which has carried out operation and management for sewerage service base on a contract with KCSA, it is proposed that MoRDCH as a line of ministry responsible for supervising water and sewerage services in Ukraine is appointed as PEA, separately from PIA.

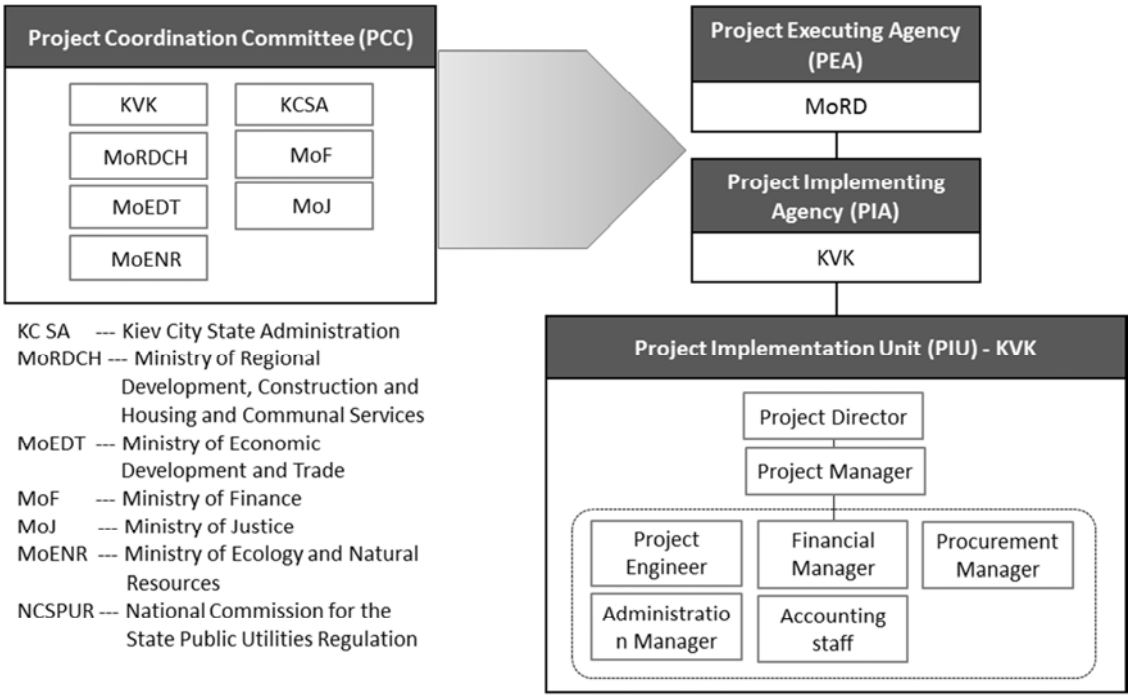
The main features of the institutional framework for Project implementation are shown in the following table.

Table 7.1 Institutional Framework for Project Implementation

Project organization	Institutions responsible	Role and responsibility
Project Coordination Committee (PCC)	- Ministry of Regional Development and Housing (Chair) - Kiev City State Administration - Ministry of Economy - Ministry of Environment - Ministry of Justice - Ministry of Foreign Affairs	• Project overall coordination for planning and implementation though ad hoc meetings • Coordinating stakeholder's interest relevant to the project activities enhancing dispute settlement and smooth project implementation
Project Executing Agency (PEA)	Ministry of Regional Development and Housing (MoRDCH) <u>Working Group</u> - International cooperation dept. - Water and sewerage dept. - Infrastructure project implementation dept. - Construction dept. - Legal dept.	• Overseeing of comprehensive management of project implementation according to a loan contract • Planning, monitoring and reviewing the progress of projects as a competent authority • Allocation of budget • Guidance to PIA and PIU
Project Implementation Agency (PIA)	PJSC KVK	• Overall technical supervision • Establishing a monitoring system for tracking the progress of the project • Monitoring the progress of Project technically and financially
Project Implementation Unit (PIU)	PJSC KVK DSSE	• Project management through daily work activities • Supervision of daily work activities • Monitoring and coordination of daily work activities • Budgetary management

Source: JICA Study Team

An institutional framework consisted of PEA, PIA, PIU and PCC for the Project implementation shall be proposed after an exchange of views with PJSC KVK as the following Figure.



Source: JICA Study Team

Figure 7.1 Project Implementation Structure

7.1.1 Project Executing Agency (PEA)

MoRDCH shall be the specialized ministry as the PEA designated to be responsible for overall supervision and execution of the Project. The Department of Housing and Utility Infrastructure (DoHUI) will be responsible for utility service including water, sewerage and sanitation works. Main role and duty of the PEA is to oversee and supervise overall activities during the project implementation by exercising its mandate and its power. DoHUI of MoRDH will be responsible for management and monitoring of the project activities by their expertise and specialized knowledge on development of sewerage projects from the technical view point.
The main functions of PEA will be shown as follows;

- To monitor and evaluate the progress of the Project as a competent authority technically and financially
- To make the project progress accountable in compliance with the terms and conditions set in the loan agreement
- To provide a guidance on project management of sewerage reconstruction project to KVK as PIA and PIU
- To coordinate communication between relevant governmental agencies in a systematic way

as a representative of competent authority

- To timely release the funds to PIA and also properly manage the disbursement of JICA funds in accordance to the payment principle

7.1.2 Project Implementation Agency (PIA)

KVK shall be a PIA to exercise monitoring and technical supervision of Project. After the monitoring, PIA provides relevant and timely feedback to PIU.

- To be comprehensively responsible for the project implementation in accordance with the loan agreement
- To coordinate and manage the Project activities through monitoring and technical supervision
- To establish a monitoring and evaluation system that would track the progress of the Project
- To support the PIU for planning and implementation of project activities technically and financially
- To Provide timely feedback on project planning and implementation to PIU
- To report to the government on the overall progress of the Project
- To call regular meetings for the duration of the Project, and special meetings as the necessity arises

7.1.3 Project Implementation Unit (PIU)

(1) Main Function of PIU

A PIU shall be established within DSSE of PJSC KVK as a principal entity for the project implementation. PIU is an ad hoc entity to be established for the project implementation. PIU is aimed at enhancing management and monitoring of the project, and be an independent organization to implement the specified project during the limited period. It will be headed and staffed by a full-time Project Director (PD), probably by the Chief Engineer, and will create a Project office consisting of the staff members of technical section, management section, and administration section in the PIU of PJSC KVK.

PIU shall be tasked with managing and monitoring the day-today activities of the project at the field level. The Project Director has a responsibility and authority for overall activities including coordination between sections and construction companies to ensure the progress of the project within the implementation period. PIU will be managed under the supervision of PIA, PEA and PCC.

The technical section supervises reduction of NRW and water quality management etc. The waterworks management section is responsible for improvement of water tariff rates, operational works by using performance indicators, revenue collection. It is recommended that administration

section included the function of finance and accounting for ensuring financial resources and smooth payment works of legal and contract management.

Main functions of the PIU are shown as follows.

- Supervising and monitoring day-to-day project activities
- Preparing project implementation and work plan and reporting the progress of the project with the assistance of the consultant;
- Arranging and supervising construction works
- Arranging procurement of goods, works and services for the project
- Organizing monitoring and evaluation activities;
- Receiving and distributing funds for project activities
- Maintaining accounts of the project and arranging audit

PIU should be created in order to ensure smooth work of the ODA loan and project implementation. The composition of PIU likely consists of administration, financial and technical sections. It will be effective to employ expert or specialized consultants in order to enhance the ODA procedure smoothly.

The PIU generally consists of a project manager, an engineering manager, technical engineers, a procurement manager, a financial manager, an administration manager, accountants and so on.

The Project director should have the responsibility and authority of all activities such as planning, coordination between sections, its management and so on. Also PD should have an authority to coordinate private companies and supervise financial and accounting section of PMU as well in order to secure sufficient financial resources and appropriate payment for smooth construction works.

(2) Staffing of Project Implementation Unit (PIU)

(A) Staffing

The following staffing plan for the PIU is recommended. The duty of the PD may be taken by key members of DSSE. It is desirable that these personnel are appointed from DSSE of KVK from the viewpoint of capacity development of staff members and synergy effects. The number of persons is not necessarily limited to this table, which only serves as an indication.

Table 7.1 Staffing for PMU (Example)

Areas	Position	No.
Management		
1	Project Director	1
2	Project Manager	1
Technical section（including manager）		

Areas	Position	No.
3	Engineer (civil, mechanical, electrical, architectural)	8
4	Assistant Engineer	14
Administration and Finance（including manager）		
7	Finance and accounting	2
8	Administration	2
9	Procurement	2
Total		30

Source: JICA Study Team

(B) Major Tasks and Duties of PIU Staff

The major tasks and duties of the Project Implementation Unit (PIU) are shown as below.

Table 7.2 Major Tasks and Duties of PIU Staff

Designation	Major Tasks and Duties
Project Director	• Coordinate the works in general • Manage and supervise the technical tasks • Bear direct responsibility for day-to-day consulting services • Represent the Consultant's Team in matters relating to the performance of services • Review all documents and communicate • Provide direction and guidance for PIU staffs
Project Manager	• Assist Project Director in carrying out all tasks and duties of Project Director • Perform specific issues/aspects delegated by Project Director • Represent the Consultant's team during absence of Project Director
Project Engineer	• Assist Project Director in carrying out implementation, management and supervision of technical studies • Undertake technical planning activities of project • Implement design, oversee and supervision of overall civil works for reconstruction, rehabilitation and replacement of WWTP and other facilities at field level activities • Implement design, oversee and supervision of overall architecture works for building and re-building at field level activities • Monitor project activities and accomplishments regularly • Prepare supporting reports on the progress of project regularly and submit it to relevant stakeholders • Assist supervision of contract work
Project Assistant Engineer	• Support Project Engineers' activities of implementation and management, mainly supervision and monitoring at filed levels effectively and efficiently • Facilitate the preparation of technical planning • Assist in preparation of supporting reports

Designation	Major Tasks and Duties
	• Assist to monitor the progress of project works at field level
Accountant	• Implement project accounting and financial practice in overall • Prepare financial reports on disbursement and accounting on timely basis
Administrator	• Develop, implement and manage administration works such as records system, office documentation, communication system etc. • Coordinates and processes procurement of goods and services

Source: KVK

7.1.4 Project Coordination Committee (PCC)

PCC is a supreme organization to oversee project implementation and monitoring. The main functions of PCC will be coordinating activities among stakeholders to enhance dispute settlement and smooth project implementation.

There are various members nominated for PCC, however the man line of authority shall be four entities represented by KVK, MoRDH, MoF and MoENR. Other member agencies such as MoJ, MoEDT, KCSA and NCSPUR are could be positioned as advisory agencies from their specialized aspects.

Min role of each agencies are indicated as below:

- KVK as a chair agency is a primary agency to implement the project by appropriate coordination and management
- MoRDCH as the core agency is comprehensively responsible for supervising the project implementation
- MoF is responsible for the disbursement of ODA funding according to the progress of project implementation and for the analysis and advisory works on PIA's ability to recover the project costs to PIA
- MoEDT shall make advisory works on project implementation based on the experiences of supervising investment projects
- MoENR is responsible for monitoring and supervisory service on environmental impact of the project
- MoJ shall make advisory works on legal matters related to the project implementation
- KCSA as the property owner shall make advisory works from the viewpoint to secure municipal sewerage services
- NCSPUR as a regular shall make advisory works on sewerage works management, especially tariff setting and cost recovery

The committee will be held regularly, for instance quarterly in addition to at the beginning of the project, the terminal occasion. PCC shall be co-chaired by the project director and the department of

housing and utility infrastructure of MoRDCH. PCC coordinates the necessary issues for agreement, discussion and cooperation on the project activities. It regularly reviews the progress of project activities and gives instruction and guidance for project implementation.

7.1.5 Other Relevant Institutions

(1) KCSA

KCSA as the owner of the sewerage facilities will make the decisions on any changes to the sewerage facilities, for instance reconstruction and new construction. KCSA delegates its function of BAS and pipeline system to KVK based on the Contract. All decisions regarding reconstruction and new construction need to be agreed by KCSA.

KCSA is, however, recognized as solely an owner to monitor the relevant information including O&M. Also KCSA is not an autonomous city, which is a part of the structure of administrative and territorial unit of Ukraine, and complies with all legislation and regulations currently in effect, according to the information from KVK. Additionally, the financing allocation structure is not yet determined by MoF and MoE, however most likely be through MoF to KVK. Therefore KCSA may not be fully involved in the main stream of project implementation structure as the PEA and PIA, but rather be a member of the PCC.

(2) NCSPUR (National Commission for the State Public Utilities Regulation)

The participation of NCSPUR in the project implementation structure is not yet determined. The Study team proposes that it needs to be involved in a member of PCC since its activity is deeply related to revenue generation through tariff rate setting and to repayment of the loan.

7.2 Proposed Organizational Arrangement of KVK BAS

In order to efficiently and effectively operate and maintain the facilities which will be rehabilitated, replaced and newly constructed by the Project, it is suggested to rearrange some of the existing sections/groups of BAS.
The three main changes are proposed as follows.

- Creation of a new section of for operation and maintenance of incineration facilities
- Integration of exiting repair and maintenance sections
- Upgrading existing sludge treatment section

Separately from the above organizational rearrangement, it is suggested that a functional analysis on new organizational structure is carried out to determine any overlapping and overlooking functions.

7.2.1 Section of Incineration Facilities Operation

A new section is proposed to be created to be responsible for operation and maintenance of the sludge incinerator plant which is to be newly constructed. This incineration facility is completely new technology for KVK and BAS so expertise and know-how for daily operation needs to be obtained by the staff of this section through technology transfer of the Project.

Day-to-day operation of incineration facilities will be managed by 4 shift teams composed of 4 mechanics and 1 electrician as 1 team. Some necessary new staff will be recruited by KVK and the remaining new staff will be shifted from current BAS employees. It is assumed that the Project will enable to promote rationalization and automation of the system by reconstruction, rehabilitation and replacement of facilities in BAS, so that the number of overall staffs can be reduced. From the respect of social policy, however, the utilization of these redundant staff within BAS should be fully considered as much as possible through rearrangement and transfer to the above sections.

A necessary staffing plan with their specialized background is shown as the following table.

Table 7.3 Staffing of the Section of Incineration Facilities Operation

Specialties	Number of Employees
A. Engineer	
Mechanic	1
Electrician	1
Sanitation (hygiene)	1
Laboratory	2
Others Plants manager Deputy-managers	3 (1) Mechanical works (1), Electrical works (1)
B. Operation	
Mechanic	16（4 staff×4 teams）
Electrician	4 (1 staff×4 teams)
Others	0
	28

Source: JICA Study Team

7.2.2 Sludge Treatment Section

The sludge treatment section will handle the operation of new machines to be installed such as sludge thickener and sludge dewatering machine. The same as incinerator facilities, expertise and know-how of these machines for daily operation will need to be obtained by the staff of this section through technology transfer of the Project. For instance, the running speeds of belts, dosing rate of coagulant and feeding amount of sludge for thickener machine and rotating speed of screws, dosing rate of coagulant and mixing speed for dewatering machine have to be adjusted by the operators.

A necessary staffing plan with their specialized background is shown in the following table.

Table 7.4 Staffing of the Sludge Treatment Section

Specialties	Number of Employees
1. Engineer	
Mechanic	1
Electrician	1
Sanitation (hygiene)	1
Laboratory	2
Others Manager Deputy-managers	3 (1), Mechanical works (1) Electrical work (1)
2. Operation	
Mechanic	12 (3 staff × 4 teams)
Electrician	4 (1 staff × 4 teams)
Others	0
Total	24

Source: JICA Study Team

7.2.3 Repair and Maintenance Section

The maintenance of incineration facilities, sludge thickener and dewatering facilities to be newly constructed are managed by this section. At least, 18 personnel and 13 personnel could be required for maintenance of incineration facilities, and thickener and dewatering facilities respectively.

It is also important to note that current separately existing sections of energy equipment, measuring devices and means of automation, building and construction need to be integrated into the same section. The existing personnel amounting to 85 should be efficiently reallocated to this section including maintenance staff for newly installed facilities.

Table 7.5 Staffing of Repair and Maintenance Section

Specialties	Number of Employees
1. Maintenance (Incineration Facilities)	
Mechanic	10
Electrician	5
Others-Cleanings	3
Total	18
2. Maintenance (Sludge Thickener and Dewatering Facilities	
Mechanic	7
Electrician	4
Others-Cleanings	2
Total	13
3. Maintenance (Others)	
Total	Approximately 50

Source: JICA Study Team

7.3 Current Organizational Structure of KCSA

7.3.1 Organization of KCSA

Kiev is a national-level subordinated municipality (officially "a city with special status"), which means that the city is directly subordinated to the national-level government rather than to the regional level authorities.

Kiev City Council is the highest representative body of the city community. The members of city council are directly elected by the public and the council is chaired by the Mayor of Kiev or the City Council Secretary (elected among the council members).

7.3.2 Main Features of Department of Housing and Utility Infrastructure (DHUI)

DHUI is a responsible department to oversee water supply and sewerage service within the covered areas.

The main mission of the department, particularly related to water and sewerage service, is summarized as follows:

- To provide the implementation of state policy in the sphere of housing and utility services such as housing, water and sewerage, fuel and energy, sanitary cleaning, complex development, organization and implementation of measures to reform, determining priority areas of development.
- To increase the level and quality of utility services to the population of the city ensuring proper maintenance and operation of housing and housing and communal services of the city.
- To promote of centralized heating, centralized hot and cold water systems, drainage, landslide events, integrated municipal (public) services, sanitation and environmental cleanliness and culture of waste management
- To analyze prices and tariffs for funeral services and ritual objects belonging under the law.
- To provides organizational and technical support of the license fees of the executive body of the Kiev City Council (Kiev City State Administration) for the licensing of economic activities of water supply and sewerage and for the business of heat production, heat transportation backbone and local (distribution) distribution network, supplying heat.

7.4 Risk Analysis and Safety Measures

7.4.1 Risk Analysis

Table 7.6 indicates the potential risks and the relevant preventive measures and mitigations for the Project from its construction through operation. It evaluates the subjective probabilities of its occurrences and relative impacts.

The most common risks are associated with the lack of capacities of the contractors. The most standard solution is to design and undertake tenders that enable the selection of qualified contractors with proper commitments. To realize effective tenders, it is critical to procure a qualified consultant who is capable of close coordination with the PIU. The contractor contract should be designed to provide appropriate incentives to induce higher performance and penalties to discourage underperformances.

Furthermore, there may be some financial and political risks such as scarcity of domestic capital, undermining the balance of payments and political insecurity and fragile situation.

Table 7.6 Risk Analysis and Measures

Phase	Risks	Odds	Impacts	Measures
Construction	Delay in land preparation	H	M - Delays in implementation schedule	- Securing sufficient budget by the local government and coordination between the governmental agencies - Confirmation of the issue at the LA sign between both countries
	Delay in local approval procedure of the Japanese companies	H	H - Confirmation of the domestic legislation	- Thorough qualification assessment at PQ - Sufficient qualification evaluation at tender
	Procurement of unqualified contractor	M	H - Delay in schedule - Increase in cost - Underperformance in designed capacities	- Thorough qualification assessment at PQ - Sufficient qualification evaluation at tender
	Delay in implementation schedule	M	H - Increase in cost - Loss of opportunity for providing benefits of the Project	- Shortening of procurement schedule - Strategic construction packaging while retaining economy of scale - Inclusion of performance guarantee and bonus to the contract - Inclusion of penalty clause for delays
	Lack of finance due to depreciation of yen	M	H Delay in implementation	- Pragmatic cost estimation - Speeding up of implementation - Provision of counterpart funding - Use of dollar-based loan repayment program of JICA, “Currency Conversion Scheme of ODA Loans”
	Lack of local funding	H	H Delay in implementation	- Confirmation of loan conditions - Due evaluation of financial capacities

Phase	Risks	Odds	Impacts	Measures
				of KVK and the relevant governmental agencies
	Negative impacts on neighboring residents	M	M Noise/air pollution by construction vehicles etc.	- Adoption and implementation of strict environmental management plan
	Unsuccessful tender	M	M (Causes) Gap between cost estimation and implementation cost	- Selection and procurement of reliable consultation - Effective and well-designed tender documentation - Use of detailed design based tender (FIDIC Redbook) for well-established technologies to encourage cost competition - Use of design-build based tender (FIDIC Yellow Book) for more technologically innovative fields to encourage more cost reduction
	Under-achievement of designed capacities	L	H - Increase in OM costs - Underperformance in service levels	- Clarification of contractor obligations for compensation and modification during indemnity period - Inclusion of performance guarantee and bonus to the contract - Reinforcement of training program
	Under-achievement by contractors	M	H - Delay in implementation - Increase in construction costs	- Strict qualification assessment of contracts - Use of performance bond - Inclusion of penalty clause for delays
	Fragile political stability	H	H - Delay in implementation - Increase in construction costs	- Careful assessment of political situation-and the future projection - Inclusion of penalty clause for delays in case of extraordinary situation
Operation and Maintenance	Under-achievement in treatment capacities	M	M - Lack of revenue - High unit cost for treatment due to under-utilization level	- Planed connection program for the unconnected areas to the collectors - Consistent and effective sewer to collector switching program
	Under-achievement of designed effluent water quality	M	H - Increase in unit cost for treatment due to inefficient operations - Violation of effluent limit values due to deficiencies	- Control of rainwater filtration within separate sewer system areas - Supervision and control of industry effluents without proper treatment
	Under-achievement in operation and maintenance capacities	L	M - Operation accidents - Inefficient operations - Increase in OM costs	- Reinforcement of training program - Long-term institutional development (recruitment of young qualified engineers)
	Lack of access to sludge disposal	M	L Increase in OM costs	- Early start in planning for obtaining landfill areas - Investigation and development of alternative disposal technologies - Close coordination with landfill management bodies

Phase	Risks	Odds	Impacts	Measures
	Under-achievement in treatment efficiency	L	M Increase in OM costs	- Clarification of contractor obligations for compensation and modification during indemnity period - Use of life-cycle cost in tender price evaluation - Inclusion of performance guarantee and bonus to the contract - Inclusion of penalty clause for delays
	Below 100％ Bill Recovery	M	M Lack of revenue income	- Reduction of account receivable - Improvement in customer service and information management
	Appropriate and timely tariff revision	H	H Lack of revenue income	- Tariff structure affordable by low income households - Continuous revision of tariff - Transparency of tariff revision and accountability to customers - Close coordination with city government and council

Note: H: High, M: Medium, L: Low
Source: JICA Study Team

7.4.2 Safety Measures

(1) Safety Measures under Construction in consideration of Risk Management

Safety measures are very important under construction. Once accidents occurred, they would impact on not only workers and contractors but also delay of construction and society. In order to mitigate the construction disasters; risk management is applied widely based on ILO-OSH. Risk management needs formation of organization in contractor, timing of implementation, objects of risk assessment and acquisition of information. Table below shows the Risk and Safety Measures.

Table 7.7 Safety Measures under Construction

Item	Probability	Reason for Assessment	Mitigation Measures (Safety Measure)
Workers	H	H Accidents to construction workers are expected with a fixed probability. Working conditions and safety of construction shall be considered	Working condition during construction should be managed by contractor based on national law (Law on Labor Protection) and the international guidelines such as Environmental. Health. and Safety Guidelines by IFC as follows: • Provision of adequate healthcare facilities (first aid) within construction sites. • Training of all construction workers in basic sanitation and healthcare issues. general health and safety matters. and on the specific hazards of their work. • Personal protection equipment for workers such as safety boots, helmets, gloves, protective clothing. spectacles and ear

Item	Probability	Reason for Assessment	Mitigation Measures (Safety Measure)
			protection
Accidents in general	M	M The construction site is within the existing BSA so that the impact on citizens is not expected. Accidents are expected with a fixed probability due to operation of construction machinery and increase of traffic volume during construction.	Accident prevention measures inside the construction area will be taken by contractor which should meet the requirement of ILO standards to secure the safety of working conditions. The safety training such as wearing working clothes and work shoes. traffic safety and public health should be provided by the contractor
Accidents caused by specific construction conditions	H	M BAS construction has specific risk of accidents accordance with large-scale, complicated multi-processed reconstruction under severely cold in winter and short construction period.	In consideration with characteristics of BAS construction site, after implementing risk assessment of every work process construction works should start.
Existing social Infrastructures and services	M	M The materials and equipment for construction will be transported to WWTP site. The WWTP site is located away from the city center and main road. The traffic at the roundabout from Mykoly Bazhana Avenue to Kolektorna street (where BAS is located) and the Kolektorna street will be disturbed. Kolektorna street does not connect with residential area and impact is not large.	Advanced notice for construction work time and schedule should be informed to the citizens. The materials and equipment should be transported during the less traffic time .Intensive entering of construction vehicle into the construction site should be avoided. If it cannot be avoided, the consultation with the police and cooperation of traffic police shall be required.

Note: H: High, M: Medium, L: Low
Source: JICA Study Team

7.5 Operational and Effect Indicators

Operation indicator and Effect indicator are mandatory set to enable project monitoring and evaluation on the basis of consistent indicators used from the ex-ante to ex-post stages.

After the initiation of the project, the executing agency is requested to measure and record the actual performance of the operation and effect indicators for the mid-term review, ex-post evaluation and ex-post monitoring after the project completion.

Operation and Effect indicators are defined as below.

Table 7.8 Operational and Effect Indicators

Operation indicator	An indicator to measure, quantitatively, the operational status of a project.
Effect indicator	An indicator to measure, quantitatively, the effects generated by a project

Source: JICA Evaluation Handbook for ODA Loan Projects

The Operation and the Effect indicators for the Project are proposed as follows.

Table 7.9 Operational and Effect Indicators

Operation Indicators					
Indicator name		Policy and method of establishing the indicator	Present	Target	Purpose
1	Population served by tertiary treatment (persons)	Population served by tertiary treatment （persons） Yearly data	0	1,278,000	To assess if the sewerage water operation is properly conducted
2	Operational rate of BAS (%)	（ Average volume of treated wastewater / Treatment capacity （m3/day）） ×100	-	80%	To assess if the BAS is properly operated
3	Reduction rate of contaminants (%) （influent, effluent, reduction rate） BOD concentration COD concentration TSS concentration T-N concentration T-P concentration	Monthly data （monthly average of data obtained regularly）	 95% 87% 94% 55% 74%	 95% 90% 96% 80% 84%	To assess if the BAS is properly operated
4	Form of sludge disposal	Amount of sludge disposal by form of disposal* Yearly data	0% (Accumulated at the temporary sludge disposal site)	Landfill : 50% Construction materials : 50%	To assess effect of environment burden reduction and resource recovery
5	Rate of sludge recycled	（Amount of sludge recycled） / （Amount of sludge）	0%	50%	To assess effect of environment burden reduction and resource recovery

Effect Indicator					
Indicator name		Policy and method of establishing the indicator	Present	Target	Purpose
1	Percentage of population served by tertiary treatment （%）	Population served by tertiary treatment （persons） / Population necessary for tertiary treatment（persons）×100	0%	29%	To assess if the sewerage water operation is properly conducted
2	Effluent Conformity with EU Directive (equivalent to EU Standards) BOD concentration COD concentration TSS concentration T-N concentration T-P concentration	Max allowable number of samples exceeding Effluent Limit Values 5 samples (sampling 41-53 per year) BOD5 <15 mg/l COD <80 mg/l TSS <15 mg/l T-N <10 mg/l T-P < 1.0 mg/l	BOD 100% COD 100% TSS 60% T-N 30% T-P 30%	BOD 100% COD 100% TSS 80% T-N 80% T-P 80%	To assess if the sewerage water operation is properly conducted
3	Number of customer complaint on odor (claim)	Number of customer complaint on odor to BAS（claim/ year） Yearly data	About 30 claims/ year	15 claims/ year	To assess if the BAS is properly managed and if a measure on odor reduction is conducted
4	Ratio of cost recovery （%）	（Amount of service charge collected） / （Cost of treatment service） Yearly data（monthly average of data obtained regularly）	67%	75%	To assess if sewerage works is properly managed
5	Reduction ration of sludge disposal cost （%）	（Volume recycled） / （Volume of sludge） Yearly data（monthly average of data obtained regularly）	0%	50%	To assess if sewerage works is properly managed

Source: JICA Study Team

8. Environmental and Social Considerations

8.1 EIA Report Preparation

The EIA reports for component 1 to 10 have been developed by KIP with which KVK made the contract for project document preparation. TOR of this Study is to review the existing EIA report to confirm the necessity of additional survey based on JICA's Guidelines for Environmental and Social Considerations (April 2010) (hereinafter referred as "JICA Guidelines"), and propose the additional survey to KVK. EIA report was reviewed, the comments were prepared and submitted to KVK and based on the comments, EIA report was modified. The results of environmental and social considerations are described in this Chapter.

8.2 Policy, Laws and Regulations related to Environmental and Social Considerations

8.2.1 Environmental Policy

There are several policy documents regarding environment at national and local levels such as:

- Law of Ukraine "On the Basic Principles (Strategy) of the National Environmental Policy of Ukraine for the period until 2020",
- National Action Plan for Environmental Protection for 2011-2015 (Resolution of the Cabinet of Ministers of Ukraine of May 25 2011 No 577-p),
- Kiev City General Plan

8.2.2 Laws and Regulations on Environmental and Social Considerations

There are several codes, laws, resolutions and regulations related to environmental protection, EIA, and sanitation. The major laws are listed below:

- Water Code of Ukraine (June 6, 1995)
- The Land Code of Ukraine (October 25, 2001)
- Forest Code of Ukraine (January 21, 1994)
- The Law of Ukraine "On Environmental Protection (June 25, 1991)
- The Law of Ukraine "On Protection of Atmospheric Air (October 16, 1992)
- The Law of Ukraine "On Ecological Expertise" (February 9, 1995)
- The Law of Ukraine "On Waste" (March 5, 1998)

(1) Regulations on EIA

The EIA is a formalized procedure defined by the national standards "DBN (State Construction Rules) A.2.2-1-2003 Structure and Contents of Environmental Impact Assessment (EIA) for the Design and Construction of Enterprises, Buildings and Constructions", adopted by the Order No. 214 of the Ministry of Construction and Architecture of Ukraine as of 15.12.2003. According to DBN

A.2.2-1-2003, the project design documents need to include an EIA report. An EIA report should be prepared for new construction, expansion, reconstruction and technical re-equipment of the industrial facilities and civil usage. This is obligatory for government, local and regional authorities, enterprises, institutions and organizations regardless of ownership and departmental affiliation and individuals who operate within Ukraine.

The preparation of EIA is mandatory for the activities and facilities that are highly hazardous approved by the Cabinet of Ministers of Ukraine of July 27, 1995 No. 554 which is amended by 06 June, 2011, No. 630, "20. Construction of sewer systems and treatment plants" is included in the list and the EIA is mandatory for this Project.

The structure and contents of EIA report are as follows:

- Grounds for EIA,
- Physical and geographical characteristics of the construction area of the designed facility,
- General description of the designed facility
- Assessment of the impact of the proposed activities on the environment (climate and microclimate, ambient air, geological environment, water environment, soil, flora and fauna, reserves),
- Assessment of the impact of the proposed activities on the social environment,
- Assessment of the impact of the proposed activities on the anthropogenic environment,
- Comprehensive measures to ensure regulatory environment and its safety,
- Assessment of the impact on environment during construction (ambient air, noise, other physical effects, surface and groundwater, soil, flora and fauna, reserves, human life conditions, history and culture monuments, man-made objects),
- Statement of environmental effects of activities.

(2) Regulations on Public Consultation

The right to free access to information about ecological state of the environment, the right of the public to participate in discussing projects, location, construction and reconstruction of objects which may have a negative impact on the state of the natural environment, are defined by the Constitution of Ukraine, provisions of a number of international treaties ratified by Ukraine, laws of Ukraine and other statutory instruments, such as:

- Law of Ukraine "On Protection of Natural Environment",
- Law of Ukraine "On Ecological Expertise"
- Law of Ukraine "On Information",
- Law of Ukraine "On Access to Public information"
- Decree No. 168 of Ministry of Environment "On Approval of the Public participation in decision-making in Environmental protection", December 18, 2003
- Cabinet of Ministers of Ukraine No. 771 " On Approval of the Public Involvement to Discuss the

Decision-making which may affect the Environment, June 29, 2011

- State Environmental Expertise and issues involving the Public in order to Implement Environmental Rights on Free Access to Environmental Information
- DBN (State Construction Rules) A.2.2-1-2003 Structure and Contents of Environmental Impact Assessment (EIA) for the Design and Construction of Enterprises, Buildings and Constructions", adopted by the Order No. 214 of the Ministry of Construction and Architecture of Ukraine as of 15.12.2003

The participants of public debate are the authorities, enterprises, institutions and organizations regardless of ownership, entrepreneurs who are planning to do business, the media and the interested public.

The public discussion should include:

- Informing the public about the beginning of the draft decision and the opportunity to take part in the public discussion,
- Public access to the draft decision documents on which the decision is made, and other necessary information,
- To allow the public to submit comments/proposals when making a decision, participate in public hearings and other forms of public discussions,
- Review of submitted comments/proposals,
- Inform the public of incorporation or rejection of submitted comments/proposals with specification of grounds for such rejection or approval,
- Ensure public review of the decision.

The types of decisions for which public involvement is required are:

- The development of international, national, regional, local and other regional programs and local plans, policies and other documents,
- Preparation of draft laws and other regulations,
- State environmental review of EIA for hazardous facilities and activities,
- Relevant documents on the use of natural resources, activities associated with pollution of the environment, the handling of hazardous substances, waste and accommodation,
- Costs associated with the implementation of environmental measures through environmental protection fund.

For projects with activities and facilities having high environmental risk, public discussion is conducted in two stages: (i) at the first stage of the preparation of materials for the evaluation of impact on the environment by activities and facilities that are highly hazardous, (ii) state environmental expert review.

The forms of public participation in decision-making on issues that produce or could have a negative impact on the environment are:

- Expert, working groups, commission, committees to develop programs, plans, strategies, projects, regulations, risk assessment,
- Work within the state environmental expert committees,
- Public discussion during the parliamentary hearings, conferences, seminars, round tables, discussion of sociological research, meetings of citizens in the community, etc.,
- Organization and public environmental expertise,
- Discussion of the application of environmental impacts, possible alternatives, and draft decisions on these activities during the EIA
- Appeals to the authorities on current environmental issues with the proposals and recommendations to resolve them in the manner prescribed by the Law "On Citizens",
- Liaison with the media on environmental issues,
- Other forms stipulated by the regulations of Ukraine.

The procedures of public consultation are described in Chapter 7.2.3.

8.2.3 Process of EIA Preparation, Review and Approval

The development of the EIA materials must meet the general technological scheme of the investment process of construction in the table below. The Project is in the stage of conceptual design (CD) and the EIA reports are prepared.

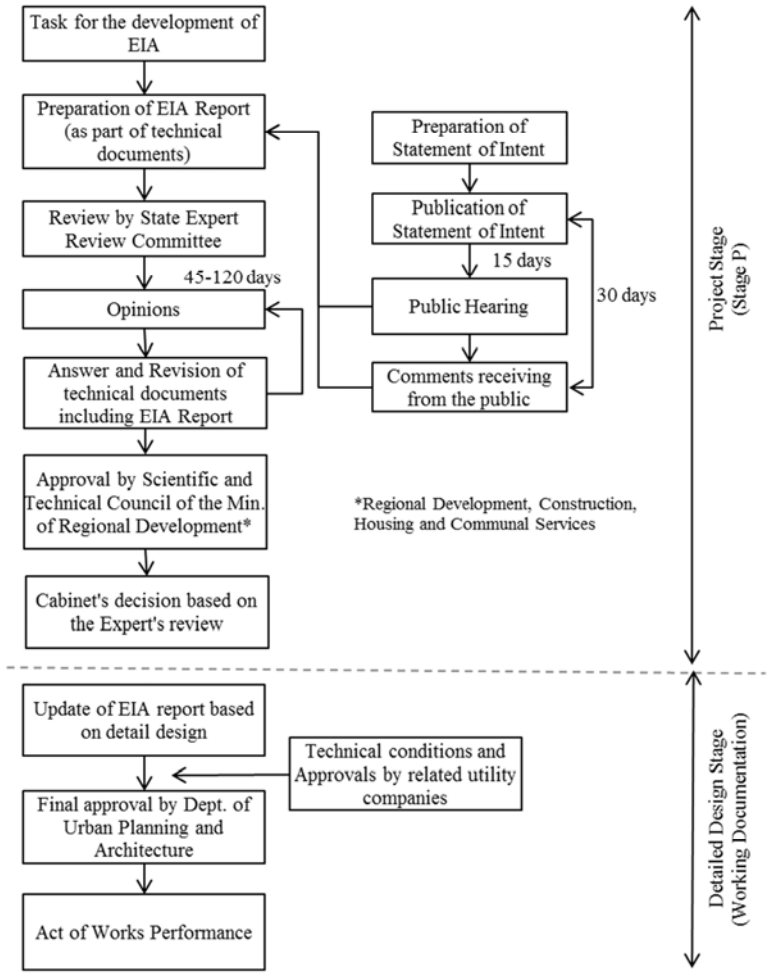
Table 8.1 Investment Process of Building

No.	Design and Construction Phase	EIA Phase
The adoption of a decision of building by investor		
Project Stage		
1	Preparation of initial data about construction of planned facility; determination of operation program, investment intentions, the needs for raw materials, energy resources and personnel etc.	Preparation of statement of intents. Preliminary assessment of impact of the designed facility on the environment.
2	Drawing possible options for the designed facility location based on environmental conditions and site development	Preparation of statement of intents.
3	Preparation and coordination of the tasks for the development of FS and conceptual design (CD)	Setting the task of designing EIA as the part of task of development of FS and conceptual design (CD).
4	Development of FS and CD to the extent prescribed by regulations.	Development of EIA in the FS and CD. Holding of public hearings and preparation of environmental impact statement.
5	Approval and adoption of FS and CD.	Complex state expert review and approval of EIA within FS and CD. Transferring environmental impact statement to the local government authority.
Detail Design Stage		
6	Preparation and coordination of the task for development of design (technical working design)	Preparation of the task for development of EIA materials within the task for development of design (detail design), taking into account changes in design considerations against those adopted in investments FS, CD or changes in urban planning situation.
7	Development of the design (technical working	Carrying out of comprehensive EIA unless it was not

No.	Design and Construction Phase	EIA Phase
	design)	carried out at the previous stages, or adjustment of EIA in line with design
8	Approval and adoption of the design	Complex state expert review and approval of EIA materials according to applicable law.
Construction		
9	Development of working project documentation	Adjustment of the EIA materials in case of change of production technology and execution of construction works that degrade environmental conditions
10	Construction of facilities	Obtaining a construction permit. Implementation of measures outlined in EIA materials.
Operation		
11	Development of design capacity (Post project analysis	Evaluating the effectiveness of conservation and protection measures in accordance with the EIA materials, adjustment of EIA materials and carrying out of post-project analysis, if required.

