Annex 3
Environmental Field Measurements Report

(Methodology, Standard Equipment Used andMeasurement Results)

Environmental Field Measurements

Methodology and Standard Equipment Used

Environmental Methodology

A. Field Measurements

Field measurements for ambient air quality and noise are important in order to assess the current environmental conditions at the project's site. In addition, to run the groundwater modeling, water quality has to be conducted, besides assessing current water quality and quantity at the recovery system.

To indentify the contamination level of the effluent lake due to the remaining sludge generated from the wastewater (in this case, most of the sludge has been stabilized for a long period due to the climate and dryness of the lake), the sludge and soil sample is also an important to be assessed.

In addition, to predict the sludge generated from the NGWWTP, wet sludge has to be collected and assessed to identify the heavy metals contain. This sludge assessment was important indication to determine the future sludge generated from NGWWTP was suitable for irrigation reuse or has to be dumped to the sanitary landfill.

Besides assessing the soil, water and sludge, the ambient air as well as the noise has to be conducted for baseline environmental conditions onsite. Based on the results, the predictions of the expected impacts due to preparation, construction and operation of the project component will be identified.

The Consultant has performed the field measurements based on the side investigations and site characteristics. The soil, water, sludge, ambient air and noise measurements were conducted by the local laboratory. The measurements have been conducted on August 7 and August 8, 2012 by Islamic University Lab. However, due to the doubt result on one of the soil sample, the soil, sludge and water samples were conducted again by Al Azhar Laboratory on September 4, 2012.

The field measurements were conducted based on a following:

A.1. Soil Analysis

Soil sampling points has to be determined based on a grid pattern and should be taken in areas which are identified as "hot spots" (in this regards, the hot spot of the effluent lake was at nearby the overflow of the polishing pond (pond #7) and nearby the overflow of the aerated pond[1]; pond # 1. In addition at the end of the effluent lake was measured to indicate the contamination pattern.

It is indicated during the site investigation that the stabilized sludge is occurred on the thin layers and some area is mixed already with the sand. These characteristics indicated that the contaminant do not spread vertically, therefore, samples was taken at 2 various depths (top layer that contain stabilized sludge and 0.5 depth that contain sand (might mixed with) sludge to indicate and develop the penetration profiles along the effluent lake.

[1]According to the original design, pond #1 designed as an aerated lagoon. However, the lagoon since the beginning is implemented as anaerobic lagoon without any aeration. Currently, as poor operation and maintenance, the pond turns to have a layer of solid particles (waste and sewage floating sludge) that cover almost half of pond's surface (especially at pond #1)

Analysis was conducted in accordance with international standard methods wherever practicable and applicable. Parameter considered for soil / stabilized sludge sample was concentrated on heavy metals and in organic contaminations.

A.2. Sludge Analysis

Sludge analysis is the basic for calculating heavy metal contamination (metal additions) when sludge is spread on farm yard. Sludge analysis from the existing BLWWTP was conducted to predict the metals contamination when the wastewater is transferred fully to the new NGWWTP.

The influent wastewater flow rate is assumed to be similar as the wastewater network mainly connected to the households. The influent characteristic of the wastewater received at BLWWTP mainly from the household processes.

Although metal concentrations will vary considerably between samples, but there is general relationship between metal and sludge dry solid (but considerably not stabilized yet) content. Thus the accurate assessment of metal contamination or metal addition to land requires collection of a representative sludge sample for dry solid analysis (according to standard sludge analysis of EPA)

Sampling of liquid sludge is generally undertaken from first treatment process or first anaerobic pond (see foot note 1 for the current condition of the pond). Settled solid (sludge) was taken at representative depth of the pond. The normal practice to analyze sludge sample is after it is turned to be dry solid content (reference made to the EPA standard for sludge analysis).

Analyses were conducted in accordance with international standard methods wherever practicable and applicable. Parameters considered for wet or liquid sludge sample was concentrated on heavy metals.

A.3. Water Analysis

Water samplings were taken at the effluent of BLWWTP, before entering the infiltration basin and from groundwater wells (MW2, MW3 and Q52).Table 1 shows the parameters that were analyzed. Similar to the soil and sludge analysis, the analysis was done according to the standard method and of using similar equipment done for the water sampling during the preparation of the original EA of NGESTP of 2006 and for the design project.

Groundwater assessment results provided by PWA wereverified and water samples taken at different points were used as the baseline water quality environmental condition.

Table 1. Proposed sampling parameters and locations

Well No. / Tested Parameters	Groundwater (MW2, MW3, Q52)	Influent to infiltration Basin
pH	x	
TDS	x	
BOD	x	x
COD	x	x
NO3	x	x

Well No. / Tested Parameters	Groundwater (MW2, MW3, Q52)	Influent to infiltration Basin
T.N &P	x	x
Cl	x	x
Detergent	x	x
F.C	x	x

A.4. Ambient air and Noise Analysis

The impact on ambient air quality and noise disturbance associated to this project will be determined during the construction of project components; decommissioning of BLWWTP, remediation works at the effluent lake as well as during operation of the project component; reuse schemes, post decommissioning works (pumping station and polishing pond (pond #7) will remain as an emergency overflow and the reuse scheme network (in this study the project component as a part of the reuse scheme will be concentrated at the infiltration ponds and reuse pipe distribution networks).

As the site characteristics of the project components vary, therefore the parameters and the sampling duration (especially for the noise and H_2S as a specific characteristic of odor generated at the treatment plant only) will be defined according to the specific site characteristic and condition and based on scientific explanation.

Ambient air quality and Noise sampling and their parameters and durations measured for the preparation of the environmental baseline conditions are as follows:

- Close to the Cemetery area (nearby the storage tank and booster pumping station (for the reuse scheme) will be constructed)

  Ambient air:

  SO_2, NO_x, CO and SPM (and PM_{10}) parameters were measured to identify the current air quality