Source: DBN (State Construction Rules) A.2.2-1-2003 Structure and Contents of Environmental Impact Assessment (EIA) for the Design and Construction of Enterprises, Buildings and Constructions

The flow of EIA from the preparation to approval in the FS and CD stage is shown in the figure below.



Source: JICA Study Team

Figure 8.1 Flow of EIA during Stage-P and Working Documentation Stage

Project Stage (Stage-P)

The EIA report as part of the technical documents is reviewed by State Expert Review Committee during Stage-P. During the review process, the technical solution, cost estimation and environmental issues are reviewed. The members of State Expert Review Committee are selected to meet the criteria established by the order of Ministry of Regional Development of 23.05.2011 No. 53. Based on the comments/opinions from the Committee, the technical documents including EIA report are modified and submitted to the Committee for approval. Then, the Scientific Council of the Ministry of Regional Development, Construction, Housing and Communal Services reviews and approves the technical documents including EIA report. After this stage, the technical documents are sent to Cabinet of Ministers for the final decision and state guarantee for the project is issued.

Detail Design Stage (Working Documentation)

The next stage after the Cabinet's Decision is the development of working documentation. At this stage, the detail design documents and EIA report which should be updated based on the technical specifications of detail design are reviewed. At the same time the approval from the utility companies such as KyivEnergo, UkrTelecom, and KyivGas should be obtained for the permission to connect these utilities to the future facilities and confirmation of no interference with existing networks/cables/pipelines etc. The final approval on the project will be provided by the Department of Urban Planning and Architecture of Kiev City State Administration by issuing Act of Works Performance. Then the construction can be started.

The public consultation shall be organized during the preparation of the EIA report. The process of public consultation is as follows.

Preparation and notice

In the beginning of the public consultation, the organizer should inform the public about:

- Contents of the Statement of Intent to carry out a specific activity,
- Summary of the project concept, construction, facility or other activities which produce or could have a negative impact on the environment,
- Name of the relevant decision-making body with the address at which one can review the documents according to which the decision is made and additional information upon request,
- Deadlines for comments,
- Decision-making process including the time and place of the public consultation, etc.

The organizer should publish the notice about the public consultation to the public. The methods of notice are: through the media (radio, television, press, and internet system), sending e-mail invitations, placing ads in public places and information centers. The public consultation shall be held within 15 days of the public notice with a set of documents containing the impact assessment on the environment.

Public consultation

The public consultation begins with the customer project solutions. The report should highlight the following issues:

- The contents of the draft decision on the proposed activity
- The possible negative impact on the environment
- Measures to prevent and reduce the impact
- Summary of the draft decision
- Content of the comments and suggestions of the public who came to the public consultation,
- Other information on the draft decision.

During the public discussion, the public are given the opportunity to freely express orally and in writing their thoughts, comments, suggestions, and recommendations. The organizer shall answer the public orally at public consultation or in writing in their end.

After public consultation

The comments/opinions from the public can be submitted to the organizer within thirty days since the publication of the public consultation. The organizer prepares the answers to the comments/proposals received from the public and information about their incorporation or reasons for rejection and publishes them in the media that are distributed on the territory, as well as placement on the official website of the organizer of the public discussion.

8.2.4 Administrative Framework related to Environmental and Social Considerations

(1) Ministry of Regional Development, Construction, Housing and Communal Services

The roles and responsibilities of Ministry of Regional Development, Construction, Housing and Communal Services are stipulated by the Decree of President of Ukraine on July 8, 2011, No. 742/2011. The main tasks of the Ministry are:

- Development and implementation of public policy in the area of:
  - Improvement of the territorial organization, administrative and territorial system of local government,
  - Construction, architecture, urban planning, construction materials, maintaining the environment of settlement,
  - Housing and communal services, housing, public welfare, floral, waste treatment, disposal, technical inventory of real property,
  - Architectural control, control of housing and utilities;
- Providing technical regulations in the field of construction, urban planning, construction materials, housing and utilities.

The main tasks of the Scientific and Technical Council are as follows:

- Review and approve priority sectors of development in the areas of the state policy on regional

development, construction and architecture, construction material industry (hereinafter “the scope functional management of the Ministry),

- Contribute to the implementation of unified science-driven policy within the scope of functional management of Ministry aimed to accelerate scientific and technical progress, increase the technical level and quality of production of products (services), widespread introduction of new highly efficient designs and inventions, as well as measures of energy and resource saving and environmentally clean technologies,
- Define main strategic directions of scientific and technical activities in construction industry, generate guidelines for promoting new achievements and best practices on issues within the scope of functional management of the Ministry, promote development modern information technology on industry-wide level,
- Review and prepare opinions on the feasibility of introduction of draft legislative and regulatory acts into the Cabinet of Ministers and Verkhovna Rada (supreme council) of Ukraine on issues within the scope of functional management of the Ministry,
- Review, approve and recommend for approval draft state standards, technical regulations, building regulations and other regulatory acts within the scope of functional management of the Ministry,
- Review and approve proposals and recommendations for formation of a full-featured residential environment, increasing the engineering, technical and economic level of new construction and improvement beautification of settlements, development of their engineering and transport infrastructure, as well as introduction of green technologies in construction materials industry,
- Analyze proposals regarding the formation of housing policy, activation of investment and innovation activities, creating financial and crediting mechanisms for housing construction,
- Provide scientific, technical and economic assessment of designed projects to be funded by the state budget within state and industry-wide targeted and scientific-technical programs, in which the Ministry is the principal implementation agency or one of the implementation agencies.

(2) State Expert Review Committee

The members of State Expert Review Committee are selected based on the Order of Ministry of Regional Development of 23.05.2011, No. 53 and the list of members is published on the website of Ministry of Regional Development. At present, 50 experts are listed. The Committee members examine the construction project to comply with the requirements for the durability and reliability of buildings and structure, the operational safety and engineering, sanitary and epidemiological welfare of the public, environment, safety, energy and emergency planning, etc. The areas of each member involved in the review are determined by the above list.

(3) Department of Urban Planning and Architecture, KCSA

The main functions of Department of Urban Planning and Architecture of Kiev City State Administration are:

- Implementation of state policy in the sphere of urban development and architecture on the territory of Kiev,
- Analysis of urban development, organization of the development, examination and submit for approval in the established order of the General Plan of Kiev and other urban planning documentation,
- Approval of architectural and planning part of the project within the authority, coordination of the activities of the urban planning regarding the complex development and construction in Kiev, improving its architectural appearance,
- Participation in taking into exploitation of the completed facilities in the established order,
- Providing compliance with the legislation on urban planning and architecture, state standards, norms and regulations, rules of construction in Kiev, approved urban development documentation, monitoring its implementation,
- Providing organization within its powers of protection and restoration of architectural monuments and urban development, park and historical and cultural landscapes.

8.2.5 Differences between JICA Guidelines and Ukraine Legislation

The major differences between JICA Guidelines and Ukraine legislation are summarized in the table below.

Table 8.2 Major Differences between JICA Guidelines and Ukraine Legislation

Item	JICA Guidelines	Ukraine Legislation	Gaps
Screening/ scoping	Screening and scoping are the process of environmental and social considerations	Screening and scoping are not included in the process of EIA.	The processes of screening and scoping lack in the Ukraine legislation.
Analysis of Alternatives	Analysis of alternatives including With/Without project scenario is required.	The EIA includes "a list of sources of potential impact of the proposed activity on the environment, considering its alternative".	It is not clear analysis of alternatives is included in the Ukraine legislation.
Monitoring	Preparation of monitoring plan, monitoring form and report on monitoring results are required.	No description about monitoring.	The monitoring is not included in Ukraine legislation.
Environmental items	The wide range of environmental and social impacts should be covered.	It covers environmental and social impacts but the items are less than JICA Guidelines.	The environmental and social items are less in Ukraine legislation.
Public consultation	The stakeholder meetings are organized at the scoping stage and draft final of EIA report.	The public consultation is organized at the draft final of EIA report and expert review stage.	There is no scoping in Ukraine legislation so that the public consultation at the scoping stage is not implemented.

Source: JICA Study Team

8.3 Baseline Data

8.3.1 Location of BAS and Related Facilities

The existing facilities of BAS are located on several land plots with the general area of 429.85 ha. The

land of each facility belongs to Kiev City State Administration. The land is used by KVK customarily since the construction of BAS and the boundaries of facility are stipulated by the technical documents. Although an official lease agreement between Kiev City State Administration and KVK was not signed, the process of signing of a lease agreement is in progress. The figure below shows the location of BAS and related facilities such as pumping stations, sludge fields, channel and discharge point.

The area of BAS is 140.3 ha, sludge field No. 1 is 54.95 ha, No2 is 65.0 ha, and No.3 is 80.85 ha. The part of channel with the area of 5.9 ha is located in Kiev city and the other part with the area of 1.7 ha is in Boryspil district of Kiev Region. The discharge point is about seven km from the BAS through the channel, which is used only for effluent discharge.

Source: JICA Study Team

Figure 8.2 Location of BAS and Related Facilities

The surrounding area of BAS is shown in the figure below. The populated residential areas around the BAS are Kharkivsky residential area in the north-west direction at the distance of 1,000 to 1,375 m, and Bortnychi village in the south-east direction at the distance of 300 to 400 m from the boundary of BAS. The adjacent buildings around the BAS are industries, factories, and garages for stocks.

Source: JICA Study Team

Figure 8.3 Location of BAS and Neighborhood Facilities

8.3.2 Sanitary Protection Zone (SPZ)

The sanitary protection zone (SPZ) is established around the objects including wastewater treatment plant that are sources of discharge of pollutants, odor, elevated levels of noise, vibration, ultrasonic and electromagnetic waves, electronic fields, ionizing radiation, etc. for the purpose of separating objects from residential buildings by Order of the Ministry of Health of Ukraine No. 173, June 19, 1996. The distance of SPZ varies based on the scale of facility and category of industry. Within the SPZ, the construction of residential facilities, social infrastructure and other facilities related to the constant presence of people is prohibited. The value at the border of the SPZ should not exceed the hygienic standards established for the settlement area. The width of the SPZ depends on the nature and capacity, processes of unfavorable factors, wind rose, the use of gas and dust treatment devices, vibration and others.

In compliance with the state sanitary regulations for planning and housing development of residential

areas (approved by the Order of the Ministry of Health of Ukraine No. 173, June 19, 1996) and national construction regulations (DBN 360-92**), for the mechanical and biological treatment facilities with sludge drying beds for fermented sludge with productive capacity of 50,000 – 280,000 m^3/day, an SPZ of 500 meters is provided. The BAS is designed for the capacity of 1,800,000 m^3/day and in accordance with the footnote 2 of the table 8.4 of DBN 360-92**, for the mechanical and biological treatment facilities with sludge drying beds with productive capacity exceeding 500,000 m^3/day an SPZ of 1,000 m is provided.

Ministry of Health of Ukraine has agreed the limits of sanitary protection zone (SPZ) which is 1,200 m from the boundary of BAS and 300 m from the Bortnychi village cemetery. In accordance with the Letter of the Ministry of Health of Ukraine No. 05.01.03-45, dated January 18, 2007 and No. 05.03.02-07/36985 dated July 23, 2007, it has been established that a SPZ for the BAS should be located 600 meters from the secondary settling tanks and 900 meters from the primary settling tanks in consideration of the BAS reconstruction, under the condition of implementation of the reconstruction of BAS such as covering of sand basin and open channel which wastewater flows into the primary sedimentation tanks, and deodorization system. However financing of the reconstruction of BAS has been stopped thus the SPZ is remained as 1,200 m.

8.3.3 Climate

According to the DSTU-N B V.1.1-27:2010, the territory belongs to the northwest climate area which has the following climate indicators and characteristics.

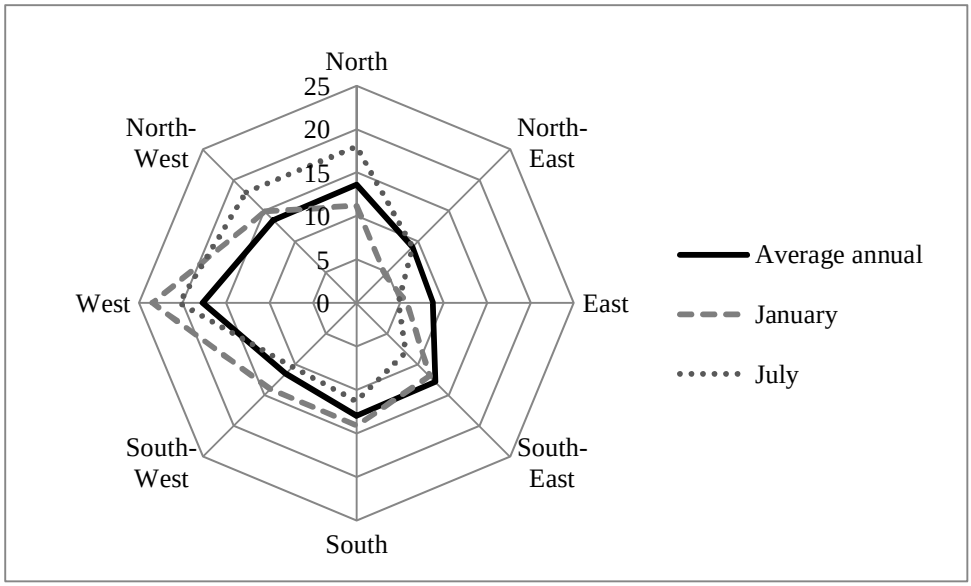
Table 8.3 Characteristics of Climate

Climatic area, subarea	Air temperature °C		Annual precipitation, mm	Relative humidity in July	Aver. Wind speed in Jan, m/s
	Average in		Abs. minimum	Abs. maximum			
	January	July					
I – Northwest (Polissya, forest steppe)	from -5 to -8	from 18 to 20	from -37 to -40	from 37 to 40	from 550 to 700	from 65 to 75	from 3 to 4

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Average air temprature (˚C)	-4.7	-3.6	1.0	9.0	15.2	18.3	19.8	19.0	13.9	8.1	1.9	-2.5	8.0
Average precipitation (mm) (snow covered days)	41 (26)	42 (25)	40 (17)	48	56	76	77	68	55	42	51 (7)	46 (20)	642
Relative air humidity (%)	83	79	74	66	62	68	69	68	74	77	84	85	74
Wind speed (m/s)	2.8	2.9	2.7	2.6	2.3	2.2	2.1	2.0	2.1	2.3	2.6	2.7	

Source: EIA Report prepared by KVK/KIP

The wind speed is not high in the city. It is the highest in February and the lowest in August. The prevailing wind direction is west and north-west as shown in the figure below.



Source: Data is obtained from EIA Report prepared by KVK/KIP

Figure 8.4 Wind Rose (%)

8.3.4 Ambient Air Quality

Air quality standards are defined by the State sanitary rules for air protection from pollution (with chemical and biological agents) in human settlements, approved by the Ministry of Health on 09.07.1997, № 201. In total, standards for 3 indicators are regulated (daily average maximum allowable concentration, one-time maximum allowable concentration, and hazard class) for more than 600 chemical and biological substances. The standards for major substances are shown in the table below.

Ambient air quality is monitored at 169 stations in 53 cities in Ukraine. The single-interval (20 minutes) and computed daily average values are the basic toxicity measurements of substance concentrations in the air (7-33 parameters). The ambient air quality of Kiev City is monitored at 16 locations by the city sanitary officer regularly (four times/year). The locations of two closest monitoring points of BAS are shown in Figure 8.5 and the table below shows the recent results.

Source: JICA Study Team

Figure 8.5 Location of Air Quality Monitoring near BAS

The results show that some parameters such as NO_2, NH_3, and H_2S exceed the maximum allowable concentration (MAC) of Ukraine.

Table 8.4 Results of Air Quality Monitoring near BAS

Unit: mg/Nm^3

Parameter	One-time max				Country' standards Upper: one-time max Lower: 24 h	WHO standards for Europe
	Monitoring location 1		Monitoring location 2			
	29.04.2013	04.07.2013	29.04.2013	04.07.2013		
SO_2	0.2	0.4	0.2	0.3	0.50 0.05	0.35 / 1 hour 1.25 / 24 hour
NO_2	0.1	0.1	0.090	0.094	0.085 0.04	0.2 / hour 0.04 / annual
NH_3	0.5	0.3	0.4	0.2	0.20 0.04	-
CH_2O	0.011	0.017	0.006	0.012	0.035 0.003	-
H_2S	0.1	0.18	0.1	0.13	0.008 -	-
CO	4.4	5.0	3.5	4.1	5.0 3.0	10.0 / 8 hour

Source: KVK, State sanitary rules for air protection from pollution (with chemical and biological agents) in human settlements, approved by the Ministry of Health on 09.07.1997, № 201, and Air Quality Guidelines for Europe, second edition, WHO

Note: The columns colored exceed the Ukraine's standards.

8.3.5 Water Quality of Channel and Dnipro River

The river water quality of Dnipro River at the confluence of the effluent are analyzed by KVK regularly (once / month from March to October). The quality is monitored at 10 locations: right bank, midst and left bank of the discharge point, 500 m upstream and 500 m downstream, and channel.

Source: JICA Study Team

Figure 8.6 Monitoring Location of River Water Quality of Dnipro River

The results of monitoring of river water quality at 10 locations are shown in the table below.

Table 8.5 Water Quality of Dnipro River and Channel as of October 2013

Sampling location	Water temperature	pH	SS mg/l	Chloride mg/l	BOD_5 mg/l	DO mg/l	COD mg/l	Phosphate mg/l	Grope of nitrogen mg/l			Bacteriological analysis	
									Ammonia nitrogen	Nitrite	Nitrate	the total microbial count	coli-index
500 m upstream													
Left bank	9	8.44	1.6	22.2	2.8	10.24	30.1	0.29	0.20	0.01	1.05	69	$24x10^2$
Center	9	8.43	3.0	20.8	2.0	10.56	32.0	0.29	0.20	0.01	1.28	122	$24x10^2$
Right bank	9	8.43	3.2	22.2	2.0	10.56	33.6	0.29	0.20	0.01	1.31	132	$62x10^2$
Discharge point													
Left bank	9	8.36	2.2	22.4	2.8	10.24	32.0	0.38	0.42	0.08	1.46	710	$24x10^3$
Center	10	8.31	2.4	25.5	2.0	10.08	34.0	0.43	0.87	0.13	1.69	1032	$62x10^3$
Right bank	10	8.32	2.8	25.7	3.2	9.92	35.2	0.46	1.03	0.16	1.86	1035	$62x10^3$
500 m downstream													
Left bank	10	8.33	2.4	25.9	3.2	9.92	32.0	0.40	0.65	0.11	1.93	780	$62x10^3$
Center	10	8.32	2.0	26.0	3.2	10.24	32.0	0.42	0.84	0.13	1.89	765	$62x10^3$
Right bank	9	8.38	3.8	25.7	2.8	10.24	34.0	0.36	0.44	0.07	1.80	583	$62x10^3$
Main channel													
	-	7.84	9.2	83.2	8.8	6.56	60.8	4.02	10.90	1.78	25.9	18300	$62x10^4$

Source: KVK

The water quality of channel and Dnipro River at the control point is stipulated by the documents for Approval and Confirmation of MPD for Substances and Action Plans to Achieve MPD for Substances in Treated Return Water issued by State Department of Environmental Protection in Kiev. The documents decide the permissible concentration and maximum permissible discharge (MPD) of the control points of main channel and Dnipro River. The approval is effective from 2 December 2011 till 2 December 2014.

Table 8.6 Results of Water Quality and MPD (maximum permissible discharge) from BAS

No.	Indicator	Actual		Approved	
		Actual concentration mg/l	Actual discharge g/hour	Approved permissible concentration mg/l	Approved MPD g/hour
Control Point #1 (main channel) – the point of complete mixing of biologically treated wastewater from blocks I, II and III of BAS (500 m downstream in the main channel from the discharge point)					
1	Ammonia nitrogen	8.45	300,610.1	8.90	667,500.0
2	BOD_5	7.40	263,256.2	15.00	1,125,000.0
3	Suspended solids	15.26	542,877.0	15.00	1,125,000.0
4	Total iron	0.28	9,961.0	0.33	24,750.0
5	Mineral content	553.00	19,673,063.5	600.00	45,000,000.0
6	Petroleum products	0.05	1,778.8	0.20	15,000,0
7	Nitrates (anion)	26.80	953,414.3	45.00	3,375,000.0
8	Nitrite (anion)	2.10	74,707.8	3.30	247,500.0
9	Synthetic surface active substances (anionic)	0.10	3,557.5	0.50	37,500,0
10	Sulfates (anion)	56.00	1,992,209.0	120.00	9,000,000.0

No.	Indicator	Actual		Approved	
		Actual concentration mg/l	Actual discharge g/hour	Approved permissible concentration mg/l	Approved MPD g/hour
11	Phosphates (anion)	6.05	215,229.7	8.00	600,000.0
12	Chlorides (anion)	80.90	2,878,030.4	350.00	2,625,000.0
13	COD	68.30	2,429,783.4	80.00	6,000,000.0
Diffusing discharge – the surface area of the Kanivske reservoir at a distance of 8 m from the left bank, 0.5 m from the surface (shown in the Figure 7.7)					
1	Ammonia nitrogen	1.6	56,920.3	2.00	150,000.0
2	BOD_5	2.50	88,937.9	4.5	337,500.0
3	Suspended solids	8.2	291,716.3	10.0	750,000.0
4	Total iron	0.46	16,364.6	0.46	34,500.0
5	Mineral content	430.0	15,297,318.8	430.0	32,250,000.0
6	Petroleum products	0.2	7,115.0	0.20	15,000.0
7	Nitrites	5.27	187,481.1	5.27	395,250.0
8	Nitrates	0.67	23,835.5	0.67	50,250.0
9	Synthetic surface active substances (anionic)	0.1	3,557.5	0.10	7,500.0
10	Sulfates (anion)	48.2	1,714,722.0	50.0	3,750,000.0
11	Phosphates (anion)	1.6	56,920.3	1.6	120,000.0
12	Chlorides (anion)	46.9	1,668,475.0	50.0	3,750,000.0
13	COD	48.1	1,711,165.2	48.1	3,607,500.0

Source: Documents for Approval and Confirmation of MPD for Substances, and Action Plans to Achieve MPD for Substances in Treated Return Water

Other indicators are as follows.

1) Floating impurities: none
2) Odor: odorless
3) Color (transparency): 25 cm
4) Temperature: no more than +3C° compared to natural
5) (pH) reaction: 6.5-8.5
6) Dissolved oxygen: not less than 4 mg/l,
7) Residual chlorine: none
8) Coliphages: under 100/l
9) Lactose-positive Escherichia coli: less than 5000/l
10) Viable parasite eggs: none

8.3.6 Water Use of Channel, groundwater and Dnipro River

Groundwater was found at the depths between 2.7 and 4.1 meters, absolute heights of 92.96 to 93.65 meters by the drilling survey. The groundwater inflow is mainly done by infiltration of atmospheric precipitation, as well as due to losses from water supply networks and by hydraulic connection with water of the Dnipro River. Seasonal fluctuations of groundwater level are also possible within 1.0 m, the main raise of groundwater level is observed during spring period, and decrease in water level in summer and winter. BAS site is generally referred as non-impounded by waters of the main aquifer under constant limiting conditions. Groundwater resources are not used around the BAS.

The water of the effluent channel is not used for any purpose.

The quality of water and water bodies is categorized as follows by Order of the Ministry of Health of Ukraine On approval of the State sanitary rules and planning development of human settlements, No. 173, June 19, 1996 in Ukraine.

Category I – UD (utility and drinking: for centralized or decentralized drinking water and water for food businesses)

Category II – CL (cultural and living: for swimming, sports recreation, and water bodies within settlements)

Table 8.7 Water Quality of Surface Water in Ukraine

Category of water use	Category I - UD For centralized or non-centralized drinking water supply and water supply for food industries	Category II - CL For swimming, sports and recreation of population as well as residential areas
Suspended solids	Contents of suspended solids must not increase < 0.25 mg/l	Contents of suspended solids must not increase <0.75 mg/l
Floating component	On the surface of the reservoir, the floating matters, patches of mineral oils or other clusters of impurities should not be detected.	
Odor	Water must not take any unusual odors with intensity of more than 1 point	
	either directly or subsequent chlorination or other processing means	Directly
Color	20 cm transparency	10 cm transparency
Temperature	Summer temperature of water as the result of water flow must not increase more than 3 ˚C compared with average monthly temperature of the warmest month of the year for the last 10 years.	
pH	Must not exceed the limits of 6.5 - 8.5	
Mineral composition	Less than 1000 mg/l, including chlorides - 350 mg/l, sulfates - 500 mg/l	
DO	Must not be less than 4 mg/l in any season of the year, taken before 12 PM	
BOD	At 20 ˚C, < 3 mg / l	At 20 ˚C, < 6 mg / l
COD	< 15 mg / l	<30 mg / l
Pathogenic agents	Water should not contain pathogenic agents	
E-coliform	Not more than 10,000 per l	Not more than 5,000 per l
Coliphage (in plaque-formed units)	Not more than 100 per l	Not more than 100 per l
Viable helminth eggs (ascarid, whipworms, toxocaras, fascioles), hexacanth teniyid and viable cysts of pathogenic intestinal protozoa	Must not be contained in 1 l	
Chemical substances	Must not be contained in concentrations, exceeding MCL	

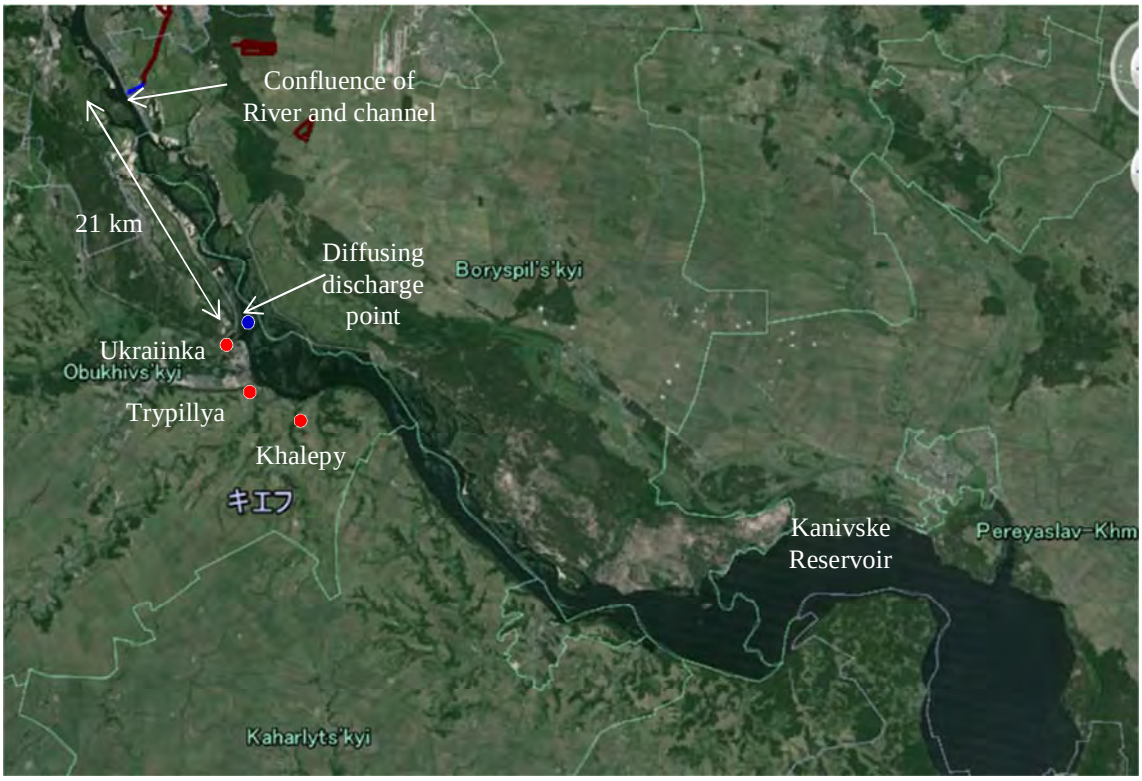
Source: Order of the Ministry of Health of Ukraine No. 173, June 19, 1996

The water of Dnipro River is used for swimming, sport and recreation activity, and water reservoirs within the territory of residential areas (Category II – CL (cultural and living)) at the 500 m downstream of the confluence of Dnipro River and channel.

The closest utility and drinking water-supply point is in the area of Ukraiinka-Trypillia-Khalepy

region, where water intake of Bila Tserkva and industrial water intake facilities are located (Category I – UD (utility and drinking)). The control point of diffusing treated sewage water of Kiev City into waters of Dnipro River is located near the village of Ukraiinka.

The Kaniv Reservoir is located 60-70 km downstream of the discharge point of effluent. The Kaniv Reservoir is a water reservoir located on the Dnipro River in Ukraine, created in 1972 by the dams of the Kaniv Hydroelectric Station. It covers a total area of 675 km^2 within Cherkasy and Kiev Oblasts.



Source: JICA Study Team

Figure 8.7 Water Use of Dnipro River

8.3.7 Odor Problem

The odor is the cause of the main complaints against the BAS. The official complaints sent to the Kiev City State Administration are recorded and answered. In 2012, Kiev City State Administration received twenty-five complaints from the citizens. In 2013, twenty-one complaints related to odor were officially received during February to September 2013. The locations of the odor complaints are shown in the figure below. The main sources of odor from BAS are preliminary treatment (screen and sand treatment) and primary sedimentation tank. The yellow colored circle shows the area within a 2 km of radius from the preliminary treatment and primary sedimentation tanks. The odor complaints occurred in a northwest direction from the BAS.

Source: JICA Study Team

Figure 8.8 Locations of Odor Complaints from the Public

The contents of complaint are to request Kiev City State Administration to take necessary measures against the odor from the BAS. Kiev City State Administration responded to each complaint and the contents are as follows.

- Inspections regarding BAS's compliance with environmental and health legislation is carried out by the State Ecological Inspectorate in the City of Kiev, as well as sanitary epidemiological service of the city and district. The control of pollutant emissions into the air from stationary sources of emissions is carried out at BAS twice a year. Research made in 2012 found no exceeding pollutant levels in emissions from stationary facilities.
- The structures of BAS are designed to be open and thus may become a cause of formation of unpleasant odors. South-eastern winds create the conditions for their spread within the residential areas. Kiev City State Administration is constantly taking steps to resolve the existing issues at the plant, including the elimination of discharge of unpleasant odors into the air.
  - In 2013 new equipment has been installed in the screening sections of Block 2 and 3, allowing for a 30 % decrease of emitting odorous compounds.
  - The reconstruction of aeration tanks is also nearing completion. By this reconstruction, the release of odorous compounds during the treatment of wastewater in the aeration tanks will be partially stopped.
  - The designs for deodorization facilities and experiments tests of air filters are developed and the project documentation for implementation of deodorization for the facilities has been completed. In case of sufficient fund, the project can be started.
- The solid waste incinerator plant "Energiya" also emits pollutants into the air. To prevent the spreading of odors, powerful fans are working. To reduce the amount of pollutants in flue gases

and proper control of environmental pollution, a series of measures was implemented in recent years. The latest inspection confirmed that the results of laboratory studies show that the level of pollutants in the flue gas does not exceed regulatory requirements and is significantly lower than allowed. Despite the absence of violations of environmental regulations at the plant, its specialists are constantly working to improve the environmental performance of different areas as well as different options for the reconstruction of the plant.

8.3.8 Solid Waste Management

The solid waste of Kiev City has been treated at the following sites:

- Landfill No. 5, located near the village of Pidhirtsi in Obukhiv district, Kiev Region,
- Solid waste incineration plant “Energiya”, located at 44 Kolektorna street, Kiev City.
- Landfill for construction and bulky waste No. 6, located in Kiev, 94-66 Chervonopraporna Street,
- Construction waste landfill of “Recultivation” LLC., located in the village of Gorenka, Kiev-Sviatoshyn District, Kiev Region,

In addition, the waste from Kiev City is disposed of at other landfills located in Brovary, Vyshgorod and Boryspil districts of Kiev Region by the appropriate local permissions and limits for waste disposal. The locations of major landfill sites around BAS are shown in the figure below.

Source: JICA Study Team

Figure 8.9 Solid Waste Treatment Site

(1) Solid Waste Landfill

Solid waste landfill No. 5 is located in Pidgirtsi, Obukhov district, Kiev region, the only landfill in Kiev, about 30 km away from the Kiev City. The operation was started in August 1986 and 50 % of solid waste generated in the City is treated in this landfill. The total area is 63.7 ha (State Certificate of Permanent Land Use issued to public utility "Kyivspetstrans" by Pidhirtsivsky village council, Obukhov district, Kiev region in accordance with decision of Pidhirtsi Village Council from 25.02.1998 № 1) and landfill is managed and operated by JSC Kyivspetstrans. The first phase of the landfill 18.15 ha is in operation since 1986, and the second phase of 17.6 ha is in operation since 1997. The amount of household waste is 300 – 330 thousand m^3 per month. In 2012, 1,389,136.77 m^3 solid wastes have been disposed at landfill no. 5. Currently disposed to landfill are 28 million m^3 and the remaining capacity is 2-3 years for first phase and 5-6 years for second phase, if the dumping is improved. According to clause “I” of Part 1 of Article 32 of Law on Ukraine “on Waste”, disposal of unprocessed (raw) waste will be prohibited starting from January 1, 2018.

(2) Solid Waste Incinerator

In addition to the landfill, a solid waste incinerator facility is in operation to treat the solid waste in Kiev, which is located close to BAS, 400 m distance in opposite of the Kolektorna Street. Incineration plant “Energiya” started its operation in 1988 and is currently managed by JSC “Kyivenergo”. The total area of the plant including access roads is 8.8 ha. The plant capacity, in case of waste combustion with existing calories of 1,600 kcal / kg is 250 thousand tons per year. There are four incineration units produced by ČKD "Dukla" (Czech Republic) with cylindrical swath grating, burning capacity 11.0 t of waste per hour per one incinerator. The design capacity of one unit is 15.0 t / hour. According to the 2009 agreed tariff, incinerator should treat at least 20-21 thousand tons of solid waste per month, or 235 thousand ton per year. During the first 11 months of 2013, 134 thousand tons of waste was treated. The remains of the waste (a mixture of slag and incinerated ash, volume is one-third of initial waste volume) are disposed of at the solid waste landfill No. 5 under a separate contract.

The plan to install a new filter to the existing incinerator in 2014 is prepared and the budget is requested from Kiev City State Administration. There are also plans to construct another unit of incinerator at the existing site or new incinerator but these plans are not concrete yet.

(3) Construction Waste Landfill

The construction and bulky waste is treated at the landfill site No. 6, located within the city territory, on Chervonopraporna Street, near the depleted quarry of Korchuvate construction material plant. The total area is 35 ha. In 1992, the area of 6.8 ha was used to construct the first stage of landfill site with a capacity of 617,000 m^3, and in 1995, 2.5 more ha were occupied with the second stage with a landfill capacity of 252,000 m^3. There capacities have been practically depleted. The third stage of the

landfill site was constructed using the area of 7.1 ha with the capacity 887,000m^3.

JSC "Ukrvodproekt" is designing a project named "Reclaiming of the I and II stages, construction of stage III and new construction of bulky and construction waste processing plant at Site #6". Simultaneously, a possibility of reclaiming the landfill site and its operation until the transfer of landfilling activity outside of Kiev is being considered.

8.3.9 Biodiversity and Cultural Heritage

There are some valuable species in the Dnipro River:

- Aldrovanda vesiculosa (aquatic plant): EN (endangered)
- Pseudanodonta complanata (bivalve): VU (vulnerable)
- Unio crassus (bivalve): EN (endangered)

Kiev territory belongs to the forest-steppe belt. According to the transitionary nature of forest-steppe, its animal world combines the features of both the forest and the steppe. In the territory of BAS, there are no endangered animals and no conditions for protection of the existence of animal species, as the territory has long been very close to urban zones. The cultural heritage in and around the BAS does not exist.

8.4 Analysis of Alternatives

8.4.1 With/Without Scenario

The analysis of available information on the current functioning of BAS points to possible negative consequences of its further operation without capital repairs. The main problems of BAS facilities are their full physical wear and obsolescence. The existing building construction, pipes, pumps and other equipment of Block 1 is unfit for further operation, and some of those are in emergency situation. Kiev City State Administration instructed not to operate the Block 1 facilities, however, due to the shortage of treatment capacities, the operation of Block 1 cannot currently be stopped. Most of the effluent standards are satisfied but some parameters such as SS, total nitrogen and phosphorus exceed the effluent standards.

The largest problem related to operation of existing facilities is the sludge fields. The sludge generated from the treatment process is treated at the sludge fields located outside of the BAS and pilot sludge platforms within BAS. The total area of sludge fields outside of BAS is 272 ha and they are located in Boryspil District of Kiev Region (7 – 14 km away) and consist of sludge fields No. 1, No.2 and No.3. In 1985, by the resolution of Boryspilska sanitary and epidemiological station, the transportation of dried sludge from sludge fields was prohibited due to the high content of heavy metals, which made it impossible to use dried sludge in agriculture as organic and mineral fertilizers. Therefore, during the last 20 years, the transportation of dried sludge from sludge fields has

practically not been done and the sludge fields turned into sludge storage grounds. The actual volumes of sediments on the fields exceed the design capacity by more than three times (as of 2012, the actual volume of dried sludge amounts to more than 10.0 million m^3 with the design volume of 3 million m^3). There is no free area reserve at the sludge fields at all. Sludge is accepted in the present sludge fields only by reinforced banking dams among the platforms. However, any further use of such method is already impossible; the height of these dams is critical, which has caused their leaking at some overflowing platforms and sediment outflow to adjacent territories. The further use of existing sludge fields will cause their overfilling, breakage of dams, sediment outflow to agricultural fields and adjacent territories. Within next 2-3 years, it will be impossible to send the sludge from the BAS to the sludge fields and to treat wastewater of Kiev City. Therefore, without project, non-treated wastewater will simply be discharged into the Dnipro River.

8.4.2 Alternatives for Sludge Treatment and Disposal

There are alternatives for sludge treatment and disposal method:

- Treated and disposed at the sludge field (drying bed) – alternative 1
- Dewatered and disposed at the solid waste treatment site – alternative 2
- Dewatered and incinerated at the existing solid waste incinerator – alternative 3
- Dewatered and incinerated at the new sludge incinerator within the BAS – alternative 4

Alternative1: Treated and disposed at the sludge field (drying bed)

The sludge is transferred to the sludge fields outside of the BAS by pump, dried by the sun and stored in the sludge field. The design capacity of existing sludge field already exceeds and the available time is for 2-3 years only by reinforced banking dams. To treat and dispose the sludge, the new sludge field will be required. The required area for sludge field will be huge as the use of the sludge for agriculture is prohibited due to the heavy metals. As the capacity of sludge field is limited, KVK made the request to allocate the additional area for sludge field to Kiev City State Administration but the request was rejected. This alternative is not possible as there is no allocation of additional area for sludge field.

Alternative 2: Dewatered and disposed at the solid waste landfill site

The solid waste landfill site is located in Pidgirtsi, Obukhov district, Kiev region, about 30 km away from Kiev City. Its operation began in August 1986 and 50 % of solid waste generated in the City is treated in this landfill. The total area is 63.7 ha. Due to the environmental problems such as unsanitary condition and leachate, the landfill should be closed by 2018 and after that the untreated waste cannot be disposed of at the landfill. The waste should be incinerated or recycled instead of landfill. The sludge contains the heavy metals and transportation of the dried sludge is prohibited since 1985. The transportation and disposal of sludge at the landfill cannot be possible.

Alternative 3: Dewatered and incinerated at the existing solid waste incinerator

There is the incinerator for solid waste in Kiev City which starts operation in 1988. The waste

incineration plant “Energy” has four furnaces, three in operation and one for back up. The capacity of the incinerator is about 250 thousand ton/year. The contract amount to be incinerated is 235 thousand ton/year and during eleven months of 2013, 134 thousand tons of wastes are treated. The facility is operating outdated equipment and needs renovation. As WWTP generates around 600 thousand ton of sludge per year, considering the present capacity of incinerator (250 ton/year) it is not sufficient to treat the sludge. The sludge cannot be treated unless construction of new incinerator. Thus, this option is not feasible.

Alternative 4: Dewatered and incinerated at the new sludge incinerator within the BAS

Sludge will be dewatered and incinerated at a new sludge incinerator which is constructed within the BAS. The land is not required as the area within the BAS can be used for the construction of incinerator. The sludge volume can be reduced to one tenth after the incineration and it reduce the necessary area for landfill. The incinerated ash can be used as an ingredient of cement, asphalt mixture and concrete products. The flue gas will be emitted into the air and the quality of flue gas should meet the standards. Among the four alternatives, this option is the most feasible to implement.

8.4.3 Alternatives for Sewage Treatment Equipment and Sludge Treatment Equipment

The alternatives for sewage treatment equipment such as aeration, blower, and sludge treatment equipment such as mechanical thickener, dewatering machine, and sludge incinerator are analyzed in Chapter 3 from the technical, operation and maintenance, space, initial cost, O&M cost and environmental and social points of view.

8.5 Scoping and TOR for Environmental and Social Survey

The screening and scoping processes are lacking in the regulations of Ukraine. To follow the JICA Guidelines, the scoping was prepared.

Table 8.8 Environmental Scoping

Category	No.	Item	Evaluation		Reason
			C	O	
Pollution Control	1	Air pollution	B-	A-	**C:** The operation of construction machines and other equipment will cause dust to rise and spread throughout the surrounding area during construction. The impact is temporary. **O:** The flue gas from the incinerator will be emitted into the air.
	2	Water pollution	C	A+	**C:** Discharge of water with suspended solids (from wheel wash settling tanks) will pollute the water. **O:** The treated wastewater which complies with EU standards will be discharged (P and N will be treated).
	3	Waste	A-	A-	**C:** Construction waste will be generated during dismantling and reconstruction of the facility. The accumulated sludge in the sludge field within BAS should be treated during ground leveling. **O:** The ash from incinerator, waste, grease, oil etc. from the screen process, and municipal waste will be generated. The waste from maintenance of incinerator will be also generated.

Category	No.	Item	Evaluation		Reason
			C	O	
	4	Soil pollution	C	D	**C:** During construction works such as pipe replacement, oil from the trucks and machinery, and wastewater might spill and contaminate the soil. **O:** No soil pollution from the BAS facilities during normal operation is expected.
	5	Noise and vibrations	B-	B-	**C:** Construction machines will cause noise and vibration during construction. **O:** The facilities such as pumping station, boiler and incinerators will emit the noise and vibration.
	6	Ground subsidence	D	B+	**C/O:** The activity which causes ground subsidence (such as use of huge amount of groundwater) is not included.
	7	Offensive odors	D	A+/C	**C:** No odor is expected form the construction activities. **O:** The rehabilitation of the wastewater treatment facility may improve the present odor problem but some impact may be expected. The odor from the wastewater and sludge treatment will be emitted.
	8	Bottom sediment	D	B+	**C:** There is no activity which influences the bottom sediment. **O:** The quality of effluent will be improved by the project implementation. The quality of bottom sediment will be also improved.
Natural Environment	9	Protected area	D	D	**C/O:** No protected areas exist in and around the project site thus no impact is expected.
	10	Flora, fauna and biodiversity	C	C	**C/O:** The habitat of three valuable species might exist downstream of effluent discharge in Dnipro River.
	11	Hydrological situation	D	D	**C/O:** The amount of discharge is not expected to change before and after the project.
	12	Topography and geographical features	D	D	**C/O:** The project is rehabilitation / reconstruction of existing facilities and construction of new facilities such as incinerators and thickeners; all construction will be implemented within the existing WWTP site. No large cutting ground or banking is included so that no impact is expected.
	13	Groundwater	D	D	**C:** Groundwater was found at the depths between 2.7 and 4.1 meters, absolute heights of 92.96 to 93.65 meters. The deepest point of the construction facility will be 93.71 m and no groundwater problem during past construction (hearing from BAS staff), so that no impact on groundwater is expected. **O:** The groundwater is not used around the BAS site. The leachate from the facility will not occur as the facility design provides the leachate control. Thus no impact on groundwater quality is expected. No groundwater intake is planned.
Social Environment	14	Involuntary resettlement and land acquisition	D	D	**C/O:** No land acquisition is required as the construction/reconstruction will be implemented within the boundary of existing facilities.
	15	The poor, indigenous & ethnic people, gender and children's right	D	D	**C/O:** No impact is expected as no land acquisition or resettlement is planned. Most of the residents have already connected to the sewerage system at present so that no impact on poor and indigenous people by the sewer connection is expected.
	16	Local economies, such as employment, livelihood, etc.	B+	D	**C:** An increase of employment by the construction can be expected. No impact on livelihood is expected as the land acquisition is not required. **O:** The employment by the operation of new facilities might be expected but negligible.
	17	Land use and utilization of local resources	D	B+	**C :** No impact is expected as land acquisition is not required. The construction will be implemented within the existing site so land use may not be changed.

Category	No.	Item	Evaluation		Reason
			C	O	
					O: The sludge accumulated in the sludge field will be treated at the proposed sludge treatment process so that the sludge field can be used for another purpose.
	18	Water usage or water rights and rights of common	D	C	**C:** During construction, no impact is expected as water intake is not planned and discharge except effluent is not occurred. **O:** Treated effluent which will comply with new effluent standards will be discharged into the effluent channel and Dnipro River, which water is used for culture and living purpose.
	19	Existing social infrastructures and services	B-	D	**C:** The materials and equipment for construction will be transported to BAS site. The disturbance of the traffic will be expected. **O :** The slight increase of traffic volume might be expected for ash transportation but the impact is negligible.
	20	Social institutions	D	D	**C/O :** No impact is expected as the project is the reconstruction/ rehabilitation of existing facilities and it will not influence the social institutions such as social infrastructure and local decision-making institutions. To enhance public involvement and information disclosure, and obtain cooperation and understanding, the public consultation was organized.
	21	Misdistribution of benefits and damages	D	D	**C/O :** As the project is the reconstruction/rehabilitation of existing facilities so that misdistribution of benefits and damages is not expected.
	22	Local conflicts of interest	D	D	**C/O :** As the project is the reconstruction/rehabilitation of existing facilities so that the local conflicts of interest is not expected.
	23	Cultural heritage	D	D	**C/O :** There is no cultural heritage in and around the WWTP.
	24	Landscape	D	D	**C:** The construction activities are implemented within the existing WWTP site. Landscape will be worsened by the tree cutting, excavation of pipe replacement, and material storage but this will not affect to the public and citizens. **O:** All the facility is located within the existing boundary so that no impact is expected on landscape.
	25	Hazards (Risk) infectious diseases	B-	D	**C:** The infectious diseases may increase by the influx of construction workers. **O:** No influx of population will be expected by the operation of the facilities so no impact is expected during operation.
	26	Working environment	C	C	**C:** Accidents to construction workers are expected. Working conditions and safety of construction shall be considered. **O:** The considerations on working environment based on Ukraine laws will be necessary.
Other	27	Accidents	B-	D	**C:** Accident may increase due to operation of construction machinery and increase of traffic volume during construction. **O:** The traffic during operation will not increase so that the accidents may not be expected.
	28	Climate change	D	C	**C:** As the construction will be limited within the project site and the impact is temporary, no impact on climate change is to be expected. **O:** There are sources such as CO_2 and N_2O impacting on the climate and microclimate from incinerator.

C: Construction, O: Operation

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/Negative impact is expected to some extent.

C: Extent of positive/negative impact is unknown (a further examination is needed, and the impact could be clarified as the study progresses).

D: No impact is expected.

Source: JICA Study Team

After review of EIA report, the additional surveys mentioned below are required to meet the requirements of JICA Guidelines. The comments including below were provided to KVK/KIP and EIA report was modified based on the comments.

Table 8.9 TOR for Additional Environmental and Social Survey

Item	Survey Item	Survey Method
Legal framework	● Policy, laws and regulations on environment, EIA, and information disclosure ● Administrative framework	● Hearing from the related organizations ● Collection from similar project documents
Baseline data	● Water quality of Dnipro River ● Air quality around BAS ● Noise and vibration ● Waste ● Odor problem	● Collection from the published documents ● Hearing from the related organizations ● Collection from similar project documents
Analysis of Alternatives	● With/Without scenario ● Sludge treatment process	● Setup several alternative and assessment from technical, social and environmental view point.
Water pollution	● River water quality during construction ● River water quality after effluent discharge during operation	● Collection from similar project documents ● Simulation of the dilution
Waste	● Disposal method of construction waste ● Reuse possibility of ash from incinerator	● Hearing from the related organizations
Flora, fauna and biodiversity	● Habitat of valuable species in Dnipro River	● Bibliographic survey
Working environment	● Measures to protect the working environment	● Regulations related to working environment ● Hearing from related organizations
Public consultation	● Procedures of public consultation ● Results of public consultation	● Laws and regulations related to public consultation and information disclosure ● Minutes of meeting of public consultation and other materials

Source: JICA Study Team

8.6 Impact Assessment and Results of Survey for Environmental and Social Considerations

8.6.1 Air Pollution

(1) Construction

The construction works will be carried out only within the boundary of BAS and construction sites outside of BAS will not be required. There is temporary air pollution by exhaust gases of vehicles, bulldozers, excavators, cranes, pollutant emissions by welding works, and dust emission by excavation. Amount of pollutants are calculated from ICE (internal combustion engines) operation, dust by the excavation, specific pollutant by welding etc. and the list of pollutant substances are shown in the table below.

Table 8.10 List of Major Pollutant Substances

Name of pollutant agent	Code of substance	Hazard class	Emission	
			g/s	t/year
Iron oxide	123	3	0.003986	0.000763
Manganese and its compounds	143	2	0.000542	0.000104
Carbon Dioxide	301	3	0.017	0.121
Soot	328	3	0.004	0.028
Sulphur dioxide	330	3	0.003	0.020
Carbon oxide	337	4	0.030	0.218
Limit carbon	2754	4	0.005	0.035
Pyruvic acid in%: lower 20	2909	3	0.047	1.196
Total:			0.110528	1.618867

Source: EIA Report prepared by KVK/KIP

In order to expedite and facilitate the estimation of pollutants concentration at ground level, the expediency assessment of this estimation shall be performed according to item 5.21. of OND-86 (general normative documentation). The only pollutant emissions to be estimated are those to meet the following conditions:

M / MAC for one-time exposure > 0.1 at H < 10m

M/MAC for one-time exposure > 0.01*H at H > 10m

where: M - one time maximum emissions from all sources, g/s

MAC - one-time maximum allowable concentration, mg/m^3

H - weighted average height of emissions sources, m

The estimation of the diffusion of ground level pollutant emissions has been assessed in terms of its expediency with reference to the emissions at 2 m level (H = 2m) and the results are shown in the table below.

Table 8.11 Calculation of Expediency of Major Pollutant Substances

Ingredients	MAC for one-time exposure	M	M / MAC	Coefficient of reasonability	Expediency
	mg/m^3	g/s	-		
Iron oxide	0.4	0.003986	0.010	0.1	No
Manganese and compounds	0.01	0.000542	0.054	0.1	No
Carbon Dioxide	0.2	0.017	0.085	0.1	No
Soot	0.15	0.004	0.027	0.1	No
Sulfur dioxide	0.5	0.003	0.006	0.1	No
Carbon oxide	5.0	0.030	0.006	0.1	No
Marginal carbon	1.0	0.005	0.005	0.1	No
Pyruvic acid in %: <20	0.5	0.047	0.094	0.1	No

Source: EIA Report prepared by KVK/KIP

According to OND-86, it proves inexpedient to estimate the diffusion of ground level pollutant emissions for all the substances as the (M/MAC) is below 0.1. Arrangement of the construction sites is expected to bring the slight increase of emissions from the road vehicles (to be used to cart the rock

away) and from the equipment of the temporary construction site. The temporary construction site is not expected to cause the exceedance of the values of MAC for one-time exposure and MAC daily average in the grounds both in emergency and normal operation mode.

(2) Operation

1) Indicators and criteria for assessment of atmosphere

Mandatory requirement of admissibility of the facility operation, that is designed, is adherence to standards of environmental safety of air. Main criterion for assessing the air quality in determining the level of direct influence of pollutant emission is the calculated concentration in the buffer zone of hygienic standards of maximum single permissible concentrations (MSPC) of pollutants in the atmospheric air under MSPC list, approved by the Chief Sanitary Doctor of Ukraine. For each of the pollutants emitted into the atmosphere there must be kept the following conditions:

$$\frac{C_M}{MPC} \leq 1$$

where: $C_м$ - maximum calculated surface concentrations of pollutants in atmospheric air, mg/m^3;

MPC - maximum permissible surface concentrations of pollutants in the atmospheric air, mg/m^3;

Measurement of atmospheric pollution by other sources that have impact on atmospheric air quality in the area is carried out by using background concentration C_f (mg/m^3). This should be carried out by the formula below:

$$\frac{C_M + C_f}{MPC} \leq 1$$

The volume of pollutant emissions from the proposed facility on the basis of background polluting and dispersion of pollution in the atmosphere should ensure environmental safety of atmospheric air, i.e., the maximum allowable surface concentrations.

2) Background concentration of pollutants in the area of BSA location

Atmospheric air quality is characterized by background concentrations of pollutants compared to the maximum single permissible concentration (MSPC). Background concentrations are determined according to the fixed observation posts as a concentration level that is exceeded by no more than 5% of case from the total number of observations.

The values of the background concentrations of pollutants in the atmospheric air for BSA, which the reconstruction provides, are adopted in accordance with the requirements of the order of the Ministry of Environment of Ukraine No. 286 30.07.2001. Observation of atmospheric air pollution in Kyiv is conducted by the Central Geophysical Observatory at 16 fixed positions. Values of background

concentrations are provided under CGO of12.09.2013, № 16-13/2382/05-672 in Table below.

Table 8.12 Background Concentrations of Pollutants

Conditional coordinates	Pollutant	Concentration	
		mg/m^3	Share of MPC
In the city	Sulfur oxide	0.0279	0.06
	Carbon monoxide	2.8829	0.58
	Nitrogen dioxide	0.1830	0.92
	Nitric oxide	0.0365	0.09
	Dust (suspended matter)	0.1850	0.37
	Hydrogen fluoride	0.0038	0.19
	Hydrogen sulfide	0.0025	0.31
	Hydrogen chloride	0.1034	0.52
	Ammonia	0.0203	0.10

Source: EIA Report prepared by KVK/KIP

For other substances the background concentrations are taken at 0.4 MPC.

3) Characteristics of design facility as source of ambient air pollution

Emissions of pollutants are calculated using specific indicators provided in "Manual of emission indicators (specific emissions) of pollutants into the ambient air by different industries"; "Methods of calculating the emissions of pollutants and greenhouse gases into the air by transportation" (order by Statecomstat of Ukraine No. 452 of 13.11.2008); and others. The calculated concentration of contamination is shown in the Chapter 7.1 of Appendix.

4) Expediency

The expediency is assessed using the same method with (1) Construction of Chapter 7.6.1.

Table 8.13 Results of Expediency

Code	Substance	MAC mg/Nm3	Emission (one-time maximum emission) g/s		M/MAC		Expediency
			Present condition	Reconstruction	Present condition	Reconstruction	
101	Aluminium oxide	0.100000	0.0000	0.0000			No
110	Vanadium pentoxide (Vanadium and compounds)	0.020000	0.0000	0.0000			No
123	**Iron oxide** (in terms of iron)**	**0.400000**	**0.0280**	**0.2580**	**0.07**	**0.645**	**Yes**
133	**Cadmium oxide (in terms of cadmium)**	**0.003000**	**0**	**0.0016**	**0**	**0.533**	**Yes**
143	**Manganese and its compounds (in terms of dioxide)**	**0.010000**	**0.0055**	**0.0080**	**0.55**	**0.8**	**Yes**
150	Sodium hydroxide (sodium hydroxide, caustic soda)	0.010000	0.0000	0.0006	0	0.06	No
155	Sodium carbonate (soda ash)	0.040000	0	0.0002	0	0.005	No
183	**Metallic mercury (mercury and compounds)**	**0.003000**	**0**	**0.0016**	**0**	**0.53**	**Yes**

Code	Substance	MAC mg/Nm3	Emission (one-time maximum emission) g/s		M/MAC		Expediency
			Present condition	Reconstruction	Present condition	Reconstruction	
184	**Lead and its compounds, except tetraethyllead**	**0.001000**	**0.0000**	**0.0016**	**0**	**1.6**	**Yes**
203	Hexavalent chromium (in terms of trioxide)	0.002000	0.0000	0.0000	0	0	No
301	**Nitrogen dioxide**	**0.200000**	**1.7331**	**7.4154**	**8.67**	**37.08**	**Yes**
302	Nitric acid in terms of HNO3 molecular (Nitric acid)	0.400000	0.0010	0.0010	0.003	0.003	No
303	**Ammonia**	**0.200000**	**0.2041**	**0.2096**	**1.02**	**1.05**	**Yes**
304	Nitrogen oxide	0.400000	0	0.0000	0	0	No
316	**Hydrogen chloride (hydrochloric acid) in terms of HCl molecular**	**0.200000**	**0.0009**	**0.3209**	**0.005**	**1.605**	**Yes**
322	Sulfuric acid in terms of H_2SO_4 molecular	0.300000	0.0002	0.0132	0.001	0.04	No
323	**Amorphous silica (aerosil-175)**	**0.020000**	**0.0049**	**0.0011**	**0.245**	**0.06**	**Yes**
328	**Black carbon**	**0.150000**	**0.2210**	**0.3245**	**1.47**	**2.16**	**Yes**
330	**Sulfur dioxide**	**0.500000**	**1.8790**	**1.6009**	**3.76**	**3.20**	**Yes**
333	**Hydrogen sulphide (sulfurated hydrogen)**	**0.008000**	**4.6395**	**0.0812**	**579.94**	**10.15**	**Yes**
337	**Carbon monoxide**	**5.000000**	**1.1196**	**5.1589**	**0.22**	**1.03**	**Yes**
342	**Fluoric gaseous compounds (fluoric)**	**0.020000**	**0.0001**	**0.3205**	**0.005**	**16.03**	**Yes**
343	Highly soluble inorganic fluorides (fluorides)	0.030000	0.0017	0.0020	0.06	0.07	No
344	Poorly soluble inorganic fluorides (fluorides)	0.200000	0.0039	0.0013	0.02	0.01	No
403	Hexane	60.000000	0.0002	0.0002	0	0	No
410	**Methane**	**50.000000**	**3639.3996**	**3.4256**	**72.79**	**0.07**	**Yes**
602	Benzene	1.500000	0.0005	0.0005	0.0003	0.0003	No
616	**Xylele**	**0.200000**	**0.0250**	**0.0040**	**0.125**	**0.02**	**Yes**
703	Benzapyrene	0.000010	0	0.0000	0	0	No
859	Difluorochloromethane (freon-22)	100.00000	0.0100	0	0.0001	0	No
1051	Dimethyl carbinol	0.600000	0.0002	0.0002	0.0003	0.0003	No
1061	Ethylic alcohol	5.000000	0.0084	0.0084	0.002	0.002	No
1715	**Methylmercaptan**	**0.000100**	**0.0270**	**0.0018**	**270**	**18**	**Yes**
1728	**Ethanethiol (ethyl mercaptan)**	**0.000030**	**0.0137**	**0.0009**	**456.67**	**30**	**Yes**
2425	Furfurol	0.050000			0	0	No
2732	Kerosene oil	1.200000	0.0038	0.0009	0.003	0.0008	No
2735	**Mineral hydrocarbon oil (spindle oil, machine oil)**	**0.050000**	**0.0262**	**0.0026**	**0.52**	**0.05**	**Yes**
2744	Type 'lotus' synthetic detergent	0.030000	0	0.0005	0	0.02	No
2754	Solvent naphtha	0.200000	0	0.0151	0	0.07	No
2752	Mineral spirit	1.000000	0.0250	0.1020	0.03	0.1	No
2754	Methane hydrocarbon c12-c19 (solvent)	1.000000	0.0155	0.0135	0.02	0.01	No
10161	Cationic polyacrylamide ak-617	0.250000	0.0162	0	0.06	0	No
10226	Titanium dioxide	0.500000	0.0014	0.0001	0.003	0.0002	No
10265	Emulsol	0.050000	0	0.0001	0	0.002	No
10293	**Wood dust**	**0.100000**	**0.0704**	**0.0070**	**0.7**	**0.07**	**Yes**
10431	**Abrasive metal dust**	**0.400000**	**0.2660**	**0.0260**	**0.67**	**0.07**	**Yes**

Source: EIA Report prepared by KVK/KIP

5) Results

For defining the level of influence of BAS facilities on ambient air, the calculation of disperse was implemented. Meteorological characteristics and coefficients, defined on conditions of dispersing the

pollutants into the ambient air for the territory of BAS are provided in the table below.

Table 8.14 Meteorological characteristics and coefficients that determine the conditions of dispersion of pollutants in ambient air

Name of value	Value
Coefficient that depends on the atmosphere stratification	200
Coefficient of relief	1.0
Average maximum temperature of the hottest month, degree	25.6
Average minimum temperature of the coldest month, degree	- 4.7
Average annual wind rose, percentage	
N	13.60
NE	9.11
E	8.80
SE	12.80
S	13.00
SW	11.50
W	17.70
NW	13.50
Average wind speed for many years, m/s	7.0

Source: EIA Report prepared by KVK/KIP

Calculation of harmful atmosphere pollutant emission is provided and indicated in the table below. Pollutant air dispersion diagrams have been assessed on estimated basis using the UMN-86 method and "EOL 2000 [h]", recommended by the Ministry of Nature of Ukraine for making calculations of dispersing of pollutants into the atmosphere. The calculation of total atmosphere pollution from all sources has been developed in accordance with the GOST 17.2.3.02-78, DSP 173-96, DSP 201-97 and other regulatory documents.

The contamination levels of the contamination substances (CS) and summation groups at the location of border of SPZ (Revutsky street and Bazhana avenue) and nearest village of Bortnychi (2 Berezneva street, distance of 430 m from the BAS border) in the present condition and after reconstruction are provided in the table below.

Table 8.15 Results of Disperse Calculation (not considering background contamination)

CS and summation group	Present condition (C_M/MPC)			After the reconstruction (C_M/MPC)		
	2 Berezneva	Revutsky street	Bazhana avenue	2 Berezneva	Revutsky street	Bazhana avenue
Hydrogen dioxide	0.04	0.04	0.06	0.43	0.13	0.10
Ammonium	0.03	0.02	0.02	0.08	0.03	0.03
Hydrogen sulphide	4.32	4.41	4.2	0.25	0.13	0.09
Methylmercaptan	4.41	3.32	3.5	0.21	0.15	0.12
Ethylmercaptan	8.34	7.15	4.25	0.34	0.26	0.20

Source: EIA Report prepared by KVK/KIP

At present condition, the value (C_M/MPC) of some substances such as Hydrogen sulphide, Methylmercaptan exceeds 1 and it means that present air quality exceeds the maximum permissible

concentrations. After the reconstruction, the values of all substances are under 1 and it means that the the pollutants emitted into the atomosphere at the border of the SPZ and nearest village Bortnychi will meet the standards of ambient air quality.

The results of dispersion calculation considering background contamination are shown in the table below.

Table 8.16 Results of Dispersion Calculation (considering background contamination)

Contaminating substance	Hazard class	MPC in air of residential areas, mg/m^3	Background concentrations of MPC	Calculating maximum ground concentrations in parts of MPC ((C_M+C_f)/MPC			
				On calculating area	Residential area	SPZ border	
					2 Berezneva	Revutsky street	Bazhana avenue
Carbon Dioxide	3	0.2	0.92	0.54	0.81	0.51	0.48
Hydrogen sulphide	2	0.008	0.31	0.49	0.25	0.13	0.09
Ammonium	4	0.2	0.10	0.35	0.15	0.10	0.10
Methylmercaptan	2	0.0001	0.40	0.42	0.21	0.15	0.12
Ethylmercaptan	-	0.00003	0.40	0.66	0.34	0.26	0.20

Source: EIA Report prepared by KVK/KIP

Analysis of calculation considering the background contamination of ambient air showed that all contamination substances and summation groups on the calculating area, nearest village Bortnychi and borders of the SPZ of BAS do not exceed the limits. Based on the results, the issue of SPZ limits' correction can be considered but after full reconstruction and entering into operation of the reconstructed BAS.

8.6.2 Water Pollution

(1) Construction

The on-site water environment influencers are tire washing facilities installed by the vehicular exit in order to prevent mud accumulation on the traffic ways of the urban streets in according with State Motor Vehicle Inspectorate of Ministry of Internal Affairs of Ukraine (letter dated 22.12.2000, № 10/4887). Toilets, showers and wash for the construction workers will be connected to the sewer and the wastewater will be treated by BAS.

(2) Operation

The standards parameters are listed in the table below as to the quality of treated effluent, that must be ensured at the outlet of each treatment block and, consequently, at station outlet and meet the requirements of the European Bathing Water Directive of 2006.

Table 8.17 Target Effluent Quality for 2021

Parameters (concentration)	Unit	Concentration
SS total	mg/l	15
BOD_5	mg/l	15
COD	mg/l	80
Total nitrogen	mg/l	10
Nitrogen ammonium	mg/l	N/A
Nitrites	mg/l	3.3
Nitrates	mg/l	45
Phosphorus general	mg/l	1
Dissolved oxygen	mg/l	4

Source: EIA Report prepared by KVK/KIP

Additionally, due to application of the requirement of UV-disinfection, quality of treated effluent also must meet the requirements of the European Bathing Water Directives of 2006. The mentioned Directive lists the following maximum permissible values.

Table 8.18 Requirements of Water Quality after UV Disinfection

Parameter	Unit	Maximum permissible level
Enterococcus	unit./100ml.	400
E. coli	unit./100ml.	1000

Source: EIA Report prepared by KVK/KIP

The hygienic requirements (MPC: maximum permissible concentration) of the composition of water in water bodies are as follows, according to the Order of the Ministry of Health of Ukraine on 19.96.96 No. 173 and Standards of 30.07.12 No. 471 approved by the Ministry of Agrarian Policy of Ukraine.

Table 8.19 Maximum Permissible Concentrations in River for Fishing Economy

Pollutants	MPC (mg/l)
SS	25.0
BOD_5	3.0
COD	62.5
Nitrogen Ammonium	1.0-2.0

Source: Standards of 30.07.12 No. 471 approved by the Ministry of Agrarian Policy of Ukraine.

According to the calculations by SNiP_2.04.03-85, the Guide to SNiP_1.02.01-85; software tool «SBROS» implementing «Methods of calculation of maximum permissible discharge (MPD) of substances into water bodies with sewage waters" (VNYYVO State Commission of Nature Protection of USSR, Kharkov, 1990); "Methodology for calculating the maximum permissible discharge (MPD) of substances in water bodies of return waters" (UkrNTsOV, Ministry of Environmental Protection of Ukraine, 1993), the rain water sewage of Kiev is dispersed between 1:60 and 1:200, depending on the minimal water consumption of 95% ensuring in the discharge point, flow velocity, discharge point, number of discharges, coefficients of non-conservative of substances and background contamination,.

During the design, the most stringent (conservative) coefficients of contamination: on the suspended solids - 20; for other pollutants - 40 are used. The adoption of conservative values of coefficient guarantees reliability of estimates of environmental impact and environmental safety. Concentrations of pollutants in the effluent from the BSA after the release into Dnipro River considering dilution in comparison with average background of water pollution, where: MPD for fishing economy purpose.

Table 8.20 Results of Water Quality after Effluent Dilution

Parameters	Norms 2021 (mg/l)	Coefficient of Dilution	After dilute (mg/l)	Concentration of Dnipro (mg/l)		
				Background average	MPD	Accepted concentration
SS total	15	20	0.75	7.2	25.0	7.95
BOD_5	15	40	0.375	1.2	3.0	1.575
COD	80	40	2	33.7	62.5	35.7
Total nitrogen	10	40	0.25	-	-	-
Nitrogen ammonium	N/A	40	-	0.57	0.5	-
Nitrites	3.3	40	0.08	0.03	-	0.11
Nitrates	45	40	1.125	2.7	-	3.825

Source: EIA Report prepared by KVK/KIP

The concentration of pollutants from waste water treatment facilities of BSA after dilution in the river does not exceed standards for facilities for fishing economy at considering average background contamination of Dnipro River.

8.6.3 Waste

(1) Construction

The construction waste will be generated during dismantling and reconstruction of the facility. The soil which is suitable for backfilling should be recycled after excavation. The recyclable waste such as iron and other metals should be recycled. The soil unusable for backfilling and construction refuse should be properly treated. The accumulated sludge in the sludge field within BAS should be disposed for ground leveling.

(2) Operation

By the operation of the BAS, the waste, sand and grease from the screen and the incinerated ash from the incinerator will be generated. The summary of the generated waste from the pre-treatment facility is shown in the table below. The other waste such as communal waste from the building, leftovers from the tree cutting and planting management, small scrap and wiping materials will be generated and the detail are described in table below.

Table 8.21 List of Waste

Waste name1	Danger class	Waste code	Measurement unit	Total	Deactivation (utilization) method
Communal (urban) waste	4	7720.3.1.01	t/yr	112,266	Energiya plant
Leftovers from tree cutting and planting management	4	0113.2.9.01	t/yr	24	Energiya plant
Mixed waste from construction and dismantlement of buildings and facilities	4	4510.2.9.09	t/yr	300	Landfill No. 6
Waste obtained in the process of street and public spots cleaning	4	7720.3.1.03	t/yr	1	Energiya plant
Wood and wooden products	4	7710.3.1.10	t/yr	3	Energiya plant
Small scrap, ferrous metals	4	7710.3.1.08	t/yr	60	Ukrsplav LLC
Small scrap, non-ferrous metals	4	7710.3.1.09	t/yr	1.5	Ukrsplav LLC
A portion of communal and similar non-specific industrial waste not processed into compost during treatment	4	9010.2.3.07	t/yr	3059.96	Energiya plant
Mud from the treatment of non-specific industrial wastewater	4	9030.2.9.04	t/yr	108,712	At the enterprise
Leftovers obtained during sand extraction	4	9030.2.9.02	t/yr	8,262	At the enterprise
BAS, 1 Kolektorna street					
Wiping materials – spoilt, worked-off and polluted	3	7730.3.1.0.6	t/yr	1.7388	Agat-1 LLC
Oils and machine & transmission oils, spoilt or worked-off	3	6000.2.8.10	t/yr	21.4254	Agat-1 LLC
Section of pump stations “Pivnichny”, 23 Vedenska street					
Wiping materials – spoilt, worked-off and polluted	3	7730.3.1.0.6	t/yr	2.3436	Agat-1 LLC
Oils and machine & transmission oils, spoilt or worked-off	3	6000.2.8.10	t/yr	7.0308	Agat-1 LLC
Section of pump stations “Pivdenny”, 90-V Stolychne shose street					
Luminescent lamps and mercury-containing waste, other spoilt or worked-off materials	3	7710.3.1.26	units/yr	2,628	Demikon LLC
Wiping materials – spoilt, worked-off and polluted	3	7730.3.1.0.6	t/yr	2.0412	Agat-1 LLC
Oils and machine & transmission oils, spoilt or worked-off	3	6000.2.8.10	t/yr	7.0308	Agat-1 LLC

1 – similarly to existing state (certificate for waste utilization)

Source: EIA Report prepared by KVK/KIP

The waste generated from the incinerator is as follows.

Table 8.22 Waste from Incinerator

Waste	Unit	Amount
Ash detained on bag filters	ton/day	108.72
Gas treatment solid waste	ton/day	8.64

Source: EIA Report prepared by KVK/KIP

The chemical composition of incinerated ash is shown in the table below. The incinerated ash can be reused for the construction materials as the ash is composed of inorganic materials after the incineration. The possible utilization method is described in Chapter 4.4.2. KVK contacted the concrete factory named ICG “Kovalska” to seek the possibility of using ash for the material of

concrete. The company provided the positive opinion of its future use as technological additives in manufacture of concrete.

Table 8.23 Major Chemical Composition of Incinerated Ash

(%)

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	P_2O_5	Cl^-
41.73	7.25	5.45	16.86	3.45	2.27	3.23	0.72	17.23	0.41

Source: JICA Study Team

During the operation of the incinerators, the filters and fire bricks will be generated as the waste by the regular maintenance. The filter should be replaced every 7-8 years and refractories 15 years. The disposal of those wastes will be required.

8.6.4 Soil Pollution

During construction works such as pipe replacement and excavation, the spillage of materials such as vehicle and machinery fuel and oil, and wastewater might be expected. In addition inappropriate disposal of waste will pollute the soil. Toilets, showers and wash for the construction workers should be connected to the sewer and the wastewater will be treated at BAS.

8.6.5 Noise and Vibration

(1) Construction

Noise

During construction works, it is planned to use a typical composition of road-building machinery and equipment, noise characteristics are determined according to the several references.

The least tight sanitary standards for the public are MAL (maximum allowable level) eq. day/night is 65/55 dBA and MAL max. day/night is 80/70 dBA. The concurrent operation of the machinery at the site of its concentration may produce the equivalent noise level as high as L.A. eq = 75-80 dBA. The construction will be implemented only during the day time so the table below shows the noise level of equipment and machinery and the exceedance of Mal eq. at the work space and public.

Table 8.24 Noise Level of Vehicles, Machinery and Equipment

Vehicles, machinery and equipment	L.A. eq dBA	Exceedance of MAL eq	
		Work space	Public
Road-construction vehicles and machinery			
Drilling machine	70	-	-
Dump truck carrying capacity 12 t	68	-	-
drop-side truck carrying capacity 5... 7 t	65	-	-
Movable compressor to 12 m 3 / min HB-10	80	-	10
Vehicles, machinery and equipment for construction of engineering structures			
Drilling Machine	70	-	-
Concrete pump	70	-	-

Vehicles, machinery and equipment	L.A. eq dBA	Exceedance of MAL eq	
		Work space	Public
cement bulk truck carrying capacity 7 t	70	-	-
Dump truck carrying capacity 12 t	68	-	-
drop-side truck carrying capacity 5...7 t	65	-	

Source: EIA Report prepared by KVK/KIP

The noise nuisance is temporary. The bandwidth of the acoustic discomfort zone changes within the range of 15 to 200 m. As the nearest residential area is located around 300-400 m away from the boundary of BAS, the impact on people is negligible.

The sanitary standards for the work space is MAL eq. = 80 dBA. The highest noise level is caused by worn-out and obsolete track-laying engineer vehicles and machinery. The worn-out and obsolete equipment shall not be used. It is recommended that the personal protective equipment against noise should be used.

Vibration

The vibration sources during construction work are vehicles and machinery based on dynamic pressure and vibratory load technologies for piling or vibratory pile driving. Compressors and pick-hammers produce lower level of vibration. The values of vibratory acceleration caused by construction machinery range from 0.04 to 0.1 m/s^2 within all the octaves, which is less than 1 % of gravitational acceleration $La.o=3*10^{-4}$ m/s^2. That way, the construction machinery generates oscillations with the level of vibratory acceleration with the range of La.V=42.5-50.5 dBV. In terms of impact on people, the non-continuous temporary vibration generated by the road works in day-time is estimated as adjusted admissible level of vibratory acceleration MAL.a.V. =40 dBV. In present day, geological and hydrological conditions of the area of the construction machinery influence on people ranges from 5 to 25 m. The expected vibration level can be reduced to the level of MAL.a.V= 40 dBV at the distance of 5.1-5.5 m from the source. Thus the sanitary regulations as to vibration displacement for the public are met immediately on the boundary of the site during construction. The workers will receive the vibration impact and the protective measures are required.

(2) Operation

Territory of the station is surrounded and separated from the residential buildings by a fence. The area between the residential buildings and BAS will be enough to reduce the noise and vibration impact on adjacent residential areas. According to the calculations, the level of noise/vibration on the border of the closest residential area does not exceed the maximum limits of noise/vibration impact.

8.6.6 Odor

The odor which will be generated by the screen facility can be mitigated by appropriate fences and covers for all odor sources in order to eliminate the impact on the operating personnel and spreading

to adjacent areas. The air diffusion analysis (see Table 8.15) shows that the pollutant substances which cause the odor such as hydrogen sulphide, methylmercaptan and ethylmercaptan will be drastically decreased and the odor problem will be solved. The ammonia will be increased but the amount in the residential area is under the ambient air quality standards. However, the pollutant emissions are calculated on condition that the deodorization system by chemical scrubbing is installed at the wastewater treatment facilities (filter efficiency is 85 %). As for the sludge treatment facilities, the odor will be transferred to the furnace which is operated 850 ˚C high temperature, thus the odor substances are easily removed.

8.6.7 Flora, Fauna and Biodiversity

According to the Red List of IUCN, the habitats of those species might exist in the downstream of effluent discharge in Dnipro River.

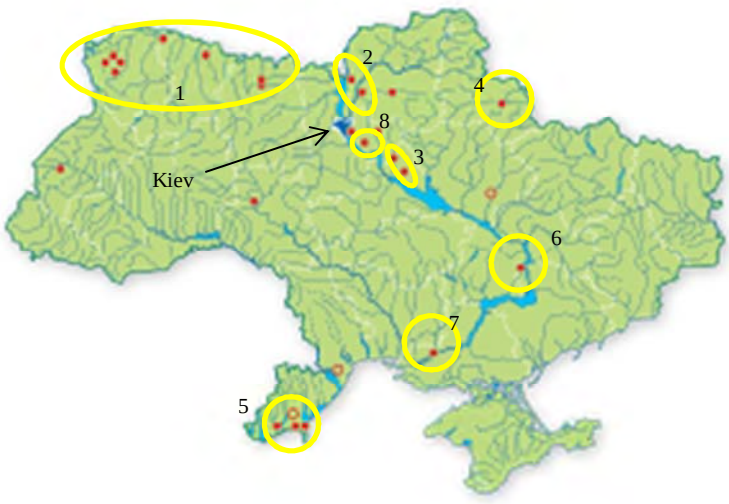
(1) Aldrovanda vesiculosa (Class EN:endangered)

Aldrovanda vesiculosa is classified as “EN”, it means endangered species. In Ukraine, there are eighteen extant, eight unverified and thirteen extinct locations in five regions. It seems some habitat (no. 3) exists in the Dnipro River after the confluence of effluent from BAS.

According to IUCN website[10], the identified location within Ukraine is as follows and the habitat map is in figure below. The number of map is corresponding with the itemization below.

1. At least thirty sites throughout the expansive Pripyat River basin, along the northern border with Belarus. These range from the Kiev reservoir and lakes near Korma in the east, to Shats’k in the east. Thirteen locations are now extinct, with seventeen persisting in the far northwest throughout the Shatskyi Biosphere Reserve, confirmed since 2000 (Shiyan 2011, Kaminski 2006, Adamec 1995a)
2. Two sites in the vicinity of Chernihiv, northeast of Kiev. Unverified since 1961 (Kamins 2006, Berta 1961).
3. Near Perejaslaw-Chmelnyzkyj, southeast of Kiev. Unverified since 1961 (Kaminski 2006).
4. In a lake near Kharkiv, in the east. Unverified since 1987 (Kaminski 2006).
5. Three sites near the mouth of the Danube River, bordering Romania. Unverified since 1993 (Kaminski 2006).
6. Throughout the Dnipro reservoir, in the southeast. Undated and unverified (Kaminski 2006).
7. Kardashyns'kyi Lyman Lake, in the extensive Dnipro delta near Kherson in the far south. Recently discovered in 2001 (Kaminski 2006).
8. Throughout the heavily vegetated Lake Rogozy, in the Olleshky sand dunes of the Dnipro Delta near Tsiuriupinsk, Kherson district. Unverified since 1976 (Herbarium Kiev, Ukraine).

[10] The IUCN Red List of Threatened Species, http://www.iucnredlist.org/details/summary/162346/0



Source: http://redbook-ua.org/item/aldrovanda-vesiculosa-l/

Figure 8.10 Habitat Map of Aldrovanda vesiculosa in Ukraine

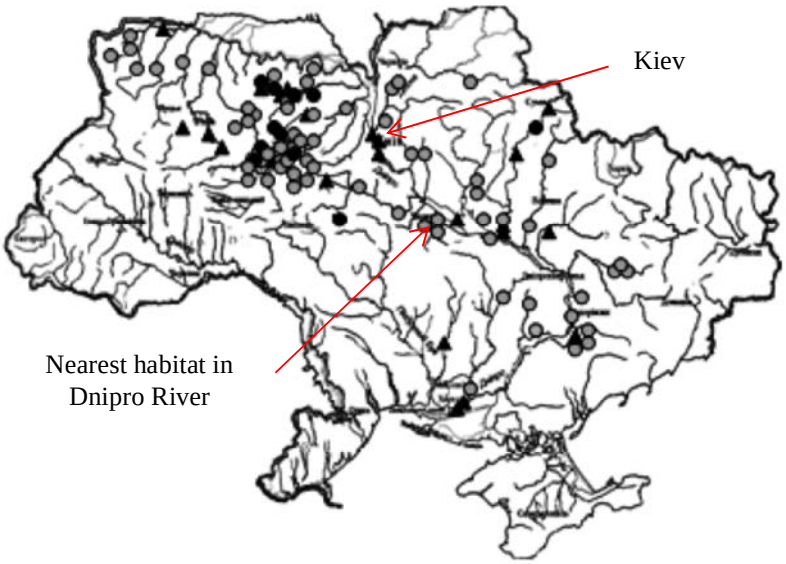
It seems that most of the habitats exist in the tributary of Dnipro River and other rivers, not the main stream of Dnipro River. The effluent from BAS will be discharged to main stream of Dnipro River through effluent channel. The effluent quality will comply with the effluent standards which meet requirements of EU Directives, and water quality of Dnipro River after dilute will meet the standards of river water quality (see Chapter 7.6.2), thus significant impact is not expected. However, further study in the detail design stage shall be required.

During construction phase, no activity which pollutes the river water is included so that no impact is expected.

(2) Pseudanodonta complanata (Class VN: vulnerable)

Pseudanodonta complanata has been assessed as Vulnerable. Only little information is found about Pseudanodonta complanata. The research[11] was conducted in the basin of the Dnipro basin, more than 80 points in May and October of 2008-2009. The research results are shown in the figure below.

[11] UDC 591.5:594.141, M.M.Pampura, LN. Yanovych, Ivan Franko State University of Zhytomry



Source: UDC 591.5:594.141, M.M.Pampura, LN. Yanovych, Ivan Franko State University of Zhytomry

Figure 8.11 Habitat Map of Pseudanodonta complanata in Ukraine

It seems that most of the habitats exist in the tributary of Dnipro River, not the main stream of Dnipro River. The nearest habitat in Dnipro River is more than 200 km downstream of effluent discharge point, so that the impact on Pseudanodonta complanata is not expected.

(3) Unio crassus (Class EN:endangered)

The species is present in the Delta of the Danube River (Bernerth et al. 2002). It seems to be absent from southern Ukraine, but still is found widely scattered over the northern part with the greatest concentration in the Pripyat Marshes/Pripyat River in northern Ukraine (Polesia). This marshland also extends in Belarussia and Russia. In their study on the malacofauna of the Psel and Vorskla River (Ukranian part of the Dnipro basin), Babko and Kurmina (2009) also refer to the species as being rare in Ukraine[12]. By the operation of the BAS, impact on Unio crassus is not expected as the habitat does not exist downstream of effluent discharge of Dnipro River.

8.6.8 Water usage or water rights and rights of common

As mentioned in the Chapter 7.3.6, the water of Dnipro River at the 500 m downstream of the confluence of Dnipro River and effluent channel is used for swimming, sport and recreation activity. The river water quality after dilute of the effluent from the BAS is assessed in Chapter 7.6.2 “water pollution” and it shows that the concentration of pollutants from waste water treatment facilities of BSA after dilution in the river will not exceed standards for facilities for fishing economy at considering average background contamination of Dnipro River.

[12] The IUCN Red List of Threatened Species, http://www.iucnredlist.org/details/22736/0

8.6.9 Existing Social Infrastructures and Services

The main route to BAS is Mykoly Bazhana Avenue – Boryspil's'ke Highway (the name is changed at the junction near BAS) and Kolektorna Street. Mykoly Bazhana Avenue – Boryspil's'ke Highway is the heavily-trafficked road which connects the city and the Boryspil Airport, having four lanes each way. The traffic flow from Mykoly Bazhana Avenue to Kolektorna Street is smooth as there is the right-turn-only lane. The traffic from the Boryspil's'ke Highway to Kolektorna Street is sometimes jammed at the busiest time of the day. During the busiest time, the traffic lights are switched off and the traffic polices control the traffic volume. When the materials and equipment shall be transported to BAS intensively, the traffic disturbance at the junction might be expected.

Source: JICA Study Team

Figure 8.12 Transportation Route to BAS

8.6.10 Hazards (Risk) Infectious Diseases

During construction, risk of infectious diseases by labors would be expected during construction due to the inflow of the construction workers from outside. In addition, it is expected that sanitation issues would become cause of prevalence of disease. Sanitation issues such as hygiene, health and environmental sanitation in and around labor camps and construction areas would be occurred in the case where sanitary facility is not adequately installed such as toilet and septic tank. Sanitation issues would cause infectious disease.

8.6.11 Working environment

(1) Construction

Minor negative impacts on occupational safety are inevitable during construction. To minimize the negative impacts, working condition during construction will be managed by contractor based on Law of Ukraine “On Labor Protection” and the regulations developed and approved by the state committee.

(2) Operation

Working condition during operation will be managed by KVK and BAS based on Law of Ukraine “On Labor Protection” and the regulations developed and approved by the state committee. BAS has regularly conducted the audits of safety and working conditions. In 2012, 46 audits were implemented based on the rules, regulations and laws on labor protection. The comprehensive measures to improve the safety, occupational health and the working environment were implemented. Those audits and improvement measures should be continued.

8.6.12 Accidents

Accidents are expected with a fixed probability due to operation of construction machinery and increase of traffic volume during construction.

Preventive mitigation measures; i) to provide personal protection equipment for workers, such as safety boots, helmets, gloves, protective clothing, spectacles and ear protection, and ii) Adequate protection to the general public, including safety barriers and marking of hazardous areas, shall be considered to avoid occurrence of construction work.

8.6.13 Climate change

The representative substances which influence the climate change (greenhouse effect) are CO_2 and Methane. The amounts of methane generated will be drastically decreased (at present: 3,639.3996 g/s, after reconstruction: 3.4256 g/s). Thus it will contribute the reduction of greenhouse gases. For other substances such as CO_2 and N_2O, the assessment will be further developed during working documentation stage (detail design).

8.7 Environmental Management Plan (EMP)

8.7.1 Mitigation Measures, Responsible Organization and Cost

Environmental mitigation and social consideration measures taken in the course of project implementation were examined based on the findings obtained through the environmental and social impact assessment. The proposed environmental and social mitigation measures include the environmental and social impact items, mitigation measures, responsibilities and cost were summarized in Table below. Should there be any changes to the EMP presented in the Report, such change shall be reviewed and evaluated by environmental expert.

Table 8.25 Assessment, Mitigation Measures, Responsible Organization and Cost

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
Pollution	Air pollution	B-	A-	B-	B-	**C:** Impact of air pollution is expected to be limited because sand dust/emission gases by construction work to affect surrounding area are site specific and temporary events. The operation of construction machines and other equipment will emit the pollutants such as NO2. CO. C12-C19 and dust into the surrounding area during construction. **O:** The flue gas from the incinerator will be emitted into the air. The concentration of pollutants in emission gas will meet emission gas standards of EU. Ground concentration of pollutants caused by emission gas will meet ambient air quality standards. The air pollution might be expected due to the ash disposal activity.	**C:** Exposed and cleared construction areas will be regularly sprayed with water to minimize dust re-suspension. Temporary stockpiles of un-recycled materials and construction spoils will be covered with tarpaulin or sack materials to prevent re-suspension of particulate matters. Construction spoils will be regularly hauled and disposed to areas duly approved by Kiev City State Administration. Daily routine check-up of construction vehicles. equipment and machineries must be strictly complied with to ensure these are in good working condition at all times.. Regularly air sampling at air pollution sensitive areas will be conducted during the construction phases of the project. **O:** The incinerator should be properly maintained and operated to exercise the maximum performance. The ash from the incinerator to the storage should be shifted by the air sealed conveyer. The sealed container or truck should be used for the transportation of ash from the BAS for recycling.	**C:** Contractor **O:** KVK	**C:** Expenses included in construction cost by Contractor **O:** Maintenance cost and personal expenses are included in O&M cost. The facility cost is included in the construction cost
	Water pollution	C	A+	B-	A+	**C:** Run off water from construction area and leakage oil and chemicals from construction activities will pollute the water. The water pollution by inappropriate disposal of waste will be expected. **O:** The treated wastewater will be discharged which comply with EU standards (P and N will be treated) and the water quality of channel and Dnipro River will be improved. The simulation results show the water quality can be met with	**C:** The channels, ditches and temporary settling pond around construction area should be prepared. The oil and chemical materials should be stored in an appropriate storage site and appropriate method to prevent permeation into the ground. The illegal dumping of waste to unregulated place should be strictly prohibited. **O:** None	**C:** Contractor	**C:** Expenses included in construction cost by Contractor

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
						the standards after dilution.			
	Waste	A-	A-	A-	A-	**C:** The construction waste will be generated during dismantling and reconstruction of the facility. The accumulated sludge in the sludge field within BAS should be treated for ground leveling. **O:** The incinerated ash from incinerator, waste, grease, oil etc. from the screen process and municipal waste will be generated.	**C:** The materials such as scrap of ferrous and non-ferrous metals, luminescent lamps and mercury containing waste should be recycled to the recycling company (Ukrsplav LLC. Agat-1 LLC. Demikon LLC). Other construction waste which cannot be recycled should be disposed of at the existing construction waste landfill site. The accumulated sludge by ground leveling should be reused for ground foundation as much as possible. The sludge which cannot be reused should be stored in the temporary storage and treated after incineration starts operation. **O:** The waste from the pre-treatment facilities, communal waste, wood, etc. should be transported to the waste incinerator "Energiya". The materials such as scrap of ferrous and non-ferrous metals, luminescent lamps and mercury containing waste should be recycled to the recycling company (Ukrsplav LLC. Agat-1 LLC. Demikon LLC) The incinerated ash should be reused such as the materials for cement.	**C:** Contractor, KVK **O:** KVK	**C:** Expenses included in construction cost by Contractor **O:** To be decided at D/D stage
	Soil pollution	C	D	B-	D	**C:** The ground contamination from the spillage of materials such as vehicle fuel, chemicals might be expected. Inappropriate disposal waste will pollute the soil. **O:** No soil pollution from BAS facilities is expected during normal operation.	**C:** The oil and chemical materials should be stored in an appropriate storage site and appropriate method should be taken to prevent permeation into the ground. The illegal dumping of waste should be strictly prohibited. **O:** None	**C:** Contractor	**C:** Expenses included in construction cost by Contractor
	Noise and vibrations	B-	B-	B-	B-	**C:** Impacts of noise and vibration by construction machineries will be expected to be limited because noise/vibration by construction work to affect surrounding area is site specific and temporary events. **O:** Impacts of noise and vibration are expected to be limited because the	**C:** Temporary noise and vibration due to construction works should be controlled by proper maintenance of equipment and vehicles, tuning of engines and mufflers to keep the MAL set by the regulations, and compliance of speed limit. The highest noise level is caused by worn-out and obsolete track-laying engineer vehicles and machinery and those shall not be used. Intensive operation of the construction machinery should be avoided. Sound-proofing	**C:** Contractor	**C:** Expenses included in construction cost by Contractor

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
						distance between BAS and residential areas keeps more than enough. By taking mitigation measures, the level of noise and vibration will comply with the standards.	sheet near the residential area will be installed as necessary. The construction schedule and period should be informed to the residences nearby in advance. Personal protective equipment against noise should be used. **O:** Territory of SPZ should be well planned and organized. Minimum planted area with the SPZ shall be 50 % for 300m to 1,000 m of SPZ and 40 % for more than 1,000 m of SPZ. The following measures should be taken: ● Installation of low noise / low vibration type of equipment, ● Arrangement of station units on separate foundations isolated from the enclosing structures and building footings, ● Anti-vibration pads used between the structural components and foundation floor, ● Isolation with resilient pads in the sleeves of air duct passages across building structures, ● Arrangement of vibration mounts and resilient pads where air ducts and their fixtures rest on the enclosing structures, ● Arrangement of noise protection covers for the station units, ● Regular maintenance of the equipment.	**O:** KVK	**O:** Cost for installation and arrangements included in construction cost by contractor
	Offensive odors	D	C	D	A+/ B-	**C:** No odor is expected. **O:** The present odor problem will be reduced by the reconstruction of wastewater treatment process. In addition the deodorization equipment will be installed. However, by the failure of the operation, the odor might be occurred. The existing sludge filed will not be used after reconstruction so that the odor	**C:** None **O:** The pollutant emissions will be reduced by the deodorization filter installation at the wastewater treatment facilities (filter efficiency is 85 %). As for the sludge treatment facilities, the odor will be transferred to the furnace which is operated 850 ˚C high temperature, thus the odor substances are easily removed. The proper operation and maintenance of the facilities should be required.	**O:** KVK	**O:** Cost for equipment installation included in the construction cost by contractor. Maintenance cost and personal

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
						problem around the sludge field may be solved. The odor from the sludge will be eliminated by combustion at the incinerator.			expenses are included in O&M cost.
Natural Environment	Flora, fauna and biodiversity	D	C-	D	D	**C:** The construction site is far from the Dnipro River (more than 5 km) and by mitigation measures the water pollution may not occur, so that the impact on valuable species in Dnipro River is not expected. **O:** The habitats of Unio crassus do not exist in the Dnipro River. The habitats of other two species (Aldrovanda vesiculosa and Pseudanodonta complanata) exist in the tributaries of Dnipro River, not main stream of Dnipro River. It seems that impact is not expected on valuable species.	**C:** None **O:** It seems that impact is not expected on valuable species based on the available information. However to ensure the impacts, further study in detail design stage shall be required.	**O:** KVK	**O:** Expenses included in the cost for detail design.
Social Environment	Existing social infrastructures and services	B-	D	B-	D	**C:** The materials and equipment for construction will be transported to WWTP site. The WWTP site is located away from the city center and main road. The traffic at the roundabout from Mykoly Bazhana Avenue to Kolektorna street (where BAS is located) and the Kolektorna street will be disturbed. Kolektorna street does not connect with residential area and impact is not large. **O:** No impact is expected.	**C:** Advanced notice for construction work time and schedule should be informed to the citizens. The materials and equipment should be transported during the less traffic time. Intensive entering of construction vehicle into the construction site should be avoided. If it cannot be avoided, the consultation with the police and cooperation of traffic police shall be required. **O:** None	**C:** Contractor	**C:** Expenses included in construction cost by Contractor
	Hazards (Risk) infectious diseases	B-	D	B-	D	**C:** The infectious diseases may increase by the influx of construction worker. **O:** No influx of population will be expected by the operation of the facilities	**C:** The educational plan to reduce the risk of infectious diseases by influx of the construction workers should be prepared and implemented by the contractor. **O:** None	**C:** Contractor	**C:** Expenses included in construction cost by Contractor

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
						so that no impact is expected.			
	Working environment	C	C	B-	B-	**C:** Accidents to construction workers are expected with a fixed probability. Working conditions and safety of construction shall be considered. **O:** Accidents to operational workers are expected.	**C:** Working condition during construction should be managed by contractor based on national law (Law on Labor Protection) and the international guidelines such as Environmental, Health, and Safety Guidelines by IFC as follows: • Provision of adequate healthcare facilities (first aid) within construction sites. • Training of all construction workers in basic sanitation and healthcare issues, general health and safety matters, and on the specific hazards of their work. • Personal protection equipment for workers such as safety boots, helmets, gloves, protective clothing. spectacles and ear protection. **O:** The training on occupational health & safety stipulated in Ukrainian law (Law on labor protection) and international guidelines such as IFC should be implemented.	**C:** Contractor **O:** KVK	**C:** Expenses included in construction cost by Contractor **O:** Personal expenses included in O&M cost.
Other	Accident	B-	D	B-	D	**C:** The construction site is within the existing BSA so that the impact on citizens is not expected. Accidents are expected with a fixed probability due to operation of construction machinery and increase of traffic volume during construction. **O:** The traffic during operation will not increase so that the increase of accidents may not be expected.	**C:** Accident prevention measures inside the construction area will be taken by contractor which should meet the requirement of ILO standards to secure the safety of working conditions. The safety training such as wearing working clothes and work shoes, traffic safety and public health should be provided by the contractor. **O:** None	**C:** Contractor	**C:** Expenses included in construction cost by Contractor
	Climate change	D	C	D	D	**C:** As the construction will be limited within the project site and the impact is temporal, the impact on climate change will not be expected. **O:** The emission amount of methane will be decreased by the reconstruction (at	**C:** None **O:** None	-	-

Category	Item	Evaluation of Scoping		Evaluation after study		Reason for Assessment	Mitigation Measures	Responsible organization	Cost
		C	O	C	O				
						present: 3,639.3996 g/s, after reconstruction: 3.4256 g/s). Thus it will contribute the reduction of greenhouse gases. For other substances such as CO_2 and N_2O, the assessment will be further developed during working documentation stage (detail design).			

C: Construction, O: Operation

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/Negative impact is expected to some extent.

C: Extent of positive/negative impact is unknown (a further examination is needed, and the impact could be clarified as the study progresses).

D: No impact is expected.

Source: JICA Study Team

8.7.2 Environmental Monitoring Plan

Environmental monitoring plan including monitoring items, location, frequency, responsible organization and cost during construction and operation phase are shown in table below. Responsible organizations are in charge of monitoring and preparation of its results. KVK shall submit the latest results to JICA on quarterly basis at construction phase and on bi-annually base at operation phase. The monitoring form is attached in Chapter 7.2 of Appendix.

Should there be any changes to the monitoring plan presented in the Report, such change shall be reviewed and evaluated by environmental expert.

Table 8.26 Environmental Monitoring Plan

Category	Item	Location	Frequency*1	Responsible organization	Cost *2
<Construction>					
Air quality	CO, SO_2, NO_2, NH_3, H_2S, Particular matter	Closest residential area around the construction site (1 location)	Once/three months	City sanitary officer	-
Water quality	Temperature, transparency, pH, BOD_5, DO, Ammonium nitrogen, Nitrite Nitrogen, Nitrate Nitrogen, Phosphate Phosphorus, E. coliform	At confluence of effluent and Dnipro River (1 location)	Once/month	KVK	Euro 1,200/year
Waste	Records of kinds and quantity of waste, and the disposal method	BAS	Continuous records	Contractor	-
Soil pollution	Spilt of oil and wastewater by visual check	Construction site of BAS	Once/month	Contractor	-
Noise and vibration	Noise and vibration level	Closest residential area around the construction site (1 location)	Once/three months	Contractor	- *3
Existing social infrastructure and services	Number of accidents by transportation of materials and equipment	Transportation route and within construction site	Continuous records	Contractor	-
Hazards (Risk) infectious diseases	Number of workers who receive educational training	Construction site of BAS	Once/month	Contractor	-
Working environment	Number of organized training on healthcare, safety matters and others.	Construction site of BAS	Once/month	Contractor	-
Accidents	Existence of accident	Construction site of BAS	As occasion arises	Contractor	-
Complaints and demand from citizens	Number and contents of complaints/ demand	BAS KVK City of Kiev	As needed during construction period	Contractor KVK	-
<Operation>					
Air quality	<Ambient air quality> CO, SO_2, NO_2, NH_3, H_2S, Particular matter	At the border of SPZ (2 locations)	Once/three months * for the first 12 months operation	City sanitary officer	-

Category	Item	Location	Frequency*1	Responsible organization	Cost *2
	<Flue gas> NO_x, CO, total dust, TOC, HCL, HF, SO_2, heavy metal	At the stack of the incinerator (4 locations: 1 for each stack)	Once/week Heavy metal: two times/year (every three months for the first 12 months operation)	KVK	Euro 11,000/year
Water quality	<Dnipro River> Temperature, transparency, pH, BOD_5, DO, Ammonium nitrogen, Nitrite Nitrogen, Nitrate Nitrogen, Phosphate Phosphorus, E. coliform	At confluence of effluent and Dnipro River (1 location)	Once/month (March – October)	KVK	Euro 7,000/year
	<Influent> Temperature, transparency, color, pH, BOD_5, COD, sulphates, chlorides, The forms of nitrogen (nitrite, nitrate, ammonia), total Phosphorus, Ferrum, Petroleum products, Heavy metals (Zn, Fe, Cu, Cr)	Inlet of wastewater (1 location)	Once/week Heavy metals: Quarterly	KVK	
	<Effluent> SS, BOD_5, COD, Total nitrogen, total Phosphorus, DO	At the discharge point to the channel (1 location)	Once/week	KVK	
	<Wastewater discharge from the incinerator> pH, temperature, TSS, Hg, Cd, Tl, As, Pb, Cr, Cu, Ni, Zn	Discharge of wastewater from the cleaning of exhaust gases (1 location)	pH, temperature, flow, SS: Once/week others: once/month	KVK	
Waste	Incinerated ash Garbage from wastewater treatment process and others	BAS	Continuous records	KVK	-
Noise and vibration	Noise and vibration level	At the border of SPZ (2 location)	Once/three months	KVK	- *3
Working environment	Labor accidents Electric shocks	BAS	Continuous record	KVK	-

*1 Monitoring frequency mentioned in the table is the minimum requirement.
*2 Personal expenses are not included.
*3 Equipment is installed during construction so that equipment cost is not included.
Source: JICA Study Team

8.8 Environmental Checklist

The environmental checklist is attached in Chapter 7.3 of Appendix.

8.9 Public Consultation

8.9.1 Preparation

With the purpose of informing the public, NGOs and mass media about the public discussion process being launched into an active phase on September 27, 2013, an announcement was placed at the

official KVK website. On October 7, 2013 a specially prepared press release about the procedures and the process of public discussion of the Project was placed there. On September 30 and October 7 respectively, similar announcements for the public were placed at the official Kiev City State Administration website and Darnytsia District State Administration in the City of Kiev. Information about holding public hearing on issues of the Project was placed in the newspaper of Kiev City Council "Khreshchatyk" of October 4, 2013 no. 144 (4351) and at the website of the company. The announcements about the public discussion and the public hearing concerning the Project were sent out by press service of KVK to e-mails of leading national and municipal information agencies. Besides, invitations to the public hearing were additionally faxed to a number of leading TV companies.

To establish a contact with interested citizens and NGO representatives, transparent letterboxes were installed at the main KVK office and at Darnytsia district state administration for collecting questions, remarks and suggestions from the public. To receive e-mail requests from the public representatives, an address of the KVK press service was defined.

8.9.2 Public Consultation

The public consultation was organized on October 10, 2013 by KVK in the assembly hall of Darnytsia district state administration in the City of Kiev at 11 Koshytsia Street. Before the public consultation started, the participants were registered and 189 people registered to participate in the public consultation. Before the public consultation started, participants of the public consultation were shown an awareness-raising film specially prepared by KVK and devoted to important issues of sewerage system and treatment facilities in Ukraine.

The agenda of the public consultation was as follows:

1) Opening Remarks
2) Role of BAS in the capital of Ukraine
3) Technical issues and future development of BAS
4) Features of technical solutions for the reconstruction BAS
5) Expected environmental and social impacts by the Project and mitigation measures
6) Technology of wastewater treatment for BAS and examples of their use in similar facilities in Europe and the world
7) Technology of sludge incinerator for BAS and its practical use in Japan
8) Open discussion

The questions / comments that came to KVK before and during public consultation and answers were as follows:

- Alternative method of disposal of sewage sludge from BAS (from several persons)
  - Chairman of KVK answered that: considering the situation of Kiev City, incineration of sewage sludge was selected as the optimal way. Incineration is the most time-tested

technological solution, which is ecologically safe and highly reliable. Incineration technology is adopted in many European countries and this will solve the problem of sludge disposal (both those generated daily and accumulated in sludge fields).

- Director of KIP answered that: under present circumstances there is practically no alternative to the incinerator for such big volumes (about 12,000 m^3 of sludge are accumulated at the station daily). The present sludge field can treat the sludge only for a few years. It is possible to construct the new sludge field but it will take127 ha for the disposal.

- Construction of WWTP in somewhere else, for example on the right bank of the Dnipro River.
  - Construction of new infrastructure in the dense constructed area on the right bank of Kiev is deeply problematic. However, such a prospect is not exempt from having to reconstruct the BAS, because a right bank treatment plant would perform a backup role.

The questions, suggestions and comments received in verbal form at the public consultation were responded to by an invited representative of Kiev City State Administration, KVK and representative of KIP. The minutes of meeting of public consultation is attached in Chapter 7.4 of Appendix.

8.9.3 Comments received during Information Disclosure

Five questions, suggestions and remarks were received from representatives of the public and citizens from October 4 till November 4, 2013, which is during 30 days from the announcement about the public consultation. The questions/comments from the citizens and the answer to their questions/comments are as follows.

- It is necessary to show the energy balance before and after the reconstruction such as energy and natural gas consumption, coverage of the produced biogas and electrical energy from wastewater and sludge treatment, etc.
  - With use of modern sustainable equipment and automation systems, operation costs for electrical energy and gas supply will be decreased. The answer shows the consumption of the energy, natural gas and biogas, etc.

- Different kinds of utilization of sludge and solid residential waste are used in the world. Please clarify the reason to select the incinerator. For incinerator, additional fuel is necessary and the burning temperature is insufficient for decomposition of dioxins and furans, and the volume of flue gas is much bigger than in case of pyrolysis or gasification. Technology of sludge gasification has much more advantages (production of synthetic flammable gas, much smaller content of harmful substances in flue gas).
  - Choice and analysis of technical solution is determined at the stage of Feasibility Study. This method was defined at the preliminary stage of the designing. The method has the following special features; full burning of organic substances is achieved by high turbulence, equal distribution of temperature, intensive and steady burning process; long durability of the furnace and low level of NOx emissions by temperature of burning 850-900˚C; operational flexibility; possible prospective investor, the Japanese Government. For cleaning of flue gas, ash, acid gases, heavy metals and NOx are eliminated in accordance with approved norms

and requirements regarding atmospheric emissions.

- If the sludge field No. 3 is out of use for more than 8 years, the sludge acquires qualities of peat. Technology of making fuel bricks from peat was created and used. The bricks were dried in an open ground to 30 % humidity and had heat power of 2,200 – 2,400 kilocalories per kg.
  - This Project provides for clearance of sludge fields by treatment at the incinerator. Ash resulting from incineration by its physical, chemical and aggregate composition can be a unique resource which can be put to good use in different spheres with a significant social, ecological and economic effectiveness. Thus, using ash and slag waste will make it possible to save money on basic materials without loss of product quality, at the same time resolving the problem of sludge utilization.
- Two solutions are suggested: (i) purification with help of bacteria (septic tank), and (ii) raising funds from wealthy Kiev citizens (monthly fee for atmosphere poisoning by car should be charged to car owners and this money should be spent to upgrade such ecologically hazardous objects as BAS.
  - Wastewater at BAS is treated mechanically and biologically until it reaches normal indicators. Installation of septic tanks during construction of new objects is against sanitary and epidemiology norms. In Ukraine, there are acting rules of wastewater gathering by communal and department sewage systems of inhabited localities. There are state bodies which control following of these rules and impose fines in case of their breach.
- Sludge at BAS contains significant amounts of heavy metals. That's why it is impossible either to utilize it in agriculture as a fertilizer, or to burn it. How is this issue resolved in the BAS reconstruction project?
  - By incineration process, ash, acid gases, heavy metals and NOx are eliminated from flue gas in accordance with approved norms and requirements. At the first stage of processing gas goes through electric filter to eliminate ash/dust. Before the second stage gas is treated by activated carbon and natrium bicarbonate in a contact chamber to eliminate acid gas, mercury and dioxins. The second stage of flue gas cleaning starts with adding reagents and finishes with eliminating polluting substances at bag filter. After the purification gas is emitted into the atmosphere through a smoke pipe.

The details about the comments and answers are described in the Chapter 7.4 of Appendix.

8.9.4 Separate Meeting with NGOs

Based on the requests, the discussion with the representatives of about 50 non-governmental organizations and associations which are members of the Public Council at Darnytsia District State Administration in the City of Kiev was held on October 28, 2013. After the discussion, the representative of the Public Council unanimously supported and confirmed the necessity to start a full-scale reconstruction of BAS and assured that the Public Council will request to approve the project and assist its launch.

8.9.5 Conclusions

The presented information about organization, holding and results of the public discussion of the Project allows drawing the following main conclusions.

- In course of the public discussion all requirements of acting legislation of Ukraine regarding arrangements, terms and volume of informing the public about planned activities of BAS were met. All NGOs and citizens that expressed their interest were given an opportunity to participate in the public discussion. At the same time, scheduled events of discussion process mostly involved Kiev population, whose territory may be affected by BAS planned activities, and the population, connected with BAS activities socially and economically;
- All questions, suggestions and remarks of the public, expressed during discussion process, both in oral and written form, were collected for further processing. All information, obtained in course of the public discussion, was systematized and analyzed for consideration in further activities of BAS by KVK.

9. Conclusion and Recommendations

The survey prepared the project plan of reconstruction of BAS which has three blocks of wastewater treatment complexes with daily capacity of 1.57 mil. m^3/day. It has been over 50 years since the beginning of operation in 1964 and the facilities have been aging. BAS is too large to reconstruct in one project in view of financial resources. Therefore, the survey was conducted for efficient project performance through the evaluation of existing BAS.

- As a result of evaluation of existing BAS, it is found that Block 1 facilities are the most deteriorated by aging. However, the treatment performance is good.
- On facilities planning, it is found that design wastewater flow and design influent qualities are almost same as those of current KVK plan. As for the wastewater treatment process, Anaerobic-Anoxic- Oxic Process (A2O Process) and rapid coagulation systems are proposed. As the sludge handling process, thickening, dewatering and incineration process are selected.

In order to formulate project planning, the following items are considered.

- Discussions between KVK and JICA brought to a conclusion that the survey should focus on Stage 1 and needs to estimate its cost. Stage 1 consists of 5 components whose main activities are rehabilitation of Block 2 and 3, reconstruction of Block 1 and new construction of sludge facilities. Land preparation for these facilities and demolishing of existing facilities are responsibility of KVK.
- Scale-wise, the cost of three cases was estimated; i) rehabilitation of Block 2 and 3 + reconstruction of Block 1 + new construction of sludge facilities, ii) reconstruction of Block1 + new construction of sludge facilities and iii) new construction of sludge facilities
- This project is supposed to use Special Terms for Economic Partnership (STEP) of Japanese ODA Loan. Since STEP Loan conditions stipulate that the ratio of goods and services to be procured from Japan shall be not less than thirty percent (30%), cost estimation was conducted by this rule.

Due to problems with aging existing facilities, dearth of sludge disposal site and odor from BAS, towards the realization of projects, concerned organizations such as the Government of Ukraine, Kiev City State Administration, KVK are required to take necessary actions in accordance with each organization's competence.

Recommendations to Government of Ukraine

- The Government of Ukraine is required to take a positive action to International Financial Organizations (IFO) towards the realization of the Project.
- Due to the necessity of a large amount of total project cost, the Central Government is advised to take an appropriate responsibility for the project financing through subsidy in consideration of public interest in the project.

- For To ensure sound financial operation, it is required to consider the possibility in perspective of prospective future revision of sewage tariff rates. Since KVK doesn't have the competent competence to set and revise sewage tariffs, Kiev City State Administration is required to negotiate and coordinate with the National Commission for the State Public Utilities Regulation (NCSPUR) on at its own initiative.
- In order to supervise project and coordinate with the related organizations, a Project Coordination Committee (PCC) is strongly recommended to be established.
- Public tax and charge such as Corporate Tax imposed to general contractors are desirable to be exempted for reduction for international procurement barrier with complicated institutions.

Recommendations to Kiev City State Administration

- Kiev City State Administration is one of the bodies administering the sewage works as well as a property owner, and is proposed to be a member of PCC. It should supervise the project in close cooperation with KVK.
- The gap between revenue from sewage tariffs and sewage expenditure shall be compensated by Kiev City State Administration. Therefore, Kiev City State Administration is needed to provide KVK with enough subsidies till KVK establishes financially sustainable sewage works, whose subsidy should be enough to cover at least the operation and maintenance costs.
- Based on City General Plan of Kiev City State Administration which has been revising for accepting sewage from satellite cities, accepting facilities such as pumping stations should be constructed according to the project progress.

Recommendations to KVK

- A Project Implementation Unit (PIU) is strongly recommended to be established within KVK as the organization for implementation and responsibility of the project.
- KVK is required to promote feasibility of the project for understanding revision of sewage tariff rates and willing-to-pay through the awareness of residents.
- As for Stage P documents prepared by the Government of Ukraine, it is required to revise the Environment Impact Assessment (EIA) report properly, since IFOs request EIA report which corresponds to screening items of International Finance Organizations (IFOs) such as JICA.
- As the sludge incinerators will be constructed in Ukraine for the first time, KVK has to obtain the understanding about the environmental and social impacts of the construction and operation of the facilities from its residents. KVK has to monitor the environmental and social impacts caused by the facilities regularly and implement appropriate mitigation measures if necessary.
- KVK is required to secure an appropriate portion of the budget of the Government of Ukraine and to secure the implementation of land preparation and demolition of existing facilities in the WWTP since these are a perquisite of the project.
- It is required to secure the capacity of the disposal site and reinforcement of the banks during construction period because of dearth of sludge disposal sites and deteriorated banks.

- It is required that the first rise pumping station which is rehabilitated by fund of Government of Ukraine should be sustainably designed for feeding sewage to existing Block 2 and Block 3, as well as Reconstructed Block1.
- Ongoing rehabilitation of aeration tanks (No.15-18) applying Danish technology in sewage treatment facilities for Block 3 is required to be completed rapidly along with this project to cope with capacity decrease of BAS by aged existing facilities, as well as sewage increase in wet weather.
- Securing of Power receiving facility owned by the power company is required to be discussed with power company since they are also aging.
- Ash from the incinerators should be beneficially used by securing cooperation with relevant companies such as cement manufacturers.
- Tentative measures are required for odor control such as covers of facilities and deodorant equipment.
- It is well understood that the situations around BAS and the sludge fields require the expeditious project implementation. As the Report proposes the Project Implementation Schedule following the procedures ordinarily required in JICA Loan projects, KVK is required to seek for any possible measures to shorten the schedule considering the pressing situations during its negotiation when JICA Loan is applied.

APPENDIX

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1. Existing Conditions of Bortnychy Aeration Station

The results of inspections conducted to evaluate the existing conditions are presented as below.

Facilities	Civil and Architectural Works	Mechanical and Electrical Works
Pozniaky pump station	Table 1.1	Table 1.2
Sewage treatment facilities for Block 1	Table 1.3	Table 1.4
Sewage treatment facilities for Block 2	Table 1.5	Table 1.6
Sewage treatment facilities for Block 3	Table 1.7	Table 1.8
Raw sludge treatment facilities	Table 1.9	Table 1.10
Excess sludge treatment facilities	Table 1.11	Table 1.12
Electrical facilities	-	Table 1.13

Remarks are as below.

	Items	Conditions	Reasons
*1	Primary settling tanks for Block 1	7 units out of 14 primary sludge collectors have been abandoned. 2 units in 2004, 3 units in 2011 and 2 units in 2012 became not operational	Main reason is corrosion and destruction of driving units, ferrous structures, paddles, etc. of sludge collectors.
*2	Secondary settling tanks for Block 1	5 units out of 12 secondary sludge collectors have been abandoned. 1 unit in 1995, 1 unit in 2009, 2 units in 2011 and 1 unit in 2013 became not operational	Main reason is corrosion and destruction of driving units, ferrous structures, paddles, etc. of sludge collectors.
*3	Digesters	4 digesters out of 8 digesters are not operational. 4 digesters, which started its operation in 1975, have been abounded from 1994.	Operation of these digesters was suspended due to the leakage of digestion gas from joint constructed precast concrete panels.
*4	Gas holders	Both gas holders are not operational at full capacity.	Both gas holders have holes on piston walls. Hence, gas holders cannot store digestion gas at full capacity due to the leakage of digestion gas from holes.

1.1 Pozniaky Pump Station

Table 1.1 Existing Conditions of Civil and Architectural Works

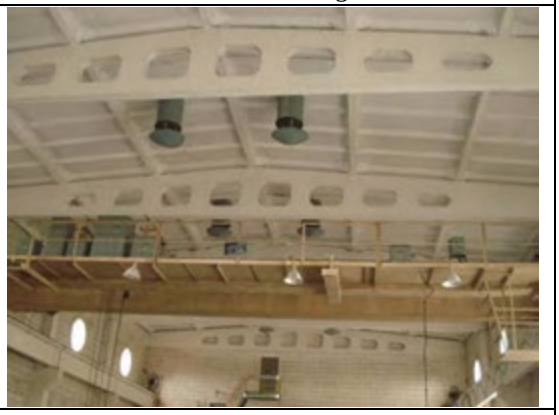
CA-1: Full view	CA-2: Celling
	
Deterioration is not found on surfaces of outside and inner surface. It is necessary to inspect and repair outside wall surfaces periodically because of rain water influence.	
CA-3: B2F passage	CA-4: B3F outer wall
	
The underground part is finished with painting, thus there is no severe concrete deterioration and corrosion caused by influence of hydrogen sulfide.	
CA-5: B3F wall of pump room	CA-6: B3F opening for screen
	
Repair works for local cracks and rebar corrosion need to be carried out as soon as possible.	Despite the corrosion caused by hydrogen sulfide, there is no severe concrete deterioration.

Table 1.2 Existing Conditions of Mechanical and Electrical Works

ME-1: Screen	ME-2: Motors of lift pumps
	
Screens are severely corroded due to the effect of corrosive gas generated from incoming sewage.	7 motor units are kept in good condition by regular maintenance.
ME-3: Lift pump	ME-4: Inner surface of pump casing
	
6 pump units are operational while 1 unit is under maintenance.	Inner surface of casing of the pump under maintenance is rusted.
ME-5: Sealing water of lift pump	ME-6: Central control panel
	
Adjustment of amount of shaft seeing water is recommended.	Proper function is maintained while rust and peeling of paint is observed.

1.2 Sewage Treatment Facilities for Block 1

Table 1.3 Existing Conditions of Civil and Architectural Works

<table>
<tr><td>CA-1: Inflow of screen building</td><td>CA-2: Settling basin wall of screen building</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Because of significant cracks, the strength of concrete building frame has decreased. Scaling damage of underground part is not considerable. However, all facilities should be rebuilt as soon as possible.</td></tr>
<tr><td>CA-3: Aeration tank</td><td>CA-4: Outer wall of aeration tank</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Peeling of this facility seems very significant. Thus, it is necessary to perform repair works by removing damaged part and repairing with polymer cement mortar as soon as possible.</td></tr>
<tr><td>CA-5: Primary settling tank</td><td>CA-6: Secondary settling tank</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>As the structure are located underground, it seems that deterioration by vapor is not considerable.</td><td>The presence of mortar showed traces of repair, but restoration of exposed rebar is necessary.</td></tr>
</table>

Table 1.4 Existing Conditions of Mechanical and Electrical Works

ME-1: Screen	ME-2: Grit collector
	
Screens are severely corroded due to the effect of corrosive gas generated from incoming sewage.	Grit collectors are severely corroded due to the effect of corrosive gas.
ME-3[*1]: Primary sludge collector	ME-4: Aeration condition
	
7 units out of 14 primary settling tanks have been abandoned due to severe damage.	Aeration is not efficient due to inefficient diffusers and air leakage from air pipes.
ME-5: Blower	ME-6[*2]: Secondary sludge collector
	
Blowers are well maintained by regular maintenance even though efficiency is very low.	5 units out of 12 secondary settling tanks have been abandoned due to severe damage.

1.3 Sewage Treatment Facilities for Block 2

Table 1.5 Existing Conditions of Civil and Architectural Works

CA-1: Screen building	CA-2: Screen building
	
Tile peeling and rebar corrosion was found in several places. Thus, it seems the repair work of the outside wall is necessary as soon as possible. In addition, there is no peeling of inside wall painting.	
CA-3: Aeration tank	CA-4: Channel of aeration tank
	
Thick rebar is used to make the thin bulkhead. As the rebar diameter is thicker compared to concrete slab size, rebar joint part cannot ensure enough concrete cover. Thus, concert peeling is taking place.	
CA-5: Driving channel	CA-6: Secondary settling tank
	
Rebar exposure on some concrete slabs is visible. It is expected that deterioration will be rapid.	Repair works have been done with common mortar. Rebar corrosion is visible on some parts.

Table 1.6 Existing Conditions of Mechanical and Electrical Works

ME-1: Screen	ME-2: Maintenance of primary collector
	
Screens of Block 2 and Block 3 have been replaced with an automatic screening system.	Sludge collectors are periodically repaired in order to maintain their function.
ME-3: Replacement of diffuser	ME-4: Replaced diffuser
	
Diffusers are replaced every 8 years on average to maintain aeration efficiency.	Air opening of replaced diffusers is clogged and some holders of diffusers are cracked.
ME-5: Aeration before replacement of diffusers	ME-6: Aeration after replacement of diffusers
	
Efficiency is expected to be low due to larger bubbles and non-uniformity before replacement.	Efficiency of aeration is restored owing to fine bubbles and uniform aeration after replacement.

1.4 Sewage Treatment Facilities for Block 3

Table 1.7 Existing Conditions of Civil and Architectural Works

CA-1: Blower building	CA-2: Primary selling tank (under repair)
	
Interior and exterior surface of blower building and RAS pump buildings are in good condition.	Due to corrosion, the steel supports collapsed.
CA-3: Aeration tank (not repaired)	CA-4: Aeration tank (repaired)
	
As well as Block 2, concrete peeling is occurred in the rebar joint part of the bulkhead.	Thickness of bulkhead is 25 cm. Thus, the facility is in good condition.
CA-5: Aeration tank (under construction)	CA-6: Effluent channel
	
In spite of absent deterioration, similar concern is raised due to thick rebar inside thin inner walls.	Concrete peeling is visible because of the lack of concrete covers and rock pockets.

Table 1.8 Existing Conditions of Mechanical and Electrical Works

ME-1: Aerated grit chamber	ME-2: Maintenance of sludge collector
	
Settled grit is periodically manually removed from chambers.	Sludge collectors are periodically repaired in order to maintain their function.
ME-3: Aeration after renovation	ME-4: Equipment procured for renovation
	
2 aeration tanks have been renovated by installing new equipment provided by Denmark.	Equipment for renovation of two aeration tanks is stored in the WWTP.
ME-5: Blower	ME-6: Panel of blowers
	
Blowers are periodically overhauled in order to maintain the function.	4 blowers are not operational since panels for these blowers have never been completed.

1.5 Raw Sludge Treatment Facilities (Anaerobic Digestion)

Table 1.9 Existing Conditions of Civil and Architectural Works

CA-1[*3]: Anaerobic digestion tank	CA-2[*3]: Anaerobic digestion tank
	
The old tanks are in operation while the new tanks are out of operation due to the leakage from joint constructed PC panels. Radical renovation of the structure is necessary.	
CA-3: Anaerobic digestion tank (leak situation)	CA-4: Boiler building
	
Leakage from operating tanks is found, the cracks in concrete of the tanks are found.	Boiler buildings and RAS buildings have been repaired by painting and properly maintained.
CA-5: Sludge distribution chamber	CA-6: Sludge distribution chamber
	
No significant deterioration was found outside and inside building surfaces. Lack of brick blocks and peeling of painted surfaces were found, but these factors do not cause problems for daily operations.	

Table 1.10 Existing Conditions of Mechanical and Electrical Works

ME-1: Agitating blower	ME-2: Panel of sludge pumps
	
Blowers which agitate sludge by injecting digestion gas are not operational.	There are two types of panels for sludge pumps (left is closed type and right is open type).
ME-3[*4]: Gas holders	ME-4: Sludge pumps
	
Both gas holders are not operational at full capacity due to leakage from holes on piston.	4 sludge pumps to transfer digested sludge to sludge fields are operational.
ME-5: Maintenance of boiler	ME-6: Automatic control panel of boilers
	
Boilers are periodically dismantled and repaired in order to maintain the safety and efficiency.	Proper function of automatic control is maintained despite of rust and peeling of paint.

1.6 Excess Sludge Treatment Facilities (Aerobic Stabilization)

Table 1.11 Existing Conditions of Civil and Architectural Works

<table>
<tr><td>CA-1: Chemical injection building</td><td>CA-2: Sludge pump building</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Despite of partial tile peeling, condition of inside and outside surfaces is comparatively good.</td><td>Despite of tile peeling and concrete deterioration, there is no rebar corrosion.</td></tr>
<tr><td>CA-3: Aerobic stabilization tank</td><td>CA-4: Aerobic stabilization tank</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Because of thick rebar into inner walls and lack of concrete covers, concrete peeling occurred.</td><td>As well as in the aeration tanks, concrete peeling occurred in the rebar joint part of the inner walls.</td></tr>
<tr><td>CA-5: Gravity thickener</td><td>CA-6: Gravity thickener (hammering test)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Tracks of repairs with help of mortar are visible on above-ground part. No significant deterioration was found. There is rebar exposure on some parts. But, partial repairs will be sufficient.</td></tr>
</table>

Table 1.12 Existing Conditions of Mechanical and Electrical Works

ME-1: Sludge thickener of excess sludge	ME-2: Open panel of sludge pumps
	
Sludge thickeners are periodically repaired in order to maintain their function.	Proper function is maintained in the safety metal cages despite of their old type.
ME-3: Aeration of aerobic stabilization	ME-4: Coagulant dosing equipment
	
Thickened excess sludge is stabilized by aerobic stabilization process.	Polymer dosing equipment is newly installed to thicken stabilized sludge.
ME-5: Sludge thickener of stabilized sludge	ME-6: Sludge pumps
	
2 sludge collectors of gravity thickeners to thicken stabilized sludge are operational.	2 sludge pumps to transfer stabilized sludge to sludge fields are operational.

1.7 Electrical Facilities

Table 1.13 Existing Conditions of Electrical Works

E-1: Lugova 110kV substation	E-2: Bortnytska 110kV substation
	
Structured type substation is operated and maintained by the electrical distribution company.	Main transformer is used for step-down to 6kV, and step-down to 35kV/10kV of electrical grid.
E-3: 6kV switchgear	E-4: Central monitoring system
	
Oil circuit breakers are well maintained and installed at 6kV feeding lines.	LCD is used for monitoring device at the central control room and the mimic panel is out of use.
E-5: Parshall flume	E-6: Sludge flow meter
	
Parshall flume is installed in influent channel of each block to measure flow to sewage treatment.	Ultrasonic type flowmeter is installed to measure sludge fed to anaerobic digestion tanks.

2. Design Calculation of Sludge Treatment Facilities of BAS

2.1 Basics for Planning

(1) Production of Raw Sludge

	Figure
Volume	12,612 m^3/day
Solid concentration	2.0 %
Solid content	252,235 kg-DS/day

(2) Production of Excess Sludge

	Figure
Volume	27,661 m^3/day
Solid concentration	0.8 %
Solid content	221,290 kg-DS/day

2.2 Design Calculation of Sludge Treatment Facilities

(1) Gravity Thickener Facilities

Type	Gravity thickener
Solid content of raw sludge	252,235 kg-DS/day
Volume of raw sludge	12,612 m^3/day
Solid concentration of raw sludge	2.0 %
Solid surface loading	75 kg/m^2/day
Solid recovery rate	85 %
Dimension of primary settling tank	Diameter 33 m x 4.0 mD
Number of primary settling tank	4 tanks
Sludge collector	Circular sludge scraper
Solid content of thickened sludge	214,400 kg-DS/day
Volume of thickened sludge	5,360 m^3/day
Solid concentration of thickened sludge	4.0 %

(2) Mechanical Thickening Facilities

Type	Belt type thickener
Solid content of excess sludge	221,290 kg-DS/day
Volume of excess sludge	27,661 m^3/day
Solid concentration of excess sludge	0.8 %
Solid recovery rate	95 %
Polymer dosing rate	0.3 %
Operation hour	24 hour
Specification of mechanical thickener	Capacity: 150 m^3/hour
Number of mechanical thickener	9 nos. (1 standby)
Solid content of thickened sludge	210,856 kg-DS/day
Volume of thickened sludge	5,271 m^3/day
Solid concentration of thickened sludge	4.0 %

(3) Mechanical Dewatering Facilities

Type	Screw press dewatering machine
Solid content of thickened sludge	425,256 kg-DS/day
Volume of thickened sludge	10,631 m^3/day
Solid concentration of thickened sludge	4.0 %
Solid recovery rate	95 %
Polymer dosing rate	1.0 %
Operation hour	24 hour
Specification of mechanical dewatering	Diameter: 1,200mm * 2 screw / 2,140 kg-DS/hour
Number of mechanical thickener	10 nos. (1 standby)
Solid content of sludge cake	408,034 kg-DS/day
Volume of sludge cake	1,700 m^3/day
Moisture content of sludge cake	76.0 %

(4) Sludge Incineration Facilities

Type	Pressurized fluidized bed incinerator
Solid content of digested sludge	408,034 kg-DS/day
Volume of digested sludge	1,700 m^3/day
Solid concentration of digested sludge	76.0 %
Operation hour	24 hour
Rate of Operating	100 %
Specification of incinerator	425 ton/day
Number of incinerator	4 nos.
Volume of ash	1.4 ton/day

3. Researches on Final Disposal of Sewage Sludge

3.1 Introduction

It was first planned to use the sludge generated at BAS for agriculture, but it was found not possible because heavy metal concentration in the sludge exceeded the permissible level. Sludge disposal site has received generated sludge, but the remaining capacity of the site is really small and it is urgently needed to establish sustainable way to dispose of sludge.

Final disposal forms include landfilling or material recycling of incinerated ash, co-incineration in garbage incinerator and so on. The following shows selection procedure of these options.

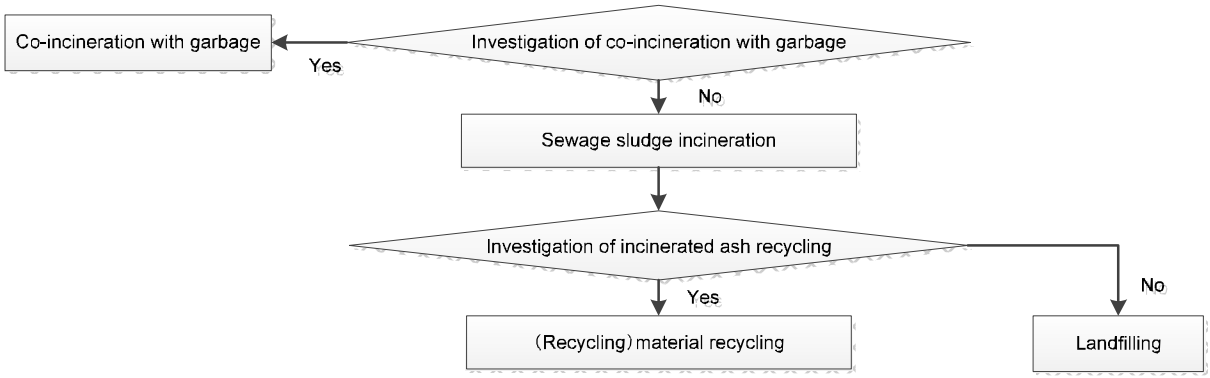


Figure 3.1 Procedure to Select Final Disposal Method

Hence, the following interviews are conducted by KVK.

- Interview on co-incineration with garbage
- Interview on recycle of incinerated ash

3.2 Interview on Co-incineration with Garbage

If sewage sludge is considerably less than garbage, co-incineration with garbage is possible. From this, it is assumed that sludge generated in small scale WWTP is possibly accepted at garbage incinerator.

Due to the order of the Director of Department of Housing and Communal Infrastructure of the executive body of Kiev City (Kiev City State Administration) Nowicki D. from 23.09.2013 № 31825, Department of Sanitation and Engineering Protection Area Management Control Operation of Housing and Communal Infrastructure of the Department of Housing and Communal Infrastructure has revised the letter from TEC International Co., LTD. from 17.09.2013 № JICA-KIEV-02 regarding the collection of data required for the study. Following answers are obtained.

- Among the generated waste, 50 % is landfilled, 15 % is incinerated.
- Landfill place is No.5 in Podgorica Obukhov.
- The incinerated ash from the “Energiya” is disposed at the No. 5 landfill.
- After 2018, the landfill will be prohibited due to the consideration of environmental protection and reduction of disposal.
- Kiev waste incineration plant “Energiya” began its operation in 1988.
- The total area of the plant, including access roads is 8.8 ha.
- The main equipment detail - 4 incineration units produced by ČKD “Dukla” (Czech Republic) with cylindrical swath grating, burning capacity 8-15 t of waste per hour.
- Plant capacity, in case of waste incineration with existing calories of 1,600 kcal/kg makes 250.0 ths ton/year.
- During the 8 month period of 2013 94.3 tons of waste was conveyed to the "Energiva" plant.
- According to the 2009 agreed tariff for thermal waste disposal plant should get at least 20-21 ths t of solid waste per month, or 235 ths ton/year.
- The number of employees over the past 5 years ranges on average about 270 people.

Since Dewatered sludge at BAS will be 1,000 ton/day, it is found the sludge from BAS cannot be accepted by the garbage incinerator.

3.3 Interview on Recycle of Incinerated Ash

Since incinerated ash is inorganic, it can be used as material for cement and soil conditioner. During survey we received the letter from Ukraine cement company, PJSC “AK Kyivvodokanal”. The letter reads as follows;

“The results of test show grounds to confirm the possibility of its future use as additives in manufacture of concrete as recycled material. However, the material has to comply with the technological requirements to concrete mixtures and products. Additionally, the ash may be used in volumes proportional to the actual volumes of production of our enterprises during the period of its use.”

The test results are as follows;

Table 3.1 Granulometric Analysis

Size of holes of control screens	Partial remainders		Full remainders (%)	Passed through screen (%)
	(g)	(%)		
5	0.00	0.00	0.00	100.00
2.5	23.00	2.30	2.30	97.70
1.25	45.00	4.50	6.80	93.20
0.63	202.00	20.20	27.00	73.00
0.315	232.00	23.20	50.20	49.80
0.14	190.00	19.00	69.20	30.80
0.08	101.00	10.10	79.30	20.70
0.045	67.00	6.70	86.00	14.00
0	140.00	14.00	100.00	0.00
Sum	1000.00			

Item	Figure
Water Content	0 %
Fineness modulus	1.6
Bulk density	930 kg/m^3
Actual density	2.33 g/cm^3
Cavitation	60.2 %
Dust and mud particle content	14.0 %
Mud masses content	0 %
pH	7.0

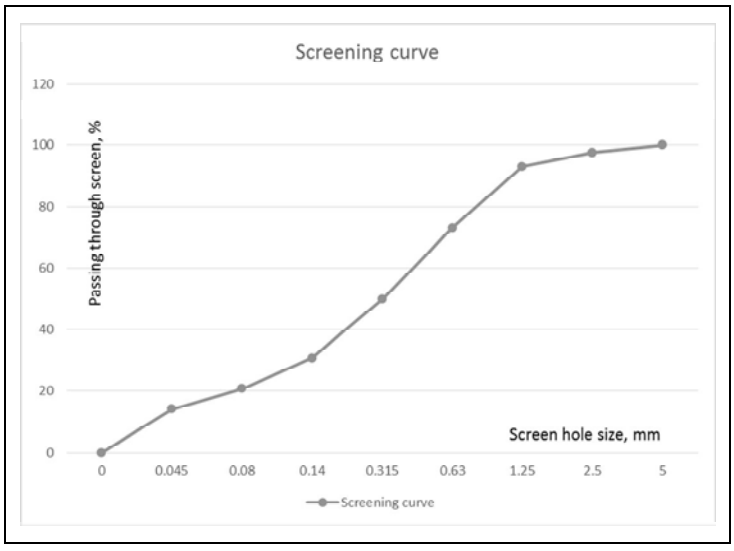


Figure 3.2 Screening Curve

4. Cost Estimation

4.1 Estimated Construction Cost

Table 4.1 Estimated Construction Cost

(1,000 Euro)

No	Items	L.C.	F.C.	Total
A.	Component 0			
A1	Dismantling of the existing facilities			
	Civil & Architectural works	6,417	0	6,417
	Mechanical & Electrical works	0	0	0
	Sub-total of A1	**6,417**	**0**	**6,417**
A2	Land preparation of the WWTP site			
	Civil & Architectural works	46,849	0	46,849
	Mechanical & Electrical works	0	0	0
	Sub-total of A2	**46,849**	**0**	**46,849**
	Sub-total of A	**53,266**	**0**	**53,266**
	Civil & Architectural works	**53,266**	**0**	**53,266**
	Mechanical & Electrical works	**0**	**0**	**0**
B.	Component 1			
B1	Preliminary and primary treatment (block-2)			
	Civil & Architectural works	8,793	0	8,793
	Mechanical & Electrical works	6,517	12,952	19,469
	Sub-total of B1	**15,310**	**12,952**	**28,262**
B2	Secondary treatment (block-2)			
	Civil & Architectural works	4,157	0	4,157
	Mechanical & Electrical works	4,500	18,336	22,836
	Sub-total of B2	**8,657**	**18,336**	**26,993**
B3	Preliminary and primary treatment (block-3)			
	Civil & Architectural works	7,003	0	7,003
	Mechanical & Electrical works	5,039	10,051	15,090
	Sub-total of B3	**12,042**	**10,051**	**22,093**
B4	Secondary treatment (block-3)			
	Civil & Architectural works	7,773	0	7,773
	Mechanical & Electrical works	3,934	16,477	20,411
	Sub-total of B4	**11,707**	**16,477**	**28,184**
B5	Piping works			
	Civil & Architectural works	19,058	0	19,058
	Mechanical & Electrical works	0	0	0
	Sub-total of B5	**19,058**	**0**	**19,058**

No	Items	L.C.	F.C.	Total
B6	Utility buildings, ancillary and landscaping work			
	Civil & Architectural works	8,911	0	8,911
	Mechanical & Electrical works	0	0	0
	Sub-total of B6	**8,911**	**0**	**8,911**
	Sub-total of B	**75,685**	**57,816**	**133,501**
	Civil & Architectural works	**27,969**	**0**	**27,969**
	Mechanical & Electrical works	**47,716**	**57,816**	**105,532**
C.	Component 2			
C1	Gravity thickener			
	Civil & Architectural works	1,971	0	1,971
	Mechanical & Electrical works	1,481	2,298	3,779
	Sub-total of C1	**3,452**	**2,298**	**5,750**
C2	Mechanical thickening and dewatering building			
	Civil & Architectural works	5,153	0	5,153
	Mechanical & Electrical works	7,637	30,990	38,627
	Sub-total of C2	**12,790**	**30,990**	**43,780**
C3	Administrating building			
	Civil & Architectural works	3,834	0	3,834
	Mechanical & Electrical works	2,846	6,818	9,664
	Sub-total of C3	**6,680**	**6,818**	**13,498**
C4	Laboratory building			
	Civil & Architectural works	3,403	0	3,403
	Mechanical & Electrical works	0	0	0
	Sub-total of C4	**3,403**	**0**	**3,403**
C5	Piping works			
	Civil & Architectural works	18,675	0	18,675
	Mechanical & Electrical works	0	0	0
	Sub-total of C5	**18,675**	**0**	**18,675**
C6	Utility buildings, ancillary and landscaping work			
	Civil & Architectural works	20,029	0	20,029
	Mechanical & Electrical works	0	0	0
	Sub-total of C6	**20,029**	**0**	**20,029**
	Sub-total of C	**65,029**	**40,106**	**105,135**
	Civil & Architectural works	**53,065**	**0**	**53,065**
	Mechanical & Electrical works	**11,964**	**40,106**	**52,070**
D.	Component 3			
D1	Sludge incineration			
	Civil & Architectural works	5,493	0	5,493
	Mechanical & Electrical works	23,363	145,965	169,328

No	Items	L.C.	F.C.	Total
	Sub-total of D1	28,856	145,965	174,821
D2	Piping works			
	Civil & Architectural works	3,584	0	3,584
	Mechanical & Electrical works	0	0	0
	Sub-total of D2	3,584	0	3,584
D3	Utility buildings, ancillary and landscaping work			
	Civil & Architectural works	4,326	0	4,326
	Mechanical & Electrical works	0	0	0
	Sub-total of D3	4,326	0	4,326
	Sub-total of D	36,766	145,965	182,731
	Civil & Architectural works	13,403	0	13,403
	Mechanical & Electrical works	23,363	145,965	169,328
E.	Component 4			
E1	Preliminary and primary treatment (block-1)			
	Civil & Architectural works	9,142	0	9,142
	Mechanical & Electrical works	4,974	13,851	18,825
	Sub-total of E1	14,116	13,851	27,967
E2	Secondary treatment (block-1)			
	Civil & Architectural works	36,319	0	36,319
	Mechanical & Electrical works	17,558	46,977	64,535
	Sub-total of E2	**53,877**	**46,977**	**100,854**
E3	Tertiary treatment and disinfection (block-1)			
	Civil & Architectural works	3,075	0	3,075
	Mechanical & Electrical works	4,933	13,667	18,600
	Sub-total of E3	**8,008**	**13,667**	**21,675**
E4	Piping works			
	Civil & Architectural works	17,213	0	17,213
	Mechanical & Electrical works	0	0	0
	Sub-total of E4	**17,213**	**0**	**17,213**
E5	Utility buildings, ancillary and landscaping work			
	Civil & Architectural works	19,574	0	19,574
	Mechanical & Electrical works	0	0	0
	Sub-total of E5	**19,574**	**0**	**19,574**
	Sub-total of E	**112,788**	**74,495**	**187,283**
	Civil & Architectural works	**85,323**	**0**	**85,323**
	Mechanical & Electrical works	**27,465**	**74,495**	**101,960**
	Total of Construction Cost	**343,534**	**318,382**	**661,916**
	Civil & Architectural works	**233,026**	**0**	**233,026**
	Mechanical & Electrical works	**110,508**	**318,382**	**428,890**

5. Study on Construction Methods

5.1 Study on Foundation Type

5.1.1 Design Conditions

(1) Soil Conditions

(A) General information

BAS has mostly plain territory of ground layer. Soil layers from surface are situated in the following order: filled soil, wash soil sand soft and fine sand compact. (Reference: addendum document-1, cutaway drawing of the treatment plant bedding). Depending on the plant territory there are places without filled soil and places where layer thickness of the “wash soil sand soft” is thin. The altitude of levee crown of “fine sand compact” is about +91.0-+93.0m. It is considered that there is no additional information about the soil layer which is situated under the “Fine sand compact”. If we consider that the foundation type of the existing structural objects is spread foundation and “fine sand compact” or “wash soil sand soft” are supporting layers, we can make conclusion that these layers are comparably good for construction works, excavation, etc. The soil cutaway drawing IV-VI of planned construction site block1 is shown on the Figure 5.1. The cutaway drawing confirms that “wash soil sand soft” layer is thick and the middle layer is plant soil. Thus, as conclusion we can say that these factors have negative impact on the structural design. Therefore, it is considered that soil cutaway drawing plan is essential for structural safe side design.

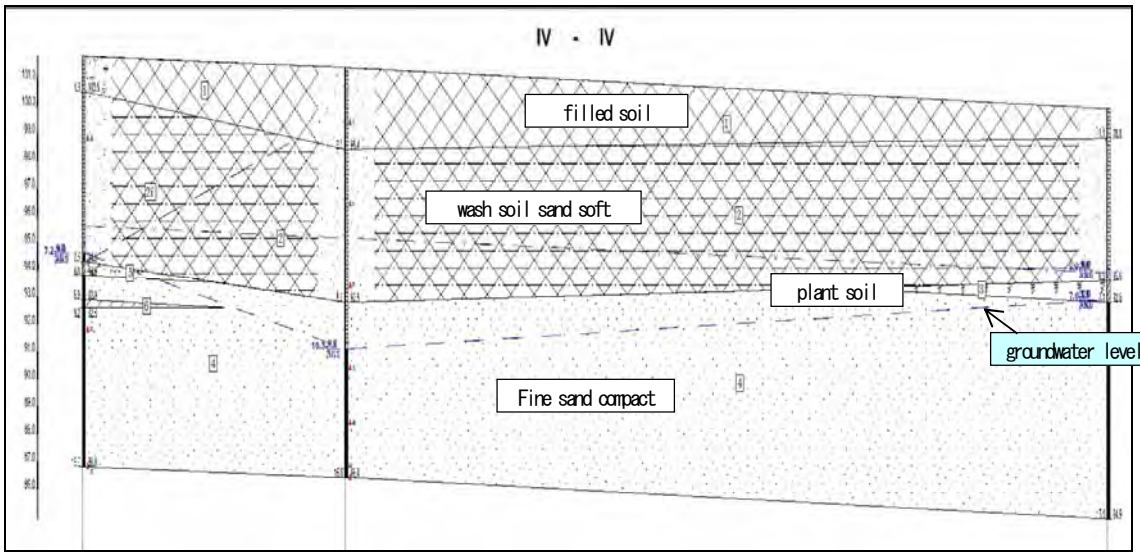


Figure 5.1 Section Plan IV-VI (Near Construction Site of New Facilities for Block 1)

(B) Soil constant

The soil constant of the each layers is showed in Figure 5.1. The internal friction angle of No. 2 and 2n "wash soil sand soft" is 27-30° , so in certain degree the bearing capacity of this soil should be enough, but taking into consideration the unit weight that is 1.50-1.65t/m^3, we can make conclusion that "wash soil sand soft" is mixed with silt fraction. In addition, the internal friction angle of No.4 "Find sand compact" is 34°. The bearing capacity of this soil is the best among the investigated soils.

Table 5.1 Soil Constant List of BAS

Index of soil genesis and age	No. in survey	Name of soil acc.to DSTU B V 2.1-2 96	Regulatory values									Estimate values						Soil layer index DBN D.2 2-1-99
			Natural moisture, fraction	Soil plasticity number	Consistency index	Voids ratio	Modulus of deformation, MPa	Soil permeaBility, m/day	Soil density, t/m3	Specific cohesion, MPa	Internal friction angle, degree	Soil density, t/m3		Specific cohesion, MPa		Internal friction angle, degree		
			W_P	I_P	I_L	e	E	K_Φ	ρ	c	φ	ρ_1	ρ_2	C_1	C_2	φ_1	φ_2	
t_{IV}	2	Filled soil				0,75	12		1,55	0,008	20	1,52	1,55	0,005	0,008	17	20	29в
t_{IV}	2	Wash soil-sand		<0,01		0,60	25	3-5	1,65	0,001	30	1,62	1,65	0,001	0,001	27	30	29a
t_{IV}	2п	Wash soil-sand soft		<0,01		0,80	6		1,50	0,001	27	1,47	1,50	0,0007	0,001	25	27	29a
e_{IV}	3	plant soil							1,54				1,54					40в
$a_{t\,I-IV}$	4	Fine sand compact		<0,01		0,60	40	5-8	1,88	0,001	34	1,84	1,88	0,0006	0,001	31	34	29a
$a_{t\,I-IV}$	4c	Fine sand middle density		<0,01		0,70	25	3-5	1,80	0,001	31	1,76	1,80	0,0006	0,001	30	31	29a
$a_{t\,I-IV}$	5	Sand with admixture of organic matters		<0,01		0,85	10	3-5	1,55	0,005	28	1,52	1,55	0,003	0,005	25	28	29a
$a_{t\,I-IV}$	6	Sand loam		0,03	I_L >1	0,58	8	0,5	1,85	0,006	20	1,82	1,85	0,006	0,006	17	20	36a
$a_{t\,I-IV}$	7	Sand loam with admixture of organic matters		0,06	I_L >1	0,86	6	0,05	1,63	0,008	18	1,61	1,63	0,005	0,008	16	18	35a

(C) Groundwater level

The main part of the groundwater level is located near the top of the "Fine sand compact" No.4 the area where the Block 1 is to be built is not flat, and the groundwater level varies between 3 and 7m from the ground level.

(2) Surrounding Environment

There is a garbage incineration plant near BAS, thus heavy vehicles frequently pass the road in front of the WWTP site. In addition, planned construction area of block 1 is separated from the boundary. Thus, it is considered that noise and vibration that possibly occur during the construction will not cause serious problems. However, due to the construction works while the existing facilities are in operation, it is necessary to pay attention to laid pipes and existing facilities in order to avoid any damages to them.

5.1.2 Study on Foundation Type

(1) Introduction

Generally speaking, the internal friction angle of larger than 30 degrees can be regarded as the supporting soil. In this regard, the soil of No.2 or 2n regarded as the supporting soil. However, taking into account its unit weight is 1.50-1.65t/m^3, the layer is supposed to include some silt. The sand layer of No.4 shows the largest friction angle of 34 degrees and shows the highest bearing capacity.

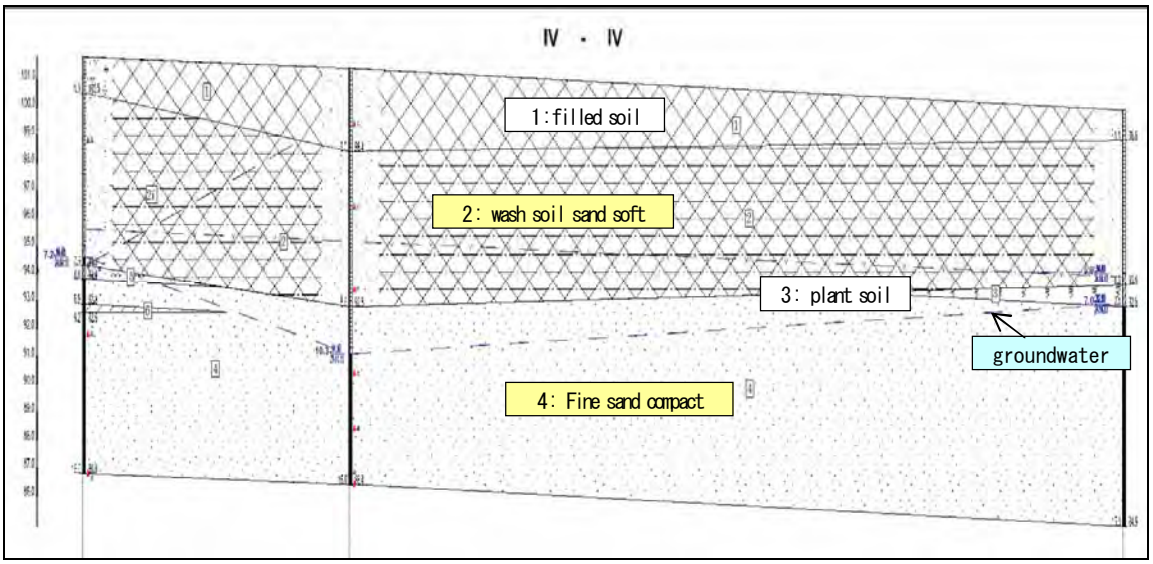


Figure 5.2 Section Plan IV-VI (Construction Site of Pretreatment/Reactor for Block 1)

(2) Verification of Bearing Capacity

Allowable bearing capacities of the foundation soil for the aeration tanks and secondary settling tanks which are main facilities were calculated and the spread foundation was checked whether it was stable or not to begin with.

(A) Aeration Tank

The depth of the aeration tank in the soil is about 4.5m, thus “alluvial sand layer” can be used as supporting layer. The allowable bearing capacity in this case was calculated.

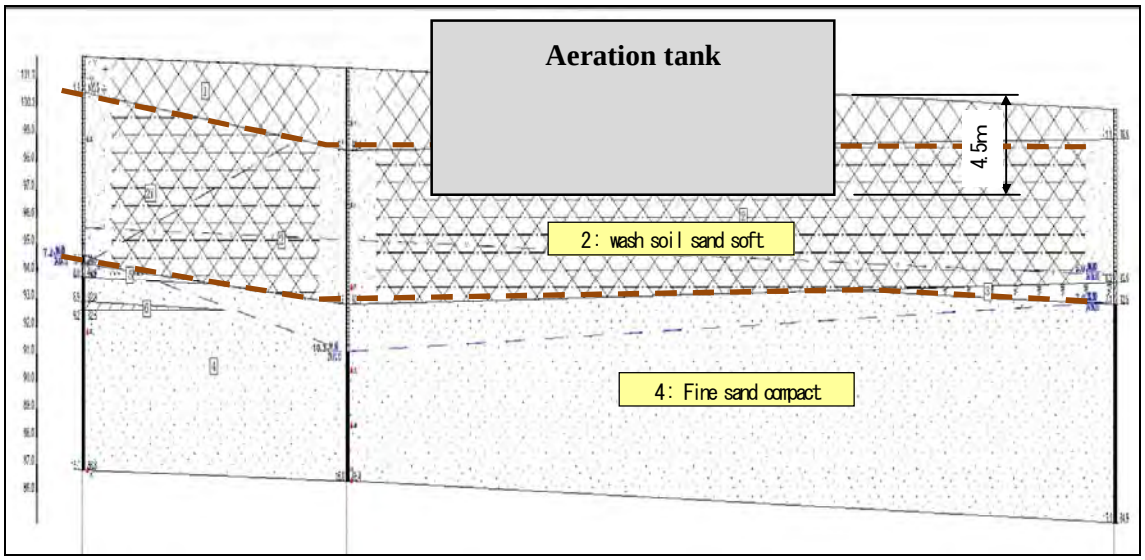


Figure 5.3　Supporting layer of Aeration Tank

The allowable bearing capacity at ordinary times was calculated as follow.

Qa＝1/3・(α・k・C・Nc・Sc＋1/2・β・γ1・B・Nr・Sr+k・γ2・Df・Nq・Sq)

Qa: soil allowable bearing capacity of the soil (kN/m^2)

C: adhesion of the soil located under foundation soil (kN/m^2)

γ_1: unit weight of the soil located under foundation soil (kN/m^3)

γ_2: unit weight of the soil located above foundation soil (kN/m^3)

α, β: foundation shape coefficient

B: minimum width of the foundation bottom (m)

k: extra coefficient regarding embedment depth effect

Nc, Nr, Nq: bearing capacity coefficients

Sc, Sq, Sr: revised coefficient towards the size effect of bearing capacity coefficient

(Details (Material-1 calculation formula of allowable bearing capacity) reference)

Each coefficient applied to aeration tanks is as follows.

C＝1.0 kN/m^2

γ_1＝γ_2＝16.5kN/m^3 (Table 5.1)

α＝1+0.3×63／136＝1.14 kN/m^3 (rectangle)

β＝1－0.4×63／136＝0.81 kN/m^3 (rectangle)

B＝63m

k＝1+0.3・4.5/63＝1.02

Nc＝8, Nr＝0.5, Nq＝3 (tan30°　=0.57)

Sc＝(1.0/10)^(-1/3)＝2.15

Sq＝(16.5×4.5/10)^(-1/3)＝0.51

Sr＝(63/1.0)^(-1/3)＝0.25

∴Qa＝1/3×(1.14×1.02×1.0×8×2.15＋1/2×0.81×16.5×63×0.5×0.25＋1.02×16.5×4.5×3×0.51)＝62.8kN/m^2

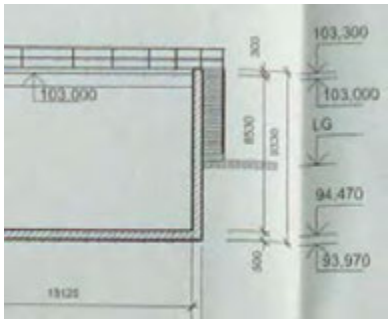


Figure 5.4　Cutaway Drawing Part of Aeration Tank

Next, average weight W per unit area of the aeration tank is calculated as follows:

W＝(bottom slab) 25kN/m^3×0.50m + (sewage water)
10kN/m3×8.5m　＝97.5 kN/m^2

Therefore,

W＝97.5 kN/m^2　＞　Qa＝62.8kN/m^2 (NG)

Thus, the bearing capacity is judged to be not sufficient in the current design. The following methods are considered as a countermeasure.

Option A：The part of “alluvial sand layer” is amended to make underlying tight sand soil as bearing layer.

Option B：To enhance bearing effect by enlarging the penetration part

(B)　　Secondary Settling Tank

The penetration depth of the secondary settling tank is about 6.0m, thus the alluvial sand layer will be the bearing layer as in the case of aeration tanks.

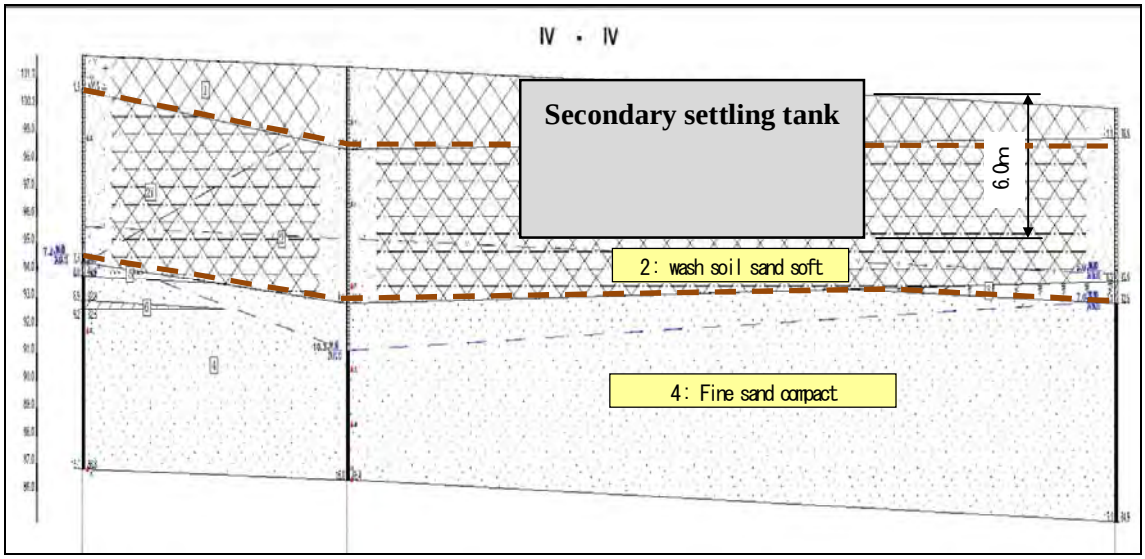


Figure 5.5　Secondary Settling Tank Bearing Soil

Allowable bearing capacity was calculated by the formula similar to the calculations regarding the aeration tanks. Each coefficient which applied to secondary settling tanks is as follows:

$C = 1.0\ kN/m^2$

$\gamma_1 = \gamma_2 = 16.5kN/m^3$ (Table 5.1)

$\alpha = 1.3\ kN/m^3$ (circular)

$\beta = 0.6\ kN/m^3$ (circular)

$B = 59m$

$k = 1+0.3 \cdot 6.0 / 59 = 1.03$

$Nc = 8$, $Nr = 0.5$, $Nq = 3$ ($\tan 30^\circ = 0.57$)

$Sc = (1.0 / 10)^{\wedge(-1/3)} = 2.15$

$Sq = (16.5 \times 6.0 / 10)^{\wedge(-1/3)} = 0.47$

$Sr = (59 / 1.0)^{\wedge(-1/3)} = 0.26$

$\therefore Qa = 1/3 \times (1.3 \times 1.03 \times 1.0 \times 8 \times 2.15 + 1/2 \times 0.6 \times 16.5 \times 59 \times 0.5 \times 0.26 + 1.03 \times 16.5 \times 6.0 \times 3 \times 0.47) = 68.3kN/m^2$

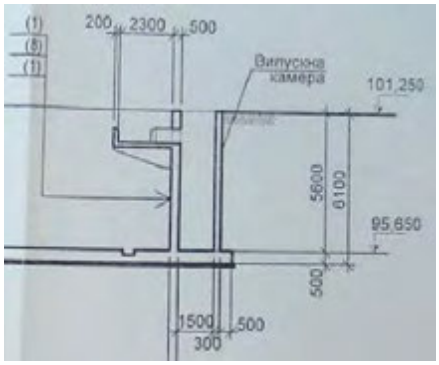


Figure 5.6 Section of Part of Secondary Settling Tank

Next, average weight W per unit area of secondary settling tank is calculated as follows:

$W = (\text{bottom slab})\ 25kN/m^3 \times 0.50m + (\text{sewage water})$

$10kN/m^3 \times 5.5m = 67.5\ kN/m^2$

Therefore,

$W = 67.5\ kN/m^2 < Qa = 68.3kN/m^2$ (OK)

Thus, the current design is proved to have the sufficient bearing capacity.

5.1.3 Selection of Foundation Type

The calculation of allowable bearing capacity in previous paragraph found that bearing capacity in the aeration tanks was not sufficient, whereas the bearing capacity for secondary settling tanks was sufficient. It is supposed that increasing the embedment depth will ensure bearing capacity. Thus, it is assumed that foundation type is not needed to change from spread foundation to pile foundation in detailed design stage. Therefore, at present the foundation type shall be in principle spread foundation. Prior to the detail design, it might be needed to conduct geotechnical investigation to judge whether

auxiliary construction such as soil amendment or soil amendment is required taking into account of the presence of organic soil, if any.

FOUNDATON TYPE→SPREAD FOUNDATION
However, it is necessary to consider regarding the penetration depth and the necessity of soil amendment in the detailed design.

5.2 Study on Earthwork Planning

5.2.1 Introduction

The scale of BAS facilities is large. BAS reconstruction design plans to build several facilities at one time. Therefore, taking into consideration the economic efficiency and construction execution of works, open cut method is preferable. However, since the excavation depth is 10m, it is necessary to think about using the grand anchor construction method as the existing facilities in operation are located close to the new facilities to construct.

In addition, countermeasures against groundwater are indispensable, because the groundwater level is as deep as GL-3 - 7m. Since clay layer which might cause consolidation settlement does not exist, the area to excavate is large enough and no facilities possibly affected by lowered groundwater level are located nearby, then it seems appropriate to adopt groundwater lowering method such as well point method. The well point method is examined to judge whether its application is really appropriate or not first of all.

PRIMARY POLICY OF EARTHWORKS PLAN
Open excavation along with groundwater lowering methods

5.2.2 Study on Open-cut Construction Method

Because the target soil is mainly sand, the slope gradient in the open cut is normally 1:1.5. The facilities with large excavation depth (around 10m): pretreatment facility (A1-1, A2-1, A4-1) and drainage pumping station for mechanical equipment (A4-13), but because of its smaller scale, it seems appropriate to use circle caisson pile method for construction.

Thus, during the construction of the pretreatment facility which requires the deepest excavation, its vicinity in the range of 15m will be included in the excavation area. When this excavation affected area on ground plan was checked, it was confirmed that there is no effects on other structures as shown in Figure 5.7.

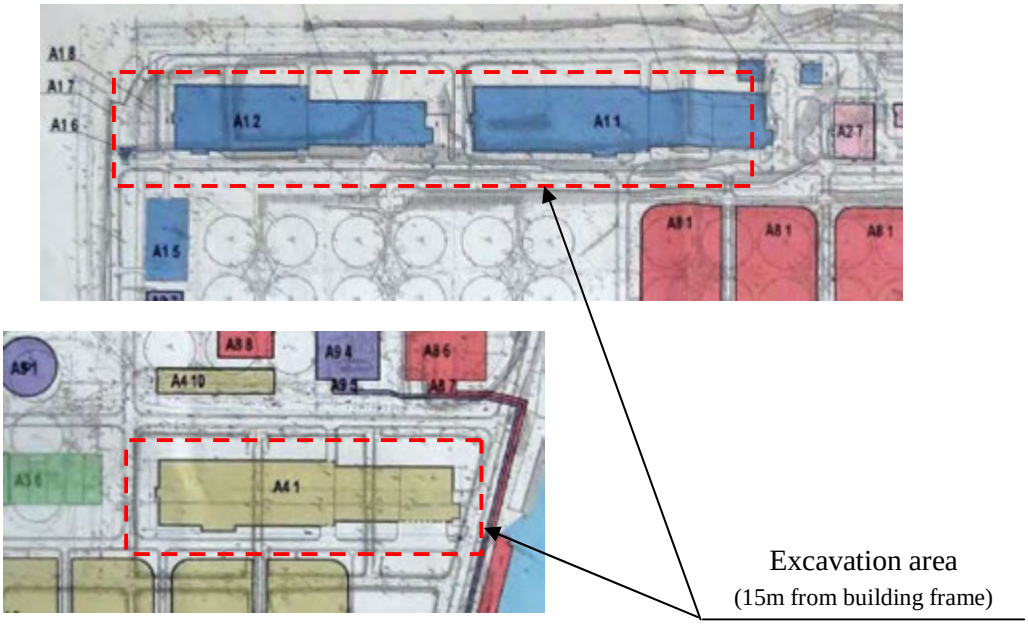


Figure 5.7 Excavation Area of Mechanical Treatment Facility

In addition, though their excavation depths are not large, there are some facilities (aeration tanks and secondary settling tanks) of new block 1 that are constructed underground close to future constructed facility. The excavation depth of this facility is about 6m, thus neighborhood in range of 9m is to become the excavation area (Figure 5.8). It is confirmed that there is no impact on other construction objects.

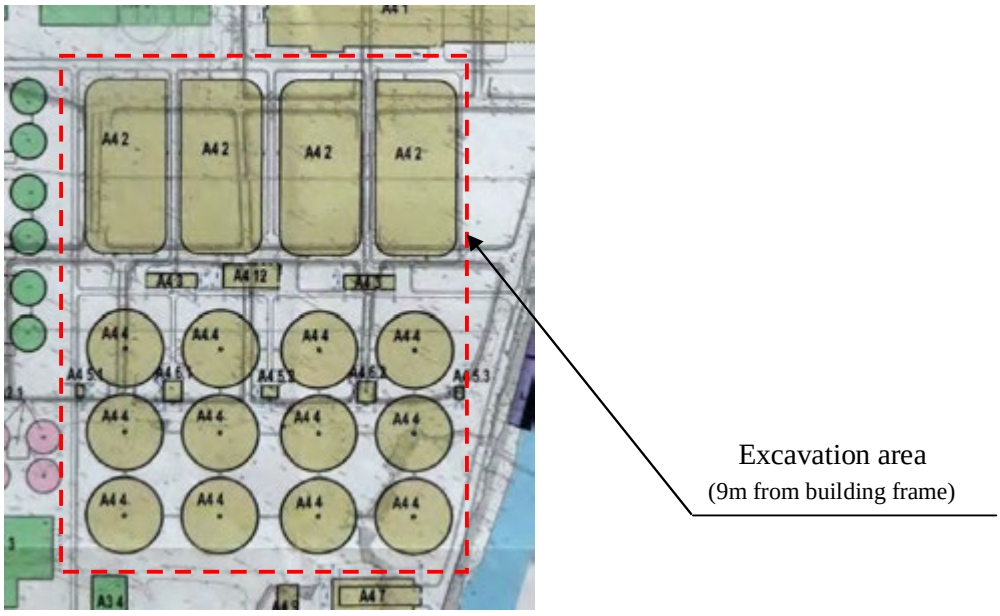


Figure 5.8 Excavation Area of Sewage Treatment Facility for Block 1

Thus, it was decided to apply the open cut construction method, in principle. After the confirmation of the distance from existing facilities in a detailed design, grand anchor construction method or soil amendment can be used as auxiliary construction methods.

5.2.3 Study on Groundwater Lowering Construction Method

Here, the suitability of the groundwater lowering construction method was studied in order to be used together with an open cut construction method. At first, as fine sand compact layer (class number 4) or wash soil sand soft layer (class number 2) are base of the excavation, based on the coefficient of water permeability of above the base of the excavation it was determined that ground lowering construction method is suitable.

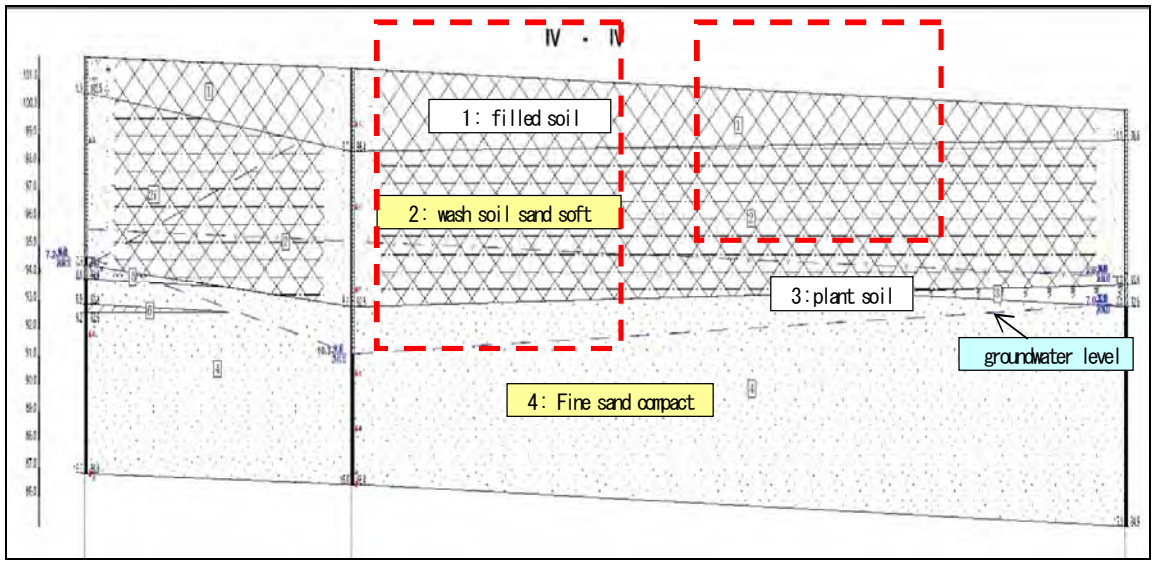


Figure 5.9 Excavation Depth and Soil Layer Contact
(Mechanical treatment facility - Aeration tank neighborhood of New Block 1)

Table 5.2 Coefficient of Permeability as for Groundwater Lowering Soil Layer

Index of soil genesis and age	No. in survey	Name of soil acc.to DSTU B V 2.1-2 96	Regulatory values									Estimate values						Soil layer index DBN D.2 2-1-99
			Natural moisture, fraction	Soil plasticity number	Consistency index	Voids ratio	Modulus of deformation, MPa	Soil permeaBility, m/day	Soil density, t/m3	Specific cohesion, MPa	Internal friction angle, degree	Soil density, t/m3		Specific cohesion, MPa		Internal friction angle, degree		
			W_P	I_P	I_l	e	E	K_Φ	ρ	c	φ	ρ_1	ρ_2	C_1	C_2	φ_1	φ_2	
t_{IV}	2	Filled soil				0,75	12		1,55	0,008	20	1,52	1,55	0,005	0,008	17	20	29a
t_{IV}	2	Wash soil-sand		<0,01		0,60	25	3-5	1,65	0,001	30	1,62	1,65	0,001	0,001	27	30	29a
t_{IV}	2n	Wash soil-sand soft		<0,01		0,80	6		1,50	0,001	27	1,47	1,50	0,0007	0,001	25	27	29a
e_{IV}	3	plant soil							1,54				1,54					40a
a_{II-IV}	4	Fine sand compact		<0,01		0,60	40	5-8	1,88	0,001	34	1,84	1,88	0,0006	0,001	31	34	29a
a_{III-IV}	4c	Fine sand middle density		<0,01		0,70	25	3-5	1,80	0,001	31	1,76	1,80	0,0006	0,001	30	31	29a
a_{II-IV}	5	Sand with admixture of organic matters		<0,01		0,85	10	3-5	1,55	0,005	28	1,52	1,55	0,003	0,005	25	28	29a
a_{II-IV}	6	Sand loam		0,03	I_L >1	0,58	8	0,5	1,85	0,006	20	1,82	1,85	0,006	0,006	17	20	36a
a_{II-IV}	7	Sand loam with admixture of organic matters		0,06	I_L >1	0,86	6	0,05	1,63	0,008	18	1,61	1,63	0,005	0,008	16	18	35a

According to Figure 5.9 and Table 5.2 where soil layers applied ground water lowering method are fine sand compact layer (class number 4)and wash soil sand soft layer (class number 2), the coefficient of water permeability was confirmed - 3-8m/day＝3.5-9.3×10-3cm/s.

According to the coefficient of water permeability, the deep well method or the well point method can be used. However, maximum water lower level is about 3m, thus coefficient of water permeability is about 10^{-3}cm/s. Under these conditions the deep well method may not be applicable due to the gravity drainage, thus well point method is the most suitable. As there are some points with groundwater level of GL-7m were confirmed, shallow sump method can be used for aeration tanks and other facilities where excavation depth is shallow. In any case, it is desirable to examine scale of groundwater lowering methods and pump installation location in a detail design, and to decide the suitable construction method.

5.2.4 Conclusion

From the above-mentioned study, it is clear that the well point method together with the open cut construction method should be used as basic methods in the earthwork plan. Depending on the excavation depth, groundwater level, interval between construction facilities, other, the grand anchor construction method or shallow sump method can be used as supplementary construction methods.

EARTHWORKS PLAN
Open excavation construction method＋Well-Point method (The supplementary methods of construction such as a grand anchor construction method, ground improvement construction method, shallow sump method, deep well method are applied depending on situation)

5.3 Study on Land Formation Planning

5.3.1 Introduction

In order to construct the main facilities of the first block, on the sludge fields BAS and open area on its south side as shown in Figure 5.10, it is necessary to consider about disposal methods of accumulated sludge there and about methods of preparing the area where it is hollow.

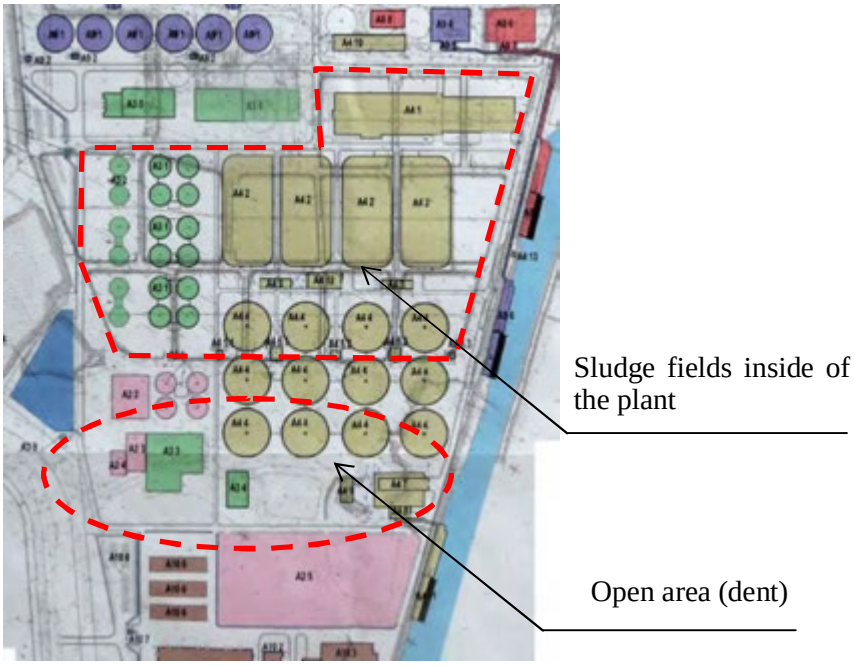


Figure 5.10 First Block Locational Planning


Photo-1 Sludge Fields inside of the Plant


Photo-2 South Side of Open Area (Dent)

5.3.2 Calculations of Work Volume

In order to consider about the methods of disposal of accumulated sludge and about the methods of land preparation on the hollows, firstly the volumes of accumulated sludge and soil for filling up the hollows are calculated. Regarding the methods of calculation, In field investigation the height of accumulated sludge and hollow depth were measured and from the plan drawing the areas area measured and from height, depth and areas their approximate volumes are sought.

■**accumulated sludge volume：V＝143,600m^2×2.5m＝359,000 → 360,000m^3**

Figure 5.11　Sludge Fields inside of the Plant Aero-photo

■**Necessary soil volume for filling：V＝47,100m^2×6.5m＝306,150 → 310,000m^3**

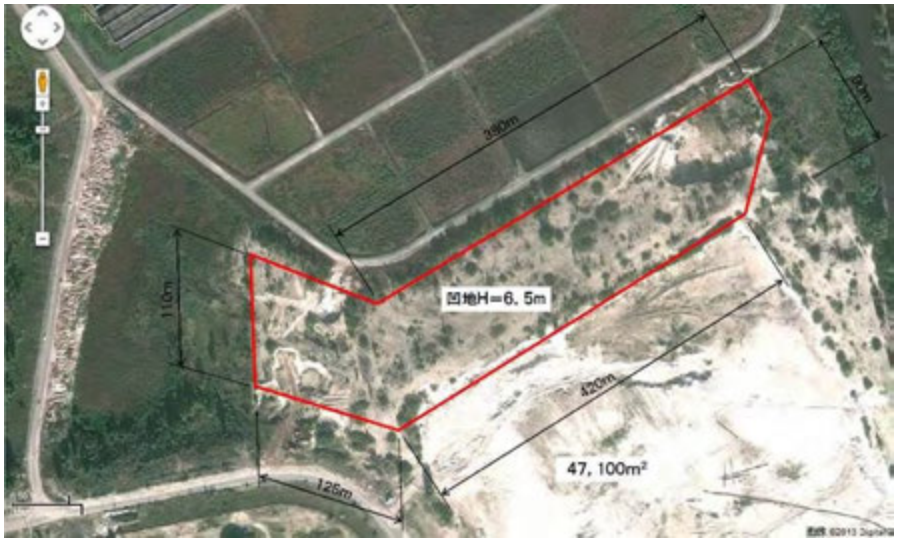


Figure 5.12　Southern Hollow Aero-photo

5.3.3　Study on Land Formation

(1)　Accumulated Sludge Disposal Methods

The following methods can be considered as accumulated sludge disposal methods:

(a) Removal from the plant territory
(b) Pump transport of the liquefied accumulated sludge → mechanical treatment process (primary

sedimentation tank) →sludge treatment process (incinerator) → removal from the plant territory (cement ingredient)

(c) Cement solidification of accumulated sludge which ~~it~~ can be used as material for construction in BAS

(A) Removal from the plant territory

Firstly, it is considered that sludge fields that are situated outside of the plant can be used as places for sludge removal. But the accepting capacity is almost limit. In April 2013 a washout occurred at the bund. For this reason, it is not preferable to use sludge fields as the carry-out destination.
Therefore, the two following methods are considered for sludge removal:
(A)-1. Liquefying accumulated sludge and pumping it
(A)-2. Removing sludge by dump trucks

(B) Return to water treatment process by reflow

According to the KVK plan, firstly water is poured into sludge fields by pump, mixed with accumulated sludge and returned. Then pumped to primary sedimentation tanks by primary squeeze pump and then usual water treatment process occurs: thickening - dewatering - incineration. After incineration, ash is removed from the plant territory as ingredient for cement.

(C) Cement solidification of accumulated sludge which it can be used as material for construction inside of the plant BAS

~~T~~The cement solidifying materials are widely used as soil improvement material, which have various kinds of solidification materials for various purposes. There aren't many examples of reusing the sewage sludge after solidification in the world. However, sludge solidification technology has been applied for sludge with high content of organic substance and moisture such as river sludge, seabed and peat, then-solidification and reuse of sewage sludge is not impossible from technical point of view. However, cement solidification technology for plant organic soil is a special construction method may affect the procurement process.

Figure 5.13 Construction Method of Cement Solidification Ash by Backhoe

(2) Study on Disposal Methods

Detail study is shown as follows on disposal methods of accumulated sludge above-mentioned.

(A) Removal from the plant territory

As mentioned above, there are serious problems, because the destination of sludge removal from plant territory is undecided yet. In case of removing sludge from BAS, it will be necessary to study this mater in detail. In addition, possible problems and risk of removal methods are summarized in Table 5.3. However, in case of transporting the accumulated sludge from BAS by dump trucks or by pump, the problems increase depending on distance to the carry out destination.

Table 5.3 Possible Problems and Risks

Methods of removal	Possible problems and risks
(A)-1 Liquefying + pumping	➢ Liquefying facilities (feeding sludge, water supply, blending) and construction of the pumping facilities ➢ Deterioration of existing sludge transportation facility
(A)-2 Removal by dump truck	➢ Prolongation of construction period ➢ Impact on the environment by running huge dump trucks and increasing traffic quantity

(B) Return to water treatment facility by reflow

In method of return to water treatment facility by reflow the following problems in each step must be considered.

Table 5.4 Possible Problems and Risks

Working process	Possible problems and risks
Water injection and stirring	➢ Specific measures of stirring method in situ are unknown. ➢ In case of stirring in situ, it is necessary to set up a new mixing tank.
Return to water treatment process	➢ SS increasing can impact on the quality of treated water
Sludge treatment process	➢ Increasing the quantity of sludge can cause the increasing of sludge treatment capacity of the current plan

(C) Cement solidification of accumulated sludge which can be used as material for construction in BAS

Possible problems and risk of cement solidification treatment of accumulated sludge on local plant facility are summarized in Table 5.5.

Table 5.5 Possible Problems and Risks

Points	Possible problems and risks
Procurement of the cement solidification material for accumulated sludge	➢ Procurement of the cement solidification material for plant soil is a problem (Procurement from the European company is unclear and the Japanese company does not have intention to export).
Use of blast furnace cement	➢ It was confirmed that blast furnace cement is effective as a solidifying material, but it is necessary to do strength test on local sludge ➢ Depending on the results of hexavalent chromium elution test, prevention of heavy metal elution measures are necessary ➢ If required strength is not reached, there is a possibility to increase cement dosage, but it causes the increasing of cost

(3) Filling Methods

Land preparation is performed by filling sand into sludge fields after disposal of sludge and into dents on south side. In case of cement solidification method and reuse of the treated sludge, about 310,000m^3 of additional sand is necessary. However, if the accumulated sludge is not reused, it will make 670,000 m^3 (310,000+360,000) of sand for filling.

There is a big problem with choosing the earth filling methods and with place of sand supply. Now, it is planned to bring sand within 20 km distance near Dnipro river, etc. Based on above conditions 2 types of earth filling are considered.

(a) type: conveying sand by dump truck + level up by bulldozer
(b) type: conveying sand by pump via pipe + level up by bulldozer

(a) type is common for earth filling but (b) type is decided according to the KVK plan. This construction method was used in the past construction, but it is expected that method of pumping water together with sand and leveling up by bulldozer is not cost effective, because water with sand must be treated after laying the pipeline.

(4) Conclusion

The reason of high costs on KVK land preparation is the purchases of sand. Because of this reason, it is considered that an effective way to reduce costs is using the method which can reduce the expenses for sand purchases. From the above, it is necessary to conduct the comprehensive study of leveling up methods, methods of earth filling procurement, treatment methods of accumulated sludge in the future detailed design.

6. Financial and Economic Analysis

6.1 Results of Willingness to Pay Survey

6.1.1 Interview Results

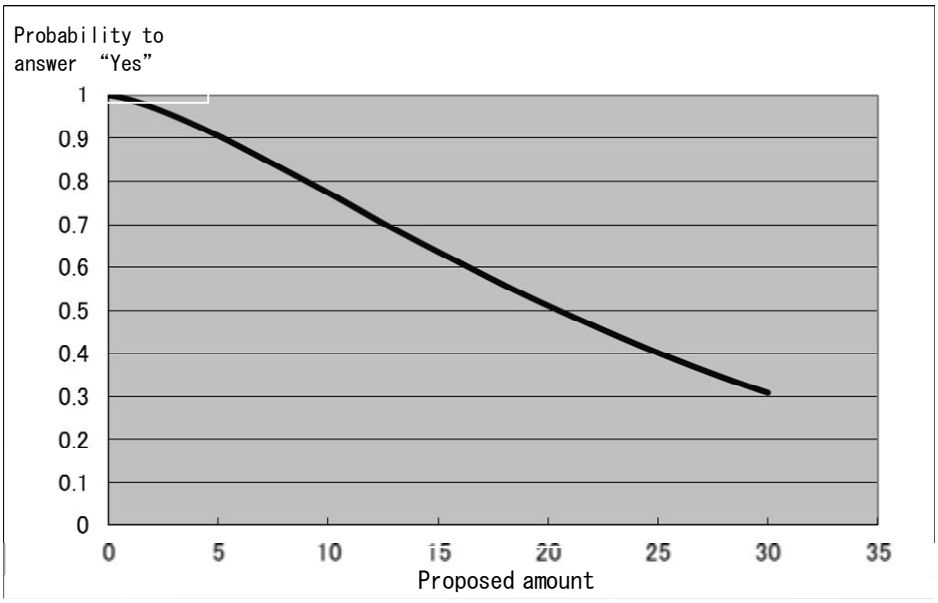
Variant 1 (No. of Ans.)

1st proposal			2nd proposal		
10 Uah	Yes	74	15 Uah	Yes	50
				No	24
	No	26	5 Uah	Yes	15
				No	11

Variant 2 (No. of Ans.)

1st proposal			2nd proposal		
20 Uah	Yes	59	30 Uah	Yes	39
				No	20
	No	42	15 Uah	Yes	15
				No	27

Estimation result by CVM Double bound Weibull model



Source: Kouichi Kuriyama, "Contingent Valuation Methods by Excel, ver.4"

6.1.2 Questionnaire Sheet

The questionnaire sheet for willingness to pay survey is attached the following page.

For Official Use Only

Do not fill up	Questionnaire №
	Var.1 Var.2

JICA/TECI/NSS

Survey on evaluation of the communal services of water supply and s ewerage and the project of Bortnichi station of aeration reconstruction

Section-A Basic Information

A- 1 Interviewer's name	**A- 2 Date of the interview** **Date: 2013** **Time (Start):** am/pm.

A- 3 Information on Respondent

Name: _____ Age: _____

District: _____

Street/ Block _____

A-4 Does your household have a connection of **sewerage service**?

□01 Yes □02 No (interview is finished)

Section-B Current Sewerage Service

B-1 Family Composition sharing the same sewerage connection

01 Adult: _____ persons
02 Child (less than 18 years old): _____ persons
03 Total: _____ persons

B-2 Do you know how much does your household monthly consume **hot water**, **cold water & sewerage**?

□01 Hot water _____ m^3/ month

□02 Cold & sewerage water _____ m^3/ month

B-3 Do you know how much does your household monthly pay for **hot water**, **cold water & sewerage** service by KVK?

□01 Hot water _____ Uah/ month

□02 Cold & sewerage water _____ Uah/ month

B-4 What do you think of current **cold water & sewerage** tariff rates? (notice: for you and your family.)
For the interviewer: only cold water and sewerage, ***do not include hot water****!*

□01 Cheap
□02 Relatively Cheap
□03 Reasonable
□04 Relatively Expensive
□05 Expensive

B-5 Does your family use any other water for drinking, except for piped water?
□**01 No** – start question B-6
□**02 Yes. If so, what kind:**
□02.1 **free** (*for example* well, etc)
□02.2 **purchased** *(for example* bottled water*)*
If so, what is the average monthly cost? (_____ Uah/ month **)**

B-6 Have your household ever felt environmental/ human health damage from the sewage-treatment plant (BAS) / or the sludge disposal site?

□01 Yes → please specify (name respondent's variant) and mark below
□02 No → interviewer specifies the below

Specification:
□01 Offensive odor (specify location: Bortnychi station of aeration / sludge fields) (underline the relevant variant)
□02 Bad water quality of effluent water from BAS treatment plant
□03 Dnipro river contamination
□04 Other _____

Section-C Evaluation of Bortnychi station of aeration and it's reconstruction

Explanation for the respondent. To be voiced
[Background information]:
Current situation on Bortnychi station of aeration – water treatment facility;

- ✓ Poor technical condition, out of date equipment installed in 1960-80 (treatment facilities), that do not have enough capacity, possibility of damaged dambs
- ✓ Poor quality of water treatment with the risk of underground water and Dnipro river contamination
- ✓ Offensive odor from the station

[Possibilities] – reconstruction of the station, projected and financed by the Japanese government (JICA)

After the reconstruction and refurbishment project, the following effects will be expected;

- Increase of effectiveness and station operation reliability
- Decrease in pollution emission, absence of the offensive odor
- Compliance of the water treatment quality to the European standards

C-1 Do you consider the BSA reconstruction to be necessary?
□01 Yes
□02 No (if so, why?)_____

Variant 1

C-2 Would your household accept to pay 10 Uha/ month as an incremental tariff to current sewerage tariff for the modernized water treatment station projected by the Japanese company, supposing to provide satisfactory sewerage service indicated the above?

To the interviewer: (*not for a cubic meter, but total; only for the sewerage, do not include tariffs for cold and hot water)*

□01 Yes → If so, would you also accept 15 Uha/ month as an incremental tariff?
□01 Yes
□02 No

No → If so, would you accept 5 Uha/ month as an incremental tariff?
□01 Yes
□02 No

Household's comments, if any: _____)

Variant 2

C-2 Would your household accept to pay 20 Uha/ month as an incremental tariff to current sewerage tariff for the modernized water treatment station projected by the Japanese company, supposing to provide satisfactory sewerage service indicated the above?

To the interviewer: (*not for a cubic meter, but total; only for the sewerage, do not include tariffs for cold and hot water)*

□01 Yes → If so, would you also accept 30 Uha/ month as an incremental tariff?

□01 Yes
□02 No

No → If so, would you accept 15 Uha/ month as an incremental tariff?

□01 Yes
□02 No

Household's comments, if any: _____)

C-3 Please, specify the average monthly income of the household, ths. Uah.

□01 to 1,500
□02 1,501 – 2,500
□03 2,501 – 3,500
□04 3,501 – 5,000
□05 5,001 – 6,500
□06 6,501 – 8,500
□07 8,501 – 10,000
□08 10,001 – 15,000
□09 15,001 – 20,000
□10 20,001 – 30,000
□11 30,001 and more

B-5 Does your family use any other water for drinking, except for piped water?
□**01 No** – start question B-6
□**02 Yes. If so, what kind:**
□02.1 **free** (*for example* well, etc)
□02.2 **purchased** *(for example* bottled water*)*
If so, what is the average monthly cost? (_____ Uah/ month)

B-6 Have your household ever felt environmental/ human health damage from the sewage-treatment plant (BAS) / or the sludge disposal site?

□01 Yes → please specify (name respondent's variant) and mark below
□02 No → interviewer specifies the below

Specification:
□01 Offensive odor (specify location: Bortnychi station of aeration / sludge fields) (underline the relevant variant)
□02 Bad water quality of effluent water from BAS treatment plant
□03 Dnipro river contamination
□04 Other _____

Section-C Evaluation of Bortnychi station of aeration and it's reconstruction

Explanation for the respondent. To be voiced
[Background information]:
Current situation on Bortnychi station of aeration – water treatment facility;

- ✓ Poor technical condition, out of date equipment installed in 1960-80 (treatment facilities), that do not have enough capacity, possibility of damaged dambs
- ✓ Poor quality of water treatment with the risk of underground water and Dnipro river contamination
- ✓ Offensive odor from the station

[Possibilities] – reconstruction of the station, projected and financed by the Japanese government (JICA)

After the reconstruction and refurbishment project, the following effects will be expected;

- Increase of effectiveness and station operation reliability
- Decrease in pollution emission, absence of the offensive odor
- Compliance of the water treatment quality to the European standards

C-1 Do you consider the BSA reconstruction to be necessary?
□01 Yes
□02 No (if so, why?)_____

Variant 1

C-2 Would your household accept to pay 10 Uha/ month as an incremental tariff to current sewerage tariff for the modernized water treatment station projected by the Japanese company, supposing to provide satisfactory sewerage service indicated the above?

To the interviewer: (*not for a cubic meter, but total; only for the sewerage, do not include tariffs for cold and hot water)*

□01 Yes → If so, would you also accept 15 Uha/ month as an incremental tariff?
□01 Yes
□02 No

No → If so, would you accept 5 Uha/ month as an incremental tariff?
□01 Yes
□02 No

Household's comments, if any: _____)

Variant 2

C-2 Would your household accept to pay 20 Uha/ month as an incremental tariff to current sewerage tariff for the modernized water treatment station projected by the Japanese company, supposing to provide satisfactory sewerage service indicated the above?

To the interviewer: (*not for a cubic meter, but total; only for the sewerage, do not include tariffs for cold and hot water)*

□01 Yes → If so, would you also accept 30 Uha/ month as an incremental tariff?

□01 Yes
□02 No

No → If so, would you accept 15 Uha/ month as an incremental tariff?

□01 Yes
□02 No

Household's comments, if any: _____)

C-3 Please, specify the average monthly income of the household, ths. Uah.

□01	to 1,500	□08	10,001 – 15,000
□02	1,501 – 2,500	□09	15,001 – 20,000
□03	2,501 – 3,500	□10	20,001 – 30,000
□04	3,501 – 5,000	□11	30,001 and more
□05	5,001 – 6,500		
□06	6,501 – 8,500		
□07	8,501 – 10,000		

Thank you for the participation in the survey

For ensuring the actuality of the survey, please sing the questionnaire or leave the con tact phone number.

Respondent's signature or telephone number

All the above information will be confidential, only utilized for the purpose of preparatory study for the Project.

Bortnychi station of aeration reconstruction projecting team JICA

6.2 Standard Conversion Factor (SCF)

SCF is estimated by using export and import statistics and the record of import custom and export duties as a part of the government revenue.
The detail is shown as below.

Table 6.1 Summary Statistics of Trade and Custom Duties

(Uah)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Import CIF	28,996,031	28,996,031	36,141,095	45,034,491	60,669,923	85,535,356	45,435,559	60,739,969	82,608,240	84,658,060	48,524,216	607,338,971
Import duties	2,582,500	3,660,614	6,370,250	6,308,166	8,060,000	12,096,000	10,382,910	8,290,000	10,243,000	12,700,056	15,075,000	95,768,496
Export FOB	32,672,318	32,672,318	34,286,748	38,367,704	49,248,064	66,954,430	39,702,883	51,430,522	68,394,196	68,809,811	41,127,637	523,666,631
Export duties	180,594	906,200	1,262,072	1,112,475	299,044	364 840.0	294,720	376,940	2,168,676	392,000	249,000	7,241,722

SCF = (Import CIF + Export FOB)/((Import CIF + Import duties) + (Export FOB - Export duties))
= 0.93

6.3 Estimation of Economic Benefits (Cost Reduction of Raw Sludge Treatment)

Considering the "Without Project" case, sewerage sludge has to be accumulated in the new sludge fields which will need to be newly purchased near Krentchi No.5 site. Hence, the land costs for purchase and the transportation costs can be considered as economic benefits of the Project.

Items	Calculation
Land costs for sludge disposal	10,000 US$/ 100m^2 (7,361 Euro/ 100 m$^{2)}$ Sludge can be disposed at the new sludge field with 5m depth. Therefore, its disposal cost per the generated raw sludge volume is estimated at: 7,361 Euro/ 500 m^3 = 14,7 Euro/m^3
Transportation costs to sludge field BAS-Krentchi No.5 (14t-Ukraine)	406 Uah/ 10km (37.4 Euro/ 10km) Distance: BAS-Krentchi No.5, approximately 20 km 37.4 Euro x 2 = 74.8 Euro per / 14t-truck

7. Environmental and Social Consideration

7.1 List of Contaminating Substances emitted into the Ambient Air

Table 7.1 List of Contaminating Substances emitted into the Ambient Air

Contaminating substance	Code	MPCм.р., mg/m3	Haz. Class	Present condition		After reconstruction	
				g/s	t/year	g/s	t/year
Aluminium oxide	101	0.100000	3				
Vanadium pentoxide (Vanadium and compounds)	110	0.020000	2				
Iron oxide** (in terms of iron)	123	0.400000	3	0.0280	0.0119	0.2580	0.2791
Cadmium oxide (in terms of cadmium)	133	0.003000	1	0	0	0.0016	0.0505
Manganese and its compounds (in terms of dioxide)	143	0.010000	3	0.0055	0.0010	0.0080	0.2246
Sodium hydroxide (sodium hydroxide, caustic soda)	150	0.010000	3	0.0000	0.0000	0.0006	0.0027
Sodium carbonate (soda ash)	155	0.040000	4	0	0	0.0002	0.0051
Metallic mercury (mercury and compounds)	183	0.003000	3	0	0	0.0016	0.0505
Lead and its compounds, except tetraethyllead	184	0.001000	3	0.0000	0.0000	0.0016	0.0505
Hexavalent chromium (in terms of trioxide)	203	0.002000	4	0.0000	0.0000	0.0000	0.0000
Nitrogen dioxide	301	0.200000*	-	1.7331	12.3571	7.4154	219.1447
Nitric acid in terms of HNO3 molecular (Nitric acid)	302	0.400000	3	0.0010	0.0007	0.0010	0.0007
Ammonia	303	0.200000	1	0.2041	6.3456	0.2096	6.6073
Nitrogen oxide	304	0.400000	2	0	0	0.0000	0.0005
Hydrogen chloride (hydrochloric acid) in terms of HCl molecular	316	0.200000	4	0.0009	0.0007	0.3209	10.0922
Sulfuric acid in terms of H_2SO_4 molecular	322	0.300000	2	0.0002	0.0002	0.0132	0.1002
Amorphous silica (aerosil-175)	323	0.020000	4	0.0049	0.0051	0.0011	0.0048
Black carbon	328	0.150000	-	0.2210	0.9590	0.3245	11.0664
Sulfur dioxide	330	0.500000	4	1.8790	11.6530	1.6009	50.4755
Hydrogen sulphide (sulfurated hydrogen)	333	0.008000	3	4.6395	45.0440	0.0812	3.2041
Carbon monoxide	337	5.000000	-	1.1196	4.5412	5.1589	148.1983
Fluoric gaseous compounds (fluoric)	342	0.020000	-	0.0001	0.0001	0.3205	1.0130
Highly soluble inorganic fluorides (fluorides)	343	0.030000	-	0.0017	0.0001	0.0020	0.0130
Poorly soluble inorganic fluorides (fluorides)	344	0.200000	-	0.0039	0.0002	0.0013	0.0066
Hexane	403	60.000000		0.0002	0.0002	0.0002	0.0002
Methane	410	50.000000 00		3639.3996	315.1857	3.4256	107.8675
Benzene	602	1.500000		0.0005	0.0004	0.0005	0.0004
Xylele	616	0.200000		0.0250	0.1238	0.0040	0.0328
Benzapyrene	703	0.000010		0	0	0.0000	0.0001
Difluorochloromethane (freon-22)	859	100.0000000		0.0100	0.0500	0	0
Dimethyl carbinol	1051	0.600000		0.0002	0.0002	0.0002	0.0002
Ethylic alcohol	1061	5.000000		0.0084	0.0060	0.0084	0.0060
Methylmercaptan	1715	0.000100		0.0270	0.8540	0.0018	0.0582
Ethanethiol (ethyl mercaptan)	1728	0.000030		0.0137	0.4065	0.0009	0.0290
Furfurol	2732	1.200000		0.0038	0.0100	0.0009	0.0100

Contaminating substance	Code	MPCм.р., mg/m3	Haz. Class	Present condition		After reconstruction	
				g/s	t/year	g/s	t/year
Kerosene oil	2735	0.050000		0.0262	0.8269	0.0026	0.0777
Mineral hydrocarbon oil (spindle oil, machine oil)	2744	0.030000		0	0	0.0005	0.0148
Type 'lotus' synthetic detergent	2754	0.200000		0	0	0.0151	0.0699
Solvent naphtha	2752	1.000000		0.0250	0.1238	0.1020	0.4719
Mineral spirit	2754	1.000000		0.0155	0.1838	0.0135	0.2938
Methane hydrocarbon c12-c19 (solvent)	10161	0.250000		0.0162	0.0058	0	0
Cationic polyacrylamide ak-617	10226	0.500000		0.0014	0.0001	0.0001	0.0000
Titanium dioxide	10265	0.050000		0	0	0.0001	0.0009
Emulsol	10293	0.100000		0.0704	0.0199	0.0070	0.0199
Wood dust	10431	0.400000		0.2660	0.0479	0.0260	0.0049
Abrasive metal dust							

Source: EIA Report prepared by KVK/KIP

7.2 Monitoring Form

The latest results of the below monitoring items shall be submitted to JICA on quarterly basis at Construction Phase, and on bi-annually base at Operation Phase. The items, standards to be applied, measurement points, and frequency for each monitoring parameter are established in the Monitoring Plan (see Chapter 7.7.2). Should there be any changes to the original plan, such change shall be reviewed and evaluated by environmental expert.

<Construction Phase>

1. Responses/Actions to comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from Government agencies	

2. Pollution

- Air Quality at the border of SPZ

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards Upper: one-time max Lower: 24 h	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
CO	mg/m^3			5.0 3.0	100 / 15mn 60 / 30mn 30 / 1h 10 / 8h	
SO_2	mg/m^3			0.50 0.05	0.5 / 10mn 0.125 / 24 h 0.05 / annual	
NO_2	mg/m^3			0.085 0.04	0.2 / 1h 0.05 / annual	
NH_3	mg/m^3			0.20 0.04	0.27 / 24 hour **	
H_2S	mg/m^3			0.008 -	0.15 / 24 hour	
Particulate matter	mg/m^3			0.50 0.15	PM10: 0.05 / 24 hour	

* Air Quality Guidelines for Europe, Second Edition, 2000

** critical levels for short-term exposure.

- Water quality of Dnipro River

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards*	Referred International Standards**	Remarks (Measurement Point, Frequency, Method, etc.)
Temperature	˚C			-	-	
Transparency	cm			25	-	
pH	-			6.5-8.5	6.5-8.5	
BOD_5	mg/l			≤ 4.5	≤ 2.0	
DO	mg/l			≥ 4	≥ 7.5	

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards*	Referred International Standards**	Remarks (Measurement Point, Frequency, Method, etc.)
Ammonium Nitrogen	mg/l			≤ 1	-	
Nitrite Nitrogen	mg/l			≤ 5.27	-	
Nitrate Nitrogen	mg/l			≤ 0.67	-	
Phosphate Phosphorus	mg/l			≤ 1.6	-	
E.Coliform	Unit/100 ml			≤ 1,000	≤ 1,000	

* Documents for Approval and Confirmation of MPD for Substances, and Action Plans to Achieve MPD for Substances in Treated Return Water. This is effective till 2 December 2014. When the MPD is changed in future, the country standards should also be changed.

** Class II for water supply, Ministry of Environment, Japan

- Waste

Kinds of Waste	Generated from	Unit	Amount	Solid Waste Management Activities

- Soil Pollution

Item	Monitoring result	Mitigation measure
Spillage of wastewater		
Spillage of oil		

- Noise / Vibration at the boundary of SPZ

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards***	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB			65* 80**	70	

* Maximum allowable level eq. day

** Maximum allowable level max. day

*** IFC General Health, and Safety (EHS) Guidelines, April 2007

3. Social Environment

- Existing social infrastructure and services

Monitoring item	Monitoring Results during Report Period	Measures to be Taken
No. of car accidents by transportation for materials and equipment	No. of cases	

- Hazards (Risk) infectious diseases

Monitoring item	Monitoring Results during Report Period	Measures to be Taken
HIV/AIDS and other STDs	Number of cases	

- Working Environment

Monitoring item	Monitoring Results during Report Period	Measures to be Taken
No. of training		
No. of staff who received training		

- Accident

Monitoring item	Monitoring Results during Report Period	Measures to be Taken
No. and contents of accident		

<Operation Phase>

1. Responses/Actions to comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from Government agencies	

2. Pollution

<Air Quality>

- At the border of SPZ

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards Upper: one-time max Lower: 24 h	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
CO	mg/m^3			5.0 3.0	100 / 15mn 60 / 30mn 30 / 1h 10 / 8h	
SO_2	mg/m^3			0.50 0.05	0.5 / 10mn 0.125 / 24 h 0.05 / annual	
NO_2	mg/m^3			0.085 0.04	0.2 / 1h 0.05 / annual	
NH_3	mg/m^3			0.20 0.04	0.27 / 24 hour **	
H_2S	mg/m^3			0.008 -	0.15 / 24 hour	
Particulate matter	mg/m^3			0.50 0.15	PM10: 0.05 / 24 hour	

* Air Quality Guidelines for Europe, Second Edition, 2000

** critical levels for short-term exposure.

- Flue Gas from the Incinerator

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards **	Referred International Standards* Upper: daily average Lower: half-hourly average	Remarks (Measurement Point, Frequency, Method, etc.)
NO_x	mg/m^3			333	200 400	
CO	mg/m^3			167	50 150*1 100*2	
Total dust	mg/m^3			33	10 30	
TOC	mg/m^3			-	10 20	
HCL	mg/m^3			20	10 60	
HF	mg/m^3			3	1 4	
SO_2	mg/m^3			333	50 200	
Cd+Tl	mg/m^3			0.13	0.05*3	
Hg	mg/m^3			0.13	0.05*3	
Sb+As+Pb+Cr+Co+ Cu+Mn+Ni+V	mg/m^3			18.7	0.5*3	

* Directive 2000/76/EC on the incineration of waste

*1: At least 95 % of all measurements determined as 10-minute average values

*2: all measurements determined as half-hourly average values taken in any 24 hour period.

*3: Average values over the sample period of a minimum of 30 minutes and a maximum of 8 hours

** The figure is converted from O2=6 % to O2=11 % to compare with International standards.

<Water Quality>

- Water quality of Dnipro River

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards*	Referred International Standards**	Remarks (Measurement Point, Frequency, Method, etc.)
Temperature	˚C			-	-	
Transparency	cm			25	-	
pH	-			6.5-8.5	6.5-8.5	
BOD_5	mg/l			≤ 4.5	≤ 2.0	
DO	mg/l			≥ 4	≥ 7.5	
Ammonium Nitrogen	mg/l			≤ 1	-	
Nitrite Nitrogen	mg/l			≤ 5.27	-	
Nitrate Nitrogen	mg/l			≤ 0.67	-	
Phosphate Phosphorus	mg/l			≤ 1.6	-	
E.Coliform	Unit/100 ml			$\leq 1,000$	$\leq 1,000$	

* Documents for Approval and Confirmation of MPD for Substances, and Action Plans to Achieve MPD for Substances in Treated Return Water. This is effective till 2 December 2014. When the MPD is changed in future, the country standards should also be changed.

** Class II for water supply, Ministry of Environment, Japan

- Water quality of influent

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Temperature	0C			-	-	
Transparency	Cm			-	-	
pH				-	-	
BOD_5	mg/l			-	-	
COD	mg/l			-	-	
Sulphates	mg/l			-	-	
Chlorides	mg/l			-	-	
Ammonia nitrogen	mg/l			-	-	
Nitrites	mg/l			-	-	
Nitrates	mg/l			-	-	
Phosphates	mg/l			-	-	
Petroleum products	mg/l			-	-	
Ferrum	mg/l			-	-	
Zn	mg/l			-	-	
Fe	mg/l			-	-	
Cu	mg/l			-	-	
Cr	mg/l			-	-	

- Water quality of effluent

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
SS	mg/l			15.00	35.00	
BOD_5	mg/l			15.00	25.00	
COD	mg/l			80.00	125.00	
Total nitrogen	mg/l			10.00	10.00	
Total phasphorus	mg/l			1.00	1.00	
DO	mg/l			4.00	-	

* EU Directives (91/271/EEC)

- Wastewater quality from the incinerator

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
pH				-	-	
Temperature	˚C			-	-	
Total suspended	mg/l			-	30 / 95 %	

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
solid					45 / 100%	
Hg	mg/l			-	0.03	
Cd	mg/l			-	0.05	
Tl	mg/l			-	0.05	
As	mg/l			-	0.15	
Pb	mg/l			-	0.2	
Cr	mg/l			-	0.5	
Cu	mg/l			-	0.5	
Ni	mg/l			-	0.5	
Zn	mg/l			-	1.5	

* Directive 2000/76/EC on the incineration of waste

- Waste

Kinds of Waste	Generated from	Unit	Amount	Solid Waste Management Activities
Incinerated ash				
Garbage				

- Noise / Vibration at the Border of SPZ

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards**	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB			65* 80**	70	

* Maximum allowable level eq. day

** Maximum allowable level max. day

*** IFC General Health, and Safety (EHS) Guidelines, April 2007

- Soil Pollution

Item	Monitoring result	Mitigation measure
Spillage of wastewater		
Spillage of oil		

3. Social Environment

- Working Environment

Monitoring item	Monitoring Results during Report Period	Measures to be Taken
No. of training		
No. of staff who received training		
Prehension of condition of occupational safety and health		

7.3 Environmental Checklist

Table 7.2 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c) - (d) -	(a) EIA report is prepared in official process in Ukraine. In Stage-P (project stage), the technical documents including EIA report was reviewed by State Expert Review Committee and based on the comments/opinions from the Committee, the technical documents including EIA report were modified. Scientific Council of the Ministry of Regional Development approved the documents. The final decision will be made by Cabinet of Ministers. (b) Technical documents including EIA report were reviewed by State Expert Review Committee, modified and approved by Scientific Council of the Ministry of Regional Development. The documents including EIA report are submitted to Cabinet of Ministers for final decision of approval in the Stage-P. (c) The comments from the State Expert Review Committee were already reflected to the technical documents including EIA report and submitted to Cabinet of Ministers for approval in Stage-P. After Stage-P, during working documentation stage (detail design stage), the detail design documents including EIA report will be updated and approved by Dept. of Urban Planning and Architecture. (d) During detail design stage, the approval from the utility company such as energy, telecommunication and gas should be obtained for the connection permission and no interference with existing networks. The final approval will be provided by Dept. of Urban Planning and Architecture of Kiev City by issuing Act of Works Performance. Then the construction can be started.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) -	(a) The public consultation was organized on 10 October 2013 and the project, potential impacts and mitigation measures were explained to the local stakeholder including NGOs and residents. The understanding from the Local stakeholders was obtained. In addition, the separate meeting with NGOs which are members of Public Council of Damytsia District State Administration in the City of Kiev was organized on 28 October, 2013. The Public Council unanimously supported and confirmed the necessity to start the reconstruction of BAS and assured that the Public Council will request to approve the project and assist its launch. (b) The comments received in the public consultation and during the disclosure period (one month after the announcement in the newspaper) were reviewed and answered in the minutes of meeting. There are no comments which should be reflected into the project design or EIA report.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) With/without project scenario was examined. The alternatives of sludge treatment (landfill, reuse, incinerate with solid waste, new incinerator) were examined from the view point of technical, social and environment.
2 Pollution Control	(1) Water Quality	(a) Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) Y	(a) The quality of the effluent will comply with the effluent standards of Ukraine and EU. (b) The sewage contains the heavy metals but the amount is decreasing due to the close of the industries in the City of Kiev.
	(2) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) The wastes such as screen waste, sand, construction refuse, excavated soil, incinerated ash will be properly treated and disposed of in accordance with the Law of Ukraine on Waste (187/98 dated 03.05.1998), State sanitary rules and norms DSanPiN 2.2.7. 029-99 "Hygienic requirements for industrial waste management and hazard class definitions for public health" and other decrees.
	(3) Soil Contamination	(a) If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) Y	(a) The heavy metals in sludge are decreasing due to the close of industries within the City of Kiev but still contain some heavy metals. The sludge which is thickened and dewatered will be incinerated at the incinerators. After incinerated, the ash can be reused as the material of cement at the cement factory. Before the transportation to the cement factory, the ash will be stored at the warehouse for temporary ash storage and the foundations will be made of single-piece steel concrete so that it will prevent the contamination of soil and groundwater.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	(a) DSP 173-96 stipulates the noise standards and DBN 360-92** and DSP 173-96 stipulate the vibration standards. By the protective measures mentioned below, the noise and vibrations will comply with the country's standards. The noise and vibration protective measures will be taken which include: arrangement of station units on separate foundations isolated from the enclosing structures and building footings, anti-vibration pads used between the structural components and foundation floor, isolation with resilient pads in the sleeves of air duct passages across building structures, arrangement of vibration mounts and resilient pads where air ducts and their fixtures rest on the enclosing structures, arrangement of noise protection covers for the station unit.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) The odor from the wastewater treatment process will be eliminated by chemical scrubbing. As for the sludge treatment facilities, the odor will be transferred to the furnace which is operated 850 ˚C high temperature, thus the odor substances are easily removed. After the reconstruction, the air quality including odor substances will meet the requirement of ambient air quality.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) There is no protected area in and around the project site.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a)N (b)N (c)- (d)-	(a) Not included in the Project site (b) Not included in the Project site (c) No significant ecological impact is expected as there is no endangered species within project site. (d) It seems that impact is not expected on valuable species based on the available information as the habitats of identified two species (Aldrovanda vesiculosa and Pseudanodonta complanata) are in the tributaries of Dnipro River, not main stream of Dnipro River where the effluent will be discharged. However to ensure the impacts, further study in detail design stage shall be required.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement?	(a)N (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-	(a) All construction activities will be implemented within the existing sites and no land acquisition is necessary. Thus involuntary resettlement is not occurred. (b)-(j) -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a) Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? (b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a)N (b)N	(a) The land acquisition is not required so that land use is not changed. The river water downstream of effluent discharge point is used for cultural and living purpose. The water intake is not planned in the project and the effluent will comply with the effluent standards so that there will be no impact on water use. (b) The project will not adversely affect the living conditions of inhabitants. The project will reduce the risk of environmental and health hazard caused by over capacity of sludge field. The present odor problems will be mitigated as mentioned above.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) The construction site is within the existing WWTP sites so that it will not include the archeological, historical, cultural and religious heritage.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) The construction is implemented within the existing WWTP site so that no adversely impact on the local landscape is expected.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?	(a) - (b) -	(a) There are no ethnic minorities and indigenous peoples within the Project site and no impact is expected. (b) -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)Y (b)Y (c)Y (d)Y	(a) Law on Labor Protection and the regulations developed and approved by the state committee will be observed in the Project. (b) The safety considerations should be prepared by the contractor, KVK and BAS which should meet the requirement of Law on Labor Protection and international guidelines such as Environmental, Health and Safety Guidelines by IFC to secure the safety of working conditions during the construction phase and operation phase. (c) The safety training such as wearing working clothes and work shoes, use of temporally toilet, traffic safety and public health should be provided by the contractor. The training on occupational health and safety stipulated by Ukrainian law and international guidelines such as IFC should be implemented during the operation phase. BAS has regularly conducted the audits of safety and working conditions, and it will be continued after the reconstruction. (d) The education such as behavior to the citizen, the action to the complaint etc. should be provided to the security guard by the contractor.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) N (c) N (d) N	(a) The noise nuisance is temporary and the bandwidth of the acoustic discomfort zone changes within the range of 15 to 200 m so that the residents around the site may not suffer from the noise. The temporary acoustic shields should be installed when necessary (in case of public complaints). For the workers, the worn-out and obsolete equipment which create highest noise level shall not be used and the personal protective equipment against noise should be used. The sanitary regulations as to vibration displacement for the public are met immediately on the boundary of the site during the construction. For the worker, the following protective means are used during the construction: vibration-isolating, vibration-absorbing and vibration-absorptive enclosures and personal protective equipment against vibration such as anti-vibration work gloves and pads. To prevent the dust accumulation in the air, the watering procedures will be provided for the sand and crushed stone before the loading-unloading operations within the construction site. For pollutant emission, the pollutant is less than the level which diffusion can be estimated, and the temporary construction site is not expected to cause the exceedance of the values of MAC. The waste by dismantling of the existing facilities will be generated. The waste will be removed to the city dumps in concurrence with the Kiev City State Administrations. (b) Two species are identified in the tributaries of Dnipro River. The construction site is far from the Dnipro River (more than 5 km) and by mitigation measures, the water pollution may not occur, so that

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				the impact on valuable species in Dnipro River is not expected. (c) As described in (a), the noise and vibration may not reach to the residential area as the nearest residential area is located at the distance of 600 m. (d) The materials and equipment will be transported to the WWTP. The WWTP is located at the end of the road, Kolektorna Street which connects the WWTP to the main road (Mykoly Bazhana Avenue and Boryspil's'ke Highway). The main road has enough lanes to cater the increased transportation so that the traffic congestion may not occur.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) - (c) - (d) Y	(a) The monitoring plan is prepared in the EIA report and the proponent will monitor the impacts based on the monitoring plan and report the results by monitoring form. (b) The WWTP is operated at present so that the monitoring system has already established and air quality and water quality of river, channel, inlet and effluent have been monitored. The monitoring for the new facilities such as incinerator is proposed in the EIA report. Other environmental and social parameters (noise, vibration, waste, working environment etc.) will be monitored based on the Monitoring Form. (c) The monitoring system has already established. The equipment for monitoring will be installed during the reconstruction of the facilities. (d) The WWTP prepares the statistical yearbook annually and submit it to KVK headquarters.
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)-	(a) -

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.
Source: JICA Study Team

7.4 Minutes of Meeting of Public Consultation

MINUTES
OF PUBLIC HEARING
regarding the project
"Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station"

Kyiv
October 10, 2013

Public discussion was organized by
Public Joint Stock Company "Kyivvodokanal"

The public hearing started at 11:00 in the assembly hall of Darnytsia district state administration in the city of Kyiv, located at 11 Koshytsia street.

189 people registered to participate in the public hearing.

Representatives of local government bodies are present at the public hearing:

1. First deputy head of Kyiv City State Administration - A.K.Holubchenko
2. Head of Darnytsia district state administration in the city of Kyiv - S.I.Vitkovskyi
3. Head of housing and communal infrastructure department of the executive body of Kyiv City Council (Kyiv City State Administration) - D.Y.Novytskyi

Presidium of the public hearing has been formed with the following membership:

1. A.K.Holubchenko - first deputy head of Kyiv City State Administration;
2. S.I.Vitkovskyi - head of Darnytsia district state administration in the city of Kyiv;
3. D.Y.Novytskyi - head of housing and communal infrastructure department of the executive body of Kyiv City Council (Kyiv City State Administration);
4. V.H.Chenchevyi - chairman of the board of PJSC "Kyivvodokanal";
5. A.O.Bilyk - deputy director general of PJSC "Kyivvodokanal" on technical issues and prospective development;
6. V.D.Strukova - deputy chairman of the board of PJSC "Kyivvodokanal" on legal issues and investments;
7. V.O.Yakovleva - adviser to chairman of the board of PJSC "Kyivvodokanal" on information policy;

8. M.S.Marchenko - director of “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”.

Introduction

Deputy chairman of the board of PJSC “Kyivvodokanal” on legal issues and investments V.D. Strukova informed the audience about the following.

The public hearing on the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” is held by PJSC “Kyivvodokanal” in accordance with “Arrangements for involvement of the public into discussion of issues regarding decision making which may have impact on the state of environment” approved by the Cabinet of Ministers of Ukraine on June 29, 2011 № 771. The public hearing adheres to norms of “Regulation on participation of the public in decision making in regard to environmental protection” approved by the order of Ministry of Environmental Protection of Ukraine on December 18, 2003 № 168. It aims at exercising the right of the public to take part in decision making in regard to environmental protection.

Besides, this public hearing is a part of discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” and a popular way to discover public opinion for decision making on issues which have or may have a negative impact on the state of environment. Besides, holding of such hearings is mandatory in case of decision making in regard to highly hazardous objects and activities.

Funding sources for the reconstruction shall not be subject to discussion at this public event. Funding issues will be resolved by the Government of Ukraine after the legislative procedure of coordinating the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” is completed.

In accordance with article 2.10 of the order of Ministry of Environmental Protection of Ukraine on December 18, 2003 № 168, materials of the public hearing are recorded using audiovisual methods.

It was proposed to open the event and, considering requirements of article 14 of the Arrangements, approved by the decree of the Government on June 29, 2011 № 771, to appoint:

V.H.Chenchevyi, chairman of the board of PJSC “Kyivvodokanal”, as head of the pubic hearing.

V.D.Strukova, deputy chairman of the board of PJSC “Kyivvodokanal” on legal issues and investments, as secretary of the public hearing.

Agenda and time-limit of the public hearing

Secretary of the public hearing V.D.Strukova announced the agenda and time-limit for the public hearing:

1. Speech by the first deputy head of Kyiv City State Administration A.K.Holubchenko .

2. Speech by the chairman of the board of PJSC “Kyivvodokanal” V.H.Chechnevyi.

3. Speech by the deputy director general of PJSC “Kyivvodokanal” on technical issues and prospective development A.O.Bilyk.

4. Speech by the director of “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”,

M.S.Marchenko “Special aspects of engineering solutions during reconstruction of BAS”.

5. Speech by the head of LLC “Ecoton” L.Hrunia informing about ecological aspects of implementing the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station”.

6. Presentation of the project “Technologies planned to be introduced at Bortnychi Aeration Station and examples of their application at similar objects in Europe and throughout world” by technical director of the French company “Sources” Eilene Brusso.

7. Presentation of the project “Production lines which are planned to be introduced at BAS and practice of their operation in Japan” by a member of environmental assessment working group of Japan International Cooperation Agency (JICA) Shoko Yamada.

8. Replies to suggestions and remarks of the public, received before the start of the hearing or submitted during the hearing.

9. End of the public hearing at 13:00.

The secretary of the public hearing informed, that according to article 1 of the arrangements approved by the decree of the Cabinet of Minsters of Ukraine on June 29, 2011 № 771 suggestions (remarks) are submitted in written or oral form. They are sent by e-mail, including surname, first name, paternal name and address of the person who is submitting them, within the term, specified by the procedure of public discussion, which is no less than 30 days since the date when information about the discussion was published, that is November 7, 2013.

It was explained that during registration of suggestions (remarks) last name, first name, paternal name and address of the person who is submitting them must be stated. Those present can obtain necessary forms on request and fill them out. People, who will e-mail their suggestions (remarks) to PJSC “Kyivvodokanal”, will get e-mail messages confirming their reception.

Discussion of agenda issues

1. Speech by the first deputy head of Kyiv City State Administration A.K.Holubchenko with a report titled “Significance of Bortnychi aeration station for the capital of Ukraine”.

The speaker emphasized how important the waste water facilities of Bortnychi aeration station (further referred to as BAS) are for the multi-million city and the fact that BAS reconstruction will be carried out using advanced modern technologies only. He informed that the local government has long studied cutting edge experience of construction and modernization of similar waste water treatment stations not only in Europe but in the whole world. Inhabitants of the capital of Ukraine can confidently be informed that technical solutions planned to be introduced in BAS are the most rational and ecologically safe for the city of Kyiv.

2. Speech by the chairman of the board of PJSC “Kyivvodokanal” V.H.Chenchevyi and presentation of video material to the topic “Technical state and technologies used at BAS”.

Technical state and technologies of waste water treatment have been used at BAS since 1965. Among the problems of BAS, four major ones have been identified - high level of equipment

deterioration reaching 80%; emission of bad-smelling compounds into the atmosphere; significant energy consumption and absence of sludge utilization technology, resulting in overload of sludge fields.

The planned project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” will make it possible to solve all aforementioned issues, so the start of works cannot be delayed any longer. Currently, standard indicators are managed to be achieved solely due to high professional level and rich experience of the PJSC “Kyivvodokanal” employees.

Only temporary local anti-accident measures are now being taken at BAS with the aid of the local city government, because significant improvement in the quality of waste water treatment is impossible without a full-scale reconstruction.

For instance, a first stage pumping station of BAS went completely out of order after an accident at Livoberezhnyi sewage collector D=3000 mm in January, 2012.

Besides, at the third phase of BAS some of the aeration tanks have been re-equipped to introduce technologies of denitrification and dephosphorization.

In addition, dams are being strengthened at sludge fields № 2 in order to prevent sludge fields from overflow.

But these are only temporary measures, which will help the station to hold together in case the reconstruction starts in the nearest future.

Reconstruction of BAS guarantees to Kyiv citizens a high-quality and effective system of waste water treatment adherent to European and national standards; a safe ecosystem; a healthy life without unpleasant smells and troubles with water supply and drainage.

3. Speech by the deputy director general of PJSC “Kyivvodokanal” on technical issues and prospective development A.O.Bilyk on risks associated with further functioning of BAS without conducting reconstruction.

The station is currently in pre-emergency state. Accidents can occur at any moment at any stage of the process chain which can cause an ecological and industrial disaster. In such case pollution of the Dnipro river will be inevitable and will also lead to pollution of the Black Sea. So, consequences of an accident can be of menacing proportions.

Depending on the part of BAS where an accident may occur, it may lead to a partial as well as full halt of BAS functioning, which, in its turn, will cause:

- dumping of untreated waste water into the Dnipro river for the period of emergency elimination;
- shutdown and/or flooding of sewage pumping stations of Kyiv city;
- impossibility of waste water intake.

Bad smells are the most sensitive, painful and problematic issue for inhabitants of Kyiv areas adjacent to the station.

The main sources of bad smells are:

- rake departments;
- primary settlers;
- tank of fermented sludge section.

Halt of BAS functioning will have disastrous consequences not only for Kyiv, but also for a significant part of Ukraine. If untreated waste water is dumped into the Dnipro river, even with virtual waste water volumes of 800-850 thousands m^3 per day and with the existing concentration of polluting substances, the following amounts will get into the river daily (proportion of pollution in the volume of waste water noted above):

- up to 450 tonnes of suspended solids pollution
- up to 250 tonnes of BOD5 organic pollution
- up to 30 tonnes of ammonia nitrogen
- up to 3 tonnes of general iron

Risks associated with dumping untreated waste water into the Dnipro river can be the following:

- nitrogen and phosphor compounds, poisonous for various fauna of rivers, seas and oceans, cause intensive eutrophication of water reservoirs;
- autotrophic microorganisms, while oxidizing ammonia nitrogen, decrease concentration of dissolved oxygen in the water;
- mass death of all living organisms which constitute biocenosis of the Dnipro river;
- it will be impossible to use the water for drinking - existing water treatment facilities of cities and towns cannot eliminate such level of pollution;
- high probability of mass epidemics of various diseases, which can be caused by pathogenic microorganisms getting into the river along with untreated waste water.

The Dnipro river is the main source of water supply in Ukraine. Water from the Dnipro river is used by:

- about 70% of Ukrainian population, that is to say almost 30 million people;
- 50 big cities and industrial centers of the country. Particularly, the Dnipro river is used by Kyiv, Cherkassy, Kirovohrad, Dnipropetrovsk and Zaporizhya cities as a source of drinking water supply.

Expected prospects of BAS reconstruction were outlined, namely: improvement of the state of environment in the region; attention to ecology of the main source of drinking water supply in Ukraine - the Dnipro river; high-quality and reliable treatment of waste water; stable functioning of the city's water drainage system; absence of bad smells.

4. Speech by the director of "Kyivinzhproekt" Institute, a branch of PJSC "Kyivproekt", M.S.Marchenko and presentation of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" with implementation of modern technologies and leading international experience.

The "Project" stage of the object "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" was devised by "Kyivinzhproekt" Institute together with a French company "Sources", which devises similar projects not only in France, but also in Europe and other parts of the world. 6 more subcontracting project organisations in Ukraine were involved in devising the project.

Currently the project development and the transfer of design and estimate documentation to the

state body of ecological inspection are being finished. In spite of several additional production lines and a deeper processing of waste water and sludge, Bortnychi aeration station will become more compact. Thus, for instance, the territory of the main production of BAS will be reduced from the existing 151 ha to 120 ha, making it possible to increase the distance from BAS to the inhabited area by about 1 km.

According to the project task, 2 phases of construction have been planned, 5 start-up complexes in each phase.

The first start-up complex provides for re-equipment of the 2nd and the 3rd blocks with the aim to increase reliability of BAS performance, improve waste water treatment quality, increase capacity of the blocks, shut down the fully depreciated first block and resolve the issue of air deodorizing.

The second start-up complex provides for construction of thickening tanks and a section for mechanical sludge dehydration, which will decrease the volume of sludge by more than 10 times.

The third start-up complex provides for arranging technical facilities to produce biogas and constructing a section for thermal sludge utilization, making it possible to refuse completely from pumping sludge to sludge fields.

The forth start-up complex provides for construction of a new first block, which will increase reliability and quality of BAS performance substantially and enable construction of a new second block in place of the existing one.

The fifth start-up complex provides for clearance and bank stabilization of the main channel of treated waste water, about 9 km long, and reconstruction of dispersal outlets into the Dnipro river along with planting 3000 trees.

The sixth and the seventh start-up complexes include reconstruction of SPS “Pozniaky” and SPS “Pravoberezhna” respectively. A full reconstruction of technical, electrical, sanitary, architectural parts as well as reconstruction of installed gravity-driven sewers with possible optionality of waste water distribution is planned. It will considerably increase reliability of pumping stations performance and decrease their energy consumption by 30-40%. At the same time, a system of air deodorizing will be arranged.

The eighth start-up complex provides for construction of a new second block in place of the existing one.

The ninth start-up complex provides for full modernisation and reconstruction of the existing third block.

The tenth start-up complex provides for construction of service objects: a motor pool, sections for mechanical and pumping equipment repairs, a section for electrical equipment repairs.

On completion of the construction, BAS will become a modern enterprise at the level of international standards in terms of depth of waste water treatment, reliability, environmental safety, energy efficiency, architecture and design solutions.

Judging from the degree of processing of the object as well as the intensiveness and concrete nature of negotiations on raising loans, the issue of the object’s reconstruction has never been so close to the actual solution of the problem troubling Kyivites as well as local and state government.

The reconstruction project is immensely important not only for inhabitants of Kyiv, but also for a significant part of Ukraine.

5.

Speech by the head of LLC “Ecoton” L.Hronia.

Information about ecological aspects of implementing the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” and prospects of improvement of ecological situation in the region after BAS reconstruction, presented by the director of “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”. Presentation of video materials with relevant information.

6. Speech with an interpreter by the technical director of the French company “Sources” Eilene Brusso to the topic “Technologies and examples of their implementation at similar objects in Europe and the world, planned to be introduced at Bortnychi Aeration Station” and presentation of reconstruction projects at similar objects in Europe and the world, implemented with participation of the French company “Sources”.

7. Speech with an interpreter by a member of environment assessment working group of Japan International Cooperation Agency (JISA) Shoko Yamada to the topic “Production lines, which are planned to be introduced at Bortnychi Aeration Station, and practice of their operation in Japan”. Information about experience of Japanese companies in implementing the technologies, planned to be introduced at BAS, in Europe and Japan, particularly at the stage of thermal sludge utilization plant construction. Presentation of relevant video materials.

8. Responses to suggestions and remarks of the public.

Discussion of questions concerning special aspects of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” which were sent to the e-mail address of PJSC “Kyivvodokanal” earlier.

- most of the questions concerned alternative methods of waste water sludge utilization at Bortnychi aeration station.

An answer to this question was given by the chairman of the board of PJSC “Kyivvodokanal”.

Sewage sludge utilization by burning is the most time-tested technological solution, which is ecologically safe and highly reliable. Sludge burning (after prior dehydration) is currently the best possible way to utilize it. For big megalopolises there is practically no alternative.

The technology of waste water sludge burning is used in many countries of Europe and the world as the major utilization technology. Sludge burning plants have been built in Germany, France and Holland. Major Russian cities - St.Petersburg and Moscow - have partially assumed or are assuming this technology.

Introducing a process scheme of mechanical dehydration and burning of waste water sludge at BAS will offer a chance to solve the problem of utilizing sludge (both appearing daily and already accumulated in sludge fields) entirely, and get a fully completed production cycle.

Before starting the discussion of suggestions and remarks from representatives of the public attending the event, V.D.Strukova explained that the first and last name, as well as name of a legal

person in case the question is asked by its representative, must be stated before asking a question or expressing ideas, suggestions or recommendations.

- citizen H.Sentsov - concerning decision of the executive body of Kyiv City Council (Kyiv City State Administration) to allocate funds for rehabilitation of children who live in Kyiv districts adjacent to BAS territory.

An irrefragable answer to the question was given by the first deputy head of Kyiv City State Administration A.K.Holubchenko.

- citizen M.V.Radchenko, inhabitant of Pozniaky residential district, asked why it isn't possible to build treatment facilities in a different place - for instance on the right bank of the Dnipro river.

Novytskyi D.Yu., the head of housing and communal infrastructure of the executive body of Kyiv City Council (Kyiv City State Administration), replied as follows. Construction of new treatment facilities is extremely difficult due to restricted urban conditions of residential districts on the right bank of the Dnipro river. However, even if such prospect could be considered, it would not cancel the necessity to reconstruct BAS, because treatment facilities on the right bank would only function as a reserve.

- a representative of "Henoteks" company (did not introduce himself personally) with a proposal about constructing in Kyiv a plant for thermal utilization of sludge left after treatment at BAS, and a question about alternatives to this method.

M.S.Marchenko, the director of "Kyivinzhproekt" Institute, a branch of PJSC "Kyivproekt", pointed out in reply to the presented proposal, that under present circumstances there is practically no alternative to the technology of burning waste water sludge for such big volumes (about 12000 m^3 of sludge are accumulated at the station daily).

Certainly, another course could be taken - it is possible to continue using the existing technology of sludge dehydration in sludge beds (fields) but the following should be remembered:

1. Such method of waste water sludge utilization has hardly been used in any countries of Europe or the world for many years now because of its economic inexpediency and ecological danger.

2. It is only possible to use existing sludge fields (after their full reconstruction and expansion of dams) for 1,5-2 years. After that, a need for construction of new sludge fields will certainly arise. According to PJSC "Kyivproekt', the required territory of sludge fields amounts to 127 ha.

- citizen Samokish, representative of Kyiv National University, concerning possible additional project solutions for BAS reconstruction.

In response, the director of "Kyivinzhproekt" Institute, a branch of PJSC "Kyivproekt" M.S.Marchenko suggested that the applicant should submit written proposals to the institute address for their detailed examination.

- citizen I.M.Saliy expressed his support of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi

aeration station".

9. End of the public hearing.

Secretary of the public hearing V.D.Strukova explained, that according to legislation requirements the public discussion of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" is not over and will continue till November 7, 2013. Suggestions (remarks) should be submitted in writing or sent by e-mail, including surname, first and paternal name and address of the person submitting them. The mailing address of PJSC "AK "Kyivvodokanal" is 01015, Kyiv, 1A Leiptsyzka street. The e-mail address is press@vodokanal.kiev.ua. Besides, representatives of the public have an opportunity to leave their suggestions in letter boxes before the final date of discussion. The letter boxes are located at the following addresses: 1A Leiptsyzka street - the main office of PJSC "Kyivvodokanal", and 11 Koshytsia street - office of Darnytsia district state administration in the city of Kyiv.

All received suggestions will be processed without fail within the term defined by legislation, according to appropriate procedure, and will be transferred to the executive body of Kyiv City Council (Kyiv city state council) for consideration before making the final decision.

According to the defined time-limit of this hearing, its agenda is completed, so the public hearing on the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" is over.

Head of the public hearing _____V.H.Chenchevyi

Secretary of the public hearing _____V.D.Strukova

Public Joint Stock Company
"KYIVVODOKANAL"

Materials
on public discussion of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station"

Kyiv-2013

Contents

1. General information

These materials on the public discussion of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" (further referred to as materials) constitute a description of procedures and results of the public discussion of Bortnychi aeration station reconstruction. These materials include information on liaison measures, taken in the course of October by PJSC "Kyivvodokanal" (further referred to as Company), which organized the public discussion of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station".

Start of the discussion process was prompted by:

- decree by the executive body of Kyiv city council (Kyiv city state administration), which defined PJSC "Kyivvodokanal" as the ordering customer of design and reconstruction of Bortnychi aeration

station located at 1A Kolektorna street in Darnytsia district of Kyiv city.

- decree by the Cabinet of Ministers of Ukraine of May 17, 2012 № 279-r "On allocating funds for conducting in 2012 urgent measures for environmental protection by developing design and estimate documents for sewage objects" (with alterations, made according to the decree by the Cabinet of Ministers № 1017-r of December 14, 2012);

- resolution of the Cabinet of Ministers of Ukraine of October 3, 2012 № 933 "Certain issues of developing design and estimate documents for Bortnychi aeration station located at 1A Kolektorna street in Darnytsia district of Kyiv city.

To carry out the aforementioned decree of the executive body of Kyiv city council (Kyiv city state administration) and acts of the Cabinet of Ministers of Ukraine, the Company was obliged in due order to take measures to correct design and estimate documents and comple design works, to facilitate launching of construction and assembly work, to supply Bortnychi aeration station with necessary equipment (further referred to as BAS), and to commission BAS in accordance with the scheduled date.

Holding the public discussion of materials which justify the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" was prompted by requirements and provisions of the acting legislation.

The right to free access to information about ecological state of the environment, the right of the public to participate in discussing projects, location, construction and reconstruction of objects, which may have a negative impact on the state of the natural environment, are defined by the Constitution of Ukraine, provisions of a number of international treaties ratified by Ukraine, laws of Ukraine and other statutory instruments, such as:

- Law of Ukraine "On protection of natural environment"
- Law of Ukraine "On ecological expertise"
- Law of Ukraine "On information"
- Law of Ukraine "On access to public information"
- "Arrangements for involvement of the public into discussion of issues regarding decision making which may have impact on the state of environment" approved by the Cabinet of Ministers of Ukraine on June 29, 2011 № 771
- "Regulation on participation of the public in decision making in regard to environmental protection" approved by the order of Ministry of Environmental Protection of Ukraine on December 18, 2003 № 168
- 'SCN A.2.2-1-2003. State Construction Norms of Ukraine. Designing. Contents of materials on assessment of impact on environment during design and construction of enterprises, houses and buildings" approved by the order of the State Committee for Construction of Ukraine of December 15, 2003 № 214, put into force since April 4, 2004.

2. Materials confirming placement of the information about public discussion of the project in mass media

With the purpose of informing the public, NGOs and mass media about the public discussion process being launched into an active phase on September 27, 2013, an announcement was placed at the

official PJSC “Kyivvodokanal” website http://www.vodokanal.kiev.ua. On October 7, 2013 a specially prepared press release about the procedure and the process of public discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” was placed there. On September 30 and October 7 respectively, similar announcements for the public were placed at the official Kyiv city state administration website http://kievcity.gov.ua and at the official web page of Darnytsia district state administration in the city of Kyiv.

According to requirements of the “Arrangements for involvement of the public into discussion of issues regarding decision making which may have impact on the state of environment” approved by the Cabinet of Ministers of Ukraine on June 29, 2011 № 771, information about holding of a public hearing on issues of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” was placed in the newspaper of Kyiv city council “Khreshchatyk” of October 4, 2013 № 144 (4351) and at the website of the Company. Before the public discussion started, a separate section (banner) “Public discussions” was created, where information on the public discussion of BAS reconstruction project was placed.

3. Information on sending out announcements to representatives of mass media and the public

Announcements about the public discussion and the public hearing concerning the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” were sent out by press service of PJSC "Kyivvodokanal" to e-mails of leading national and municipal information agencies, namely: “UNN”, “UNIAN”, “Interfax”, “Liga”, “RBK”, “Ukrinform”, “Ukraina Komunalna”(Communal Ukraine), “Regionews”, “Nash produkt”(Our produkt); radio stations “Holos Kyieva”(Voice of Kyiv) and “Kyiv FM”; print media “Segodnia”(Today), “Komsomolskaia Pravda v Ukraine”(Komsomol Truth in Ukraine), “Korrespondent”, “Khreshchatyk”.

Besides, invitations to the public hearing were additionally faxed to a number of leading TV-channels, namely: “Channel 5”, “News 24”, “24ua”, “First business channel”, “First National Channel”, “TRK “Ukraine”, “TRK “Kyiv”, “1+1”, “Inter”, “STB”, “Novyi Kanal”(New Channel), “KDRTRK”, “TRK “Era”, “ICTV”, “ICTV “Nadzvychaini Novyny”(Extraordinary News).

4. Stages of public discussion of the project

Activities associated with the public discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” included the following stages.

4.1. Preparation measures

Preparation measures of the Company provided for devising a preliminary plan of measures to arrange the public discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station”; creating and preparing original information materials for the public discussion by structural departments of the Company; preparing to organize and technically facilitate the public hearing.

4.2. Launching and holding the public discussion

With assistance of Kyiv city state administration the public hearing on the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” was held in the assembly hall of Darnytsia district state administration in the city of Kyiv at 11 Koshytsia street, Kyiv.

To establish a contact with interested citizens and NGOs representatives, while the public discussion was in its active phase, since the day when the announcement about holding the public hearing was published in “Khreshatyk” newspaper and to the final day of the public discussion, transparent letterboxes were installed at the main PJSC "Kyivvodokanal" office at 1A Leiptsyzka street and at Darnytsia district state administration in the city of Kyiv at 11 Koshysia street for collecting questions, remarks and suggestions of the public.

To receive e-mail requests from the public representatives, a single address of the PJSC "Kyivvodokanal" press service was defined: press@vodokanal.kiev.ua.

The public hearing on issues of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” was held on October 10, 2013 in the assembly hall of Darnytsia district state administration in the city of Kyiv at 11 Koshytsia street.

Before the public hearing started, the Company organized registration of participants. 189 people registered to participate in the public hearing on issues of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station”.

Before the public event started, participants of the public hearing were shown an awareness-raising film specially prepared by the PJSC "Kyivvodokanal" and devoted to topical issues of sewage system and treatment facilities in Ukraine.

The agenda of the public hearing included:

- Speech by the first deputy head of Kyiv City State Administration;
- Speech by the chairman of the board of PJSC “Kyivvodokanal”;
- Speech by the director of “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”;
- Speech by the head of LLC “Ekoton”;
- Presentation of the project “Technologies planned to be introduced at Bortnychi Aeration Station and examples of their application at similar objects in Europe and throughout world” by technical director of the French company “Sources”;
- Presentation of the project “Production lines which are planned to be introduced at BAS and practice of their operation in Japan” by a member of environmental assessment working group of Japan International Cooperation Agency (JICA);
- Suggestions and remarks by representatives of the public;
- Replies to suggestions and remarks of participants of the public hearing;
- Summarizing the public hearing.

With the aim of collecting and processing questions, remarks and suggestions of the public audio and video recordings of the public hearing were made.

On completion of the public hearing press service of the Company held a briefing for mass media

representatives. On October 10, 2013 the following pieces were broadcasted on TV channels to the topic of the conducted public hearing.

- “A billion Euros requested to save Kyiv from sewage” - TRK “Ukraine”
- “BAS reconstruction may start as soon as next year” - “Kyiv” Channel
- “Kyiv government presented a plan to reconstruct treatment facilities in Bortnychi” - “Channel 5”
- “BAS reconstruction to start in 2014” - “BTB” Channel

On the next day after the public hearing on the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” the PJSC "Kyivvodokanal" the press service conducted appropriate monitoring of mass media as to coverage of issues, discussed at the public hearing. According to results of the conducted monitoring, TV channels listed below broadcasted the following pieces.

Channel 5

“Kyiv government presented a plan to reconstruct treatment facilities in Bortnychi”

“A major accident can occur at Bortnychi aeration station at any moment, “Kyivvodokanal” employees caution. Most of the treatment facilities here are 90% worn down. Reconstruction of the station is scheduled for the nearest years. Is is promised that the renewed station will be safer and more economical, while the drinking water will be of higher quality. Today a public hearing concerning this project was held.

These treatment facilities are at least thirty years old.

Volodymyr Brazhnyk, director of Bortnychi aeration station: “The facilities, the metal and concrete constructions are breaking down. Of course, these blocks are critically worn. Both the equipment and the facilities themselves are 90-92% worn down. These facilities have to be replaced urgently”.

They say an ecological disaster will be imminent after several more years. Minor accidents are happening here daily. In case of a major one dirty sewage will get into the Dnipro river. Then Kyiv region along with four more regions may be left without drinking water.

Andriy Bilyk, deputy director general of PJSC “Kyivvodokanal” on technical issues: “Two to three emergencies at different links of the production chain of sewage water treatment. Employees of the station contain these accidents every day round the clock”. Vodokanal says that requirements to drinking water have increased. So, the water doesn’t meet some of the European standards.

Volodymyr Brazhnyk, director of Bortnychi aeration station: “The station was designed to treat sewage water meeting three indicators only. Now they control us using sixteen indicators. So, the station hasn’t been reconstructed, but control has increased.”

Probably the biggest problem are sludge fields in suburbs of the capital. This is where sludge which remains after water treatment is dumped. First the sludge was supposed to be dried and used as mineral fertilizer, but in the 80ies heavy metals were found in it. Since then it has been accumulated in special fields. They are now full to the brim. They will not be able to function much longer.

Valeriy Chenchevyi, chairman of the board of PJSC “Kyivvodokanal: “According to our calculations, 1,5 - 2 years. Territory of the sludge fields is 272 ha. There are about 10 millions m^3 of

sludge there, with the initial capacity of 3 millions. They are overloaded and the technology is not working anymore."

The station reconstruction project is now ready. Ukrainian, French and Japanese experts have been working on it. Of the three station blocks, two will be reconstructed and one will be constructed anew. All of it - for loan money.

Anatoliy Holubchenko, deputy head of Kyiv city state administration: "It is the loan from Japanese government that we are working on today and plan to involve at Bortnychi aeration station".

The new station should be safer, more compact and more sustainable. Water will be polished and decontaminated by ultraviolet. Besides, the bad smell which about 300 thousands of local citizens are suffering from is promised to be eliminated. As for the sludge, it is going to be dried and burnt".

Yenhenia Podobna, Viktor Snizhko, Channel 5.

http://5.ua/64926

http://www.youtube.com/watch?v=-f2BtMcw77s

TRK "Kyiv"

"BAS reconstruction may start as soon as next year"

Now its facilities are 80% worn down and are working at the edge of their capacities. The new project is ready, and its public discussion has been launched. To implement it, foreign loans will be involved.

Yuliia Podshyvalova, journalist

- This is the first and the oldest block of the station facilities. It is of respectable age - almost half a century - and it is affected by several technological diseases.

Volodymyr Brazhnyk, director of Bortnychi aeration station:

- This concrete has lost its strength, and metal constructions, as they are made of black metal, have lost their strength. Technologically, they are not equal to the tasks being set to them.

Two other blocks of the station are in better condition, as they were built later. However, they, too, can't work to their full project capacity. Two or three emergency situations occur here almost daily. Fortunately, people are not affected by them. But experts emphasize that delaying reconstruction is dangerous: even now sludge volumes are three time bigger than the project ones.

Andriy Bilyk, deputy director general of PJSC "Kyivvodokanal" on technical issues:

- It is actually dangerous due to long exploitation of the dams themselves. Their is a constant threat of a dam breach and local as well as full destruction of dams.

The stage by stage reconstruction project was developed considering achievements of other countries.

Japanese and French experts presented to the public experience of implementing such technologies. Experts from the capital believe them to be the best option. Sewage will first be treated at three pumping stations, and only then it will get to BAS.

Mykola Marchenko, director of "Kyivinzhproekt" Institute, a branch of PJSC "Kyivproekt":

- After primary settlers it goes on to secondary settlers, where waste water is polished and decontaminated by ultraviolet light. Sludge will be burnt instead of being accumulated. Besides, the new project will eliminate the bad smell which troubles people. The whole production cycle will be closed.

And the enterprise will become more sustainable - only last year more than 140 million kilowatt of energy were consumed.

Valeriy Chenchevyi, chairman of the board of PJSC "Kyivvodokanal":

- It's important to reduce the energy consumption aspect of this process by virtue of technologies and new equipment.

Ecologists have already given a positive assessment of the project. The public is invited to join the discussion. You can leave your suggestions and remarks at the main "Kyivvodokanal" office or at Darnytsia district state administration in the city of Kyiv. You can also send a letter or an e-mail.

Postal address: PJSC "Kyivvodokanal", 1A Leiptsyzka street, Kyiv, 01015

E-mail address: press@vodokanal.kiev.ua

Postal address of Darnytsia district state administraton in the city of Kyiv: 11 Koshytsia street

In the meantime, negotiations with the government of Japan are in progress in regard to raising loans guaranteed by the state. If all these processes are completed successfully, the reconstruction will start as early as next year.

Anatoliy Holubchenko, first deputy head of Kyiv city state administration:

- As for the first complex, we need to manage it in three years. And the first complex will solve the main problems - sewage technical parameters, air pollution, dehydration and issues of sludge fields.

A full modernisation of Bortnychi aeration station can be completed in five years.

Yuliia Podshyvalova, Andriy Hehelia, "Kyiv" TV channel.

http://www.kievtv.com.ua/stn/item/1964-rekonstruktsiiu-bsa-mozhut-rozpochaty-vzhe-nastupnoho-roku

UNN

"Bortnychi aeration station is 80% worn down" - "Kyivvodokanal"

KYIV. October 10. UNN. "Project capacity of Bortnychi aeration station is 1,8 mln m^3 per day. Now it can process no more than 1,1 mln. It was reported today at a public hearing on reconstruction project of Bortnychi aeration station by chairman of the board of PJSC "Kyivvodokanal" Valeriy Chenchevyi," says UNN reporter.

"Overall wear and tear of the station is 80%," V. Chenchevyi informed.

"We are currently adhering to all existing norms, but it is on the edge of our capacities," he pointed out.

According to his data, the first block of the station is 90,7% worn down. It processes only 200 thousand m^3 out of 600 thousand m^3 envisaged by the initial project. Wear and tear of the second block is 88%. Its maximum capacity is 350 thousand m^3, while now only 250 thousand are processed. The newest third block is 59,4% worn down.

"Currently we are processing from 700 thousand to 1 million m^3 through the station daily. The maximum volume the station can manage is 1,1 mln. m^3," V.Chenchevyi said, adding that the project capacity of the station is 1,8 mln.

http://www.unn.com.ua/ru/news/1259303-znoshenist-bortnitskoyi-stantsiyi-aeratsiyi-stanovit-80-kiyivvodokanal

TRK "Ukraine"

"A billion Euros requested to save Kyiv from sewage"

How to save Kyiv from its own sewage was decided today at a public hearing. A reconstruction project of Bortnychi aeration station was presented to the public. The station facilities are 80% worn down. Another accident could leave the multimillion capital and almost two dozens of neighbouring towns without a sewage system. Using a German model, Frech technologies and Japanese innovations, the modernized station will not only purify water thoroughly, but also freshen the air and burn the remains of filtration, even those accumulated in sludge fields for decades.

"The project is currently under inspection. When it is completed, the expenses will be made clearer. They amount to about 1 billion Euros. It will probably be both state budget and investors," says Volodymyr Brazhnyk, director of Bortnychi aeration station.

"When it was built, only 3 indicators were controlled. Now 16 indicators should be controlled, which means 13 indicators are not controlled," the first deputy head of Kyiv city state administration Anatoliy Holubchenko said.

Ukrafoto

"Bortnychi aeration station"

Bortnychi aeration station is a complex of engineering structures, equipment and communications, made for complete biological treatment of Kyiv waste water and processing of accumulated sludge. All residential waste water is treated here, as well as industrial waste water after preliminary treatment at the enterprises themselves. The station consists of three waste water treatment blocks, three sections of sludge processing and support sections.

http://ukrafoto.com/reportages.php?id=18513

UNN

"Bortnychi aeration station has almost completely drained its technical capacity - A. Holubchenko"

KYIV. October 10. UNN. Bortnychi aeration station has completely drained its technical capacity and ability to purify waste water from the perspective of modern technologies. It was reported today at a public hearing on Bortnychi aeration station reconstruction project by the first deputy head of Kyiv city state administration A. Holubchenko, a UNN reporter says.

According to Mr Holubchenko, Bortnychi aeration station which was constructed in phases from 1961 till 1983, "for today has completely drained its technological capacities from the perspective of modern achievements in the field of waste water treatment".

Besides, he pointed out that at the time of BAS construction in the 60ies only three indicators of water treatment used to controlled, while now 16 indicators have to be controlled. In this regard, A. Holubchenko emphasized, the issue of BAS reconstruction is "all but the most pressing issue in Kyiv".

http://www.unn.com.ua/ru/news/1259249-bortnitska-stantsiya-aeratsiyi-povnistyu-vicherpala-svoyi-tekhnichni-mozhlivosti-a-golubchenko

Golos.ua

“Bortnychi aeration station burns 350 thousand kilowatt of electricity daily”

Bortnychi aeration station (BAS), a complex of water treatment facilities gathering sewage from the whole Kyiv, burns 350 kilowatt of electrical energy daily.

Volodymyr Brazhnyk, director of BAS, informed a golos.ua reporter about it in a commentary.

“Energy rate for the station is fixed at 1 UAH per kilowatt, and we spend about 350 thousand kilowatt a day. You can go ahead and count. Electricity alone costs us more than 1 million UAH a month,” - he said.

During a “tour” of the station its director told us that until November 7, 2013 a public discussion will be held in regard to modernisation of the station, which is tormenting inhabitants of Kharkivskyi area with unbearable smell of decomposing sludge.

In the opinion of experts, the reconstruction project should provide for construction of a new waste water treatment line using technologies of denitrification and dephosphorization at all station blocks. According to technology of the 60ies, which has not changed much since then, biological treatment facilities were designed so as to comply with only three indicators of purified water. Today the quality of treated waste water has to be controlled according to 14 main indicators.

The next BAS problem to be solved is excessive energy consumption. Today the station consumes 142 million kilowatt-hours per year. Almost 60% of energy needed for BAS work is spent on airblast units which deliver air into aerotanks.

Atmospheric emissions of sulfureted hydrogen and ammonia make inhabitants of Pozniaky, Osokorky and Kharkivskyi areas suffer from bad smell. That makes about 500 thousand Kyivites. That’s why the project must include sealing manifold chambers, rines and primary settlers of BAS”.

http://ru.golos.ua/suspilstvo/13_10_10_bortnicheskaya_stantsiya_aeratsii_za_sutki_sjigaet_elektrichestva_na_350_ty#

Besides, on October 28, 2013 as part of the public discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” BAS was visited by representatives of about 50 non-governmental organizations and associations which are members of the Public council at Darnytsia district state administration in the city of Kyiv. After the event representatives of the Public council at Darnytsia district state administration in the city of Kyiv unanimously supported and confirmed the necessity to start a full-scale reconstruction of the station in accordance with the complex stage by stage project and assured the management of the Company that they will address the Public council at Kyiv city state administration with a request to approve the project and assist its launching.

4.3. Final measures

Questions, suggestions and comments, received in oral form at the public hearing held on October 10, 2013 in the assembly hall of Darnytsia district state administration in the city of Kyiv, were responded to by invited representatives of Kyiv city state administration, management of PJSC "Kyivvodokanal", and a representative of “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”directly at this hearing.

All questions, suggestions and remarks, received from representatives of the public and citizens

from October 4 till November 4, 2013 concerning the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” were collected by the press service of PJSC "Kyivvodokanal" for their further processing.

Channels for receiving questions, suggestions of the public were:

for written ones - transparent letterboxes installed at the main PJSC "Kyivvodokanal" office at 1A Leiptsyzka street and at Darnytsia district state administration in the city of Kyiv at 11 Koshysia street.

for e-mails - e-mail address of PJSC "Kyivvodokanal" press service: press@vodokanal.kiev.ua.

5. List of suggestions (remarks) of the public, received by PJSC "Kyivvodokanal" and information on their consideration

During 30 days since the day when an announcement about the public hearing was published in “Khreshchatyk” newspaper, 5 suggestions concerning the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” were received by PJSC "Kyivvodokanal". All listed suggestions had been sent to the e-mail address of the Company’s press service.

Part of suggestions sent by representatives of the public to the address of the organizer of the public discussion concerned issues of cooperation with the Company in the direction of BAS production. Other suggestions (remarks) from representatives of the public, which concerned directly the issues of the presented reconstruction project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” were sent by the organizer of the public discussion to “Kyivinzhproekt” Institute, a branch of PJSC “Kyivproekt”, for their processing.

All received questions and suggestions and information on their consideration are presented in the following table.

№	Received via	Respondent	Question	Information on consideration of the suggestion
1	*Written request to the e-mail address of PJSC "Kyivvodokanal"*	*Volodymyr Pavlovych Klius, Kyiv resident*	*1. How will consumption of energy and natural gas change after the reconstruction? What are energy expenses for utilisation of 1 m^3 of sludge according to the adopted technology? To what extent will energy spending of BAS be covered by producing biogas and electrical energy from waste water and sludge? It is necessary to show the energy balance before and after the reconstruction clearly.* *2. Currently different kinds of utilisation of sludge and solid residential waste are used in the world. I haven’t found the reason*	*1. With use of modern sustainable equipment and automation systems operation costs for electrical energy and gas supply will be decreased.* *Electrical energy consumption with middle load is 31,5 megawatt.* *Need for natural gas is 3,9 mln Nm3 per year.* *Need for heat energy - 32,33 megawatt.* *Electrical energy production with middle load:* *Cogeneration plant on biogas - 9,1 megawatt* *Steam turbine – 1,5 megawatt* *Production of heat energy - 8,2 megawatt* *2. Choice and analysis of technical solutions is determined at the stage of Technical and Economic Justification (TEJ). This method was defined at the preliminary stage of the designing. The method has the following special features.* *- high turbulence, equal distribution of temperatures, intensive and steady burning process,*

№	Received via	Respondent	Question	Information on consideration of the suggestion
			why preference was given to burning of sludge. After all, additional fuel (biogas or natural gas) is needed to burn sludge in the boiling layer; the burning temperature is insufficient for decomposure of dioxins and furans; the volume of flue gas is much bigger than in case of pyrolysis or gasification. That's why flue gas cleaning is very complicated and expensive. *Technology of sludge gasification has much more advantages (production of synthetic flammable gas, much smaller content of harmful substances in flue gas because of higher temperature, a simpler system of gas cleaning). There are more than 100 plants for plastic gasification in the world, not to mention other gasification technologies.* *3."Kyivvodokanal" company informs, that sludge fields №3 (106,9 ha) have been out of use for more than 8 years and there is no inflow of sludge into them. It is known that during a long time of preservation sludge acquires qualities of peat. As early as in 1942-1943 at Liubertsi filtration fields of Moscow city a technology of making fuel bricks from peat was created and used. The bricks were dried in an open ground to 30% humidity and had heat power of 2200-2400 kilocalories per kilogram.* *4. Thus, to improve the project of BSA reconstruction, it is suggested to involve local experts.*	*during which practically full burning of organic substances is achieved;* *- temperature of burning 850-900^{o}C ensures long durability of the furnace and a low level of NOx emissions;* *- intensive heat transfer in the fluidized bed allows decreasing the area of heat exchange surface and the overall size of the plant;* *- operational flexibility;* *- absence of moving parts in the combustion chamber facilitates durability of the plant.* *Due to drying of sludge, autothermal condition of burning is kept in the furnace.* *But the system also provides for injectors of back-up fuel (natural gas or biogas), which is supplied for starting and stopping the plant.* *The choice is also connected with a possible prospective investor. The funds come from the Japanese government. Japan is a leading producer of such technologies, and more than 300 facilities of this type with different productivity are located in the country, despite its relatively small territory.* *For cleaning of flue gas, dry gas cleaning is used. It does not create liquid waste which would require additional treatment. Ash, acid gases (HCl, SOx, HF), heavy metals and NOx are eliminated from flue gas in the gas cleaning system, in accordance with approved norms and requirements regarding atmospheric emissions.* *3,4. This project provides for clearance of sludge fields with smearing of sludge, mechanical cleaning, preparation and transporting to thermal utilisation production line where the process of incineration of incoming sludge as well as sludge from the fields takes place.* *Ash resulting from sludge incineration after waste water treatment is by its physical, chemical and aggregate composition a unique resource which can be put to good use in different spheres with a significant social, ecological and economic effectiveness.* *Thus, using ash and slag waste will make it possible to save money on basic materials without loss of the product quality, at the same time resolving the problem of sludge utilisation. There is a possibility of selling the product to construction enterprises. An enterprise Industry and Construction Group "Kovalska" responded to one such proposal about possibility of using it as a technological additive in production of concretes, as an industrial waste material on condition of virtual correspondence to requirements for concrete mixes and products, in volumes proportional to actual volumes of production at enterprises for the period of use.*

№	Received via	Respondent	Question	Information on consideration of the suggestion
2	*Written request to the e-mail address of PJSC "Kyivvodokanal"*	*Grisha*	*I would like to suggest two solutions:* *- purification with help of bacteria* *- raising funds from wealthy Kyiv citizens* *Purification with help of bacteria* *In this regard I'd like to suggest introducing new objects with an installed septic tank for bacteria to purify waste water. Also to take into account issues of cleanness control after this septic tank (in case of dumping uncleaned water or chemically killed bacteria - a fine).* *Raising funds from wealthy Kyiv citizens* *Everyone knows that automobiles are ecologically (toxically) dangerous for the atmosphere.* *Car owners should compensate it by paying a tax for poisoning the atmosphere.* *If they can afford a car, they definitely have money to spend. Let them pay a monthly fee for atmosphere poisoning.* *And this money should be spent to upgrade such ecologically hazardous objects like Bortnychi aeration station.*	*Waste water at Bortnychi aeration station is treated mechanically and biologically until it reaches normal indicators. Installment of "septic tanks" during construction of new objects is against sanitary and epidemiology norms.* *In Ukraine there are acting rules of waste water gathering by communal and department sewage systems of inhabited localities. There are state bodies which control following of these rules and impose fines in case of their breach.*
3	*Written request to the e-mail address of PJSC "Kyivvodokanal"*	*Ivan Hryhorovych, Kyiv resident*	*1) To carry out assessment of impact on environment for any project documentation an appropriate licence of the Ministry of Environment of Ukraine is needed. Unfortunately, I haven't found the company"Ekoton" in the list of licensed companies.* *Also, as to the existing level of air pollution at the edge of sanitary protection zone, it is stated in the company's presentation that approved maximum limit allowed of polluting substances is exceeded. It is a serious violation of ecological legislation and can*	*1. LLC "Ekoton" has a licence of Ministry of Regional Development of Ukraine, issued by state architecture and construction inspection, series AB № 555532 of September 21, 2010. Validity period - 5 years.* *According to appendix to the licence, the enterprise carries out commercial activities, connected with creation of architecture objects, including:* *"Developing special sections of projects 2.10.00 Assessment of impact on environment"* *Besides, a engineer-designer employed at LLC "Ekoton" has a qualification certificate. Works (services) according to the qualification certificate are: engineering and design in the field of facilitation of life and health safety of people and environment protection.* *In assessment of impact on environment section*

№	Received via	Respondent	Question	Information on consideration of the suggestion
			lead to a quite negative interference of state bodies controlling impact on the environment (sanitary and epidemiological station). Is BAS really functioning with a level of polluting the atmosphere above the norms at the edge of sanitary protection zone? *2) Once, while writing my master's paper, I came across the following problem - sludge at BAS contains significant amounts of heavy metals (as a result of Chornobyl disaster and the existing transport infrastructure). That's why it is impossible either to utilise it in agriculture as a fertilizer, or to burn it (because then heavy metals will be discharged along with flue gas). How is this issue resolved in the BAS reconstruction project?* *3) In the report of the chairman of the board of PJSC "Kyivvodokanal" Valeriy Chenchevyi in slide 7 it is mentioned that waste is transported for burning to an acting plant "Energy". Why wasn't it decided to build a separate line for sludge burning, instead of transporting it, as well as waste, to the plant (after some cooperation to get this process on track, of course)? What is going to happen to the heat utilised after sludge burning?* *4) In the report on environment consequences you gave information about a substantial increase of atmospheric emissions, mostly consisting of sludge burning products. Is there an alternative to these emissions? Why was the burning chosen and not something else?*	*analysis of current condition of BAS is based on the approved "Inventory of atmospheric emissions of polluting substances by Department of sewage enterprise operation of JSK "Kyivvodokanal" (Bortnychi aeration station), 2010." During measurements by district SES, an exceeding of normal level of polluting substances is periodically noted. These are mostly sulfureted hydrogen and methanethiol. Excess of other polluting substances has not been noted.* *2. The project provides for sludge utilisation by incineration in furnaces with fluidized beds with flue gas cleaning. To purify flue gas, dry gas cleaning is used. It does not create liquid waste which would require additional treatment. Ash, acid gases (HCl, SOx, HF), heavy metals and NOx are eliminated from flue gas in the gas cleaning system in accordance with approved norms and requirements regarding emissions into the atmosphere.* *At the first stage of processing gas goes through electric filter to eliminate ash/dust. Before the second stage gas is treated by activated carbon and natrium bicarbonate in a contact chamber to eliminate acid gas, mercury and dioxins. The second stage of flue gas cleaning starts with adding reagents and finishes with eliminating polluting substances at sleeve filter. After the purification gas is emitted into the atmosphere through a smoke pipe. During atmospheric emissions the cleaned flue gas will not exceed the following requirements:* *Component Concentration in flue gas mg/m^3* *- CO 50* *- Dust (total) 10* *- TOC 10* *- HCl 10* *- HF 1* *- SO2 50* *- NOx 200* *- Cd + Ti 0.05* *- Hg 0.05* *- Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V 0.5* *- Dioxins and furans 0.1 ng/m^3* *3. Waste transported for burning to the plant "Energy" is contamination delayed mechanically in the process of waste water treatment, which is close by its nature and composition to solid residential waste. It is burnt at this enterprise round the clock. Building a separate line for utilisation of this kind of waste is not economically and ecologically efficient, taking into account the proximity of the plant and the project solution concerning building a production line of sludge utilisation.*

№	Received via	Respondent	Question	Information on consideration of the suggestion
				As for optimal utilisation of energy, the project provides for a multi-stage turbine, which supports three options of energy usage: *- energy production at every stage of the turbine;* *- low pressure steam production for drying of sludge;* *- production of additional energy for a heating network.* *Thus, an autothermal mode of work will be facilitated for this production line, with additional release of heat and electric energy with a possibility of providing for the station's own needs or switching to local heat and electricity supply networks.* *4.When the project was being designed, normative values of polluting substances content in flue gas according to approved directives 2000/76/€ were the basis of the calculation instead of specific emissions of a concrete plant.* *After defining concrete equipment with specific emissions, results will be re-calculated.* *For reference, according to directives NO2 emissions are 200 mg/m^3, but according to passport data of a Japanese plant it is 25 mg/m^3.* *So, in the future the project documentation will be corrected in the section of assessment of impact on the environment.* *Information was presented at the public hearing about location of sludge burning facilities in big cities of Japan, France, etc. Schools are located at 200-400m distance from the facilities.*
4	*Written request to the e-mail address of PJSC "Kyivvodokanal"*	*A.V. Samokish, LLC "Energomash"*	*We would like to suggest a possibility of cooperation.* *Aim:* *Creation of a system to synthesize own energy carriers (liquid fuel, gas, coal) from excessive sludge for supplying a projected sludge burning plant.* *Sequence of actions:* *1. Lab research of a principal possibility to obtain energy carriers out of excessive sludge and raw sludge.* *2. Dehydration of excessive sludge and clarifying the burden balance on a pilot plant with capacity 10 kg per hour.* *3. Installation of a semiproduction pilot plant with capacity 100 kg per hour at BAS territory.*	*The received proposal requires additional time to be studied and should be regarded separately after conducting experimental research.*
5	*Written*	*Yu.N.Skriprin,*	*We thank you and your team for*	*The issue of using "Kalmatron" concrete requires a*

№	Received via	Respondent	Question	Information on consideration of the suggestion
	request to the e-mail address of PJSC "Kyivvodokanal"	*"Kalmatron" inc.*	*the prepared public presentation and public hearing, aimed at solution of a major municipal problem of Kyiv.* *It is obvious from your presentation, that the main causes of premature collapse of certain objects (built in different phases of construction) are the poor quality of concrete and corrosion of metal constructions.* *The Kalmatron corporation (www.kalmatron.com) produces durable concrete, which is a 21 century invention.* *The corporation is also experienced in constructing concrete elements of treatment facilities, various sewers and water lines.* *Please follow the link to see a presentation.* *http://www.kalmatron.net/2-KF-A/*	*more fundamental research after all permit documents and compliance certificates in accordance with State Construction Norms of Ukraine have been received.* *Choice and analysis of technical solutions is determined at the stage of Technical and Economic Justification (TEJ). This method was defined at the preliminary stage of the designing. The method has the following special features.* *- high turbulence, equal distribution of temperatures, intensive and steady burning process, during which practically full burning of organic substances is achieved;* *- temperature of burning 850-900^{o}C ensures long durability of the furnace and a low level of NOx emissions;* *- intensive heat transfer in the fluidized bed allows decreasing the area of heat exchange surface and the overall size of the plant;* *- operational flexibility;* *- absence of moving parts in the combustion chamber facilitates durability of the plant.* *Due to drying of sludge, autothermal condition of burning is kept in the furnace.* *But the system also provides for injectors of back-up fuel (natural gas or biogas), which is supplied for starting and stopping the plant.* *The choice is also connected with a possible prospective investor. The funds come from the Japanese government. Japan is a leading producer of such technologies, and more than 300 facilities of this type with different productivity are located in the country, despite its relatively small territory.* *For cleaning of flue gas, dry gas cleaning is used. It does not create liquid waste which would require additional treatment. Ash, acid gases (HCl, SOx, HF), heavy metals and NOx are eliminated from flue gas in the gas cleaning system, in accordance with approved norms and requirements regarding atmospheric emissions.*

From the content of responses to the suggestions (remarks) listed above by experts of "Kyivinzhproekt" Institute, a branch of PJSC "Kyivproekt", the Company drew a general conclusion that the nature of these suggestions is such that there is no necessity to consider them in the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station".

After events within the framework of the public discussion of the project "Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station" were finished, these materials containing a description of activities and results of the Company's work regarding the raised issue were prepared. Printed copies of the public

discussion materials were sent to the executive body of Kyiv city council (Kyiv city state administration) in full volume. Text of the materials must be placed at the official website of PJSC "Kyivvodokanal" http://www.vodokanal.kiev.ua.

6. Conclusions

Presented information about organization, holding and results of the public discussion of the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” allows to draw the following main conclusions.

- in course of the public discussion all requirements of acting legislation of Ukraine regarding arrangements, terms and volume of informing the public about planned activities of BAS were met. All NGOs and citizens that expressed their interest were given an opportunity to participate in the public discussion. At the same time, scheduled events of discussion process mostly involved Kyiv population, whose territory may be affected by BAS planned activities, and the population, connected with BAS activities socially and economically;
- all questions, suggestions and remarks of the public, expressed during discussion process, both in oral and written form, were collected for further processing. All information, obtained in course of the public discussion, was systematized and analyzed for consideration in further activities of Bortnychi aeration station by PJSC "Kyivvodokanal".

Appendix:

1. Minutes of the public hearing on the project “Reconstruction of sewage waste water treatment facilities and construction of production line for sludge processing and utilization at Bortnychi aeration station” of October 10, 2013 on 8 pages in a single copy.

Chairman of the board of PJSC "Kyivvodokanal" **Valeriy Chenchevyi**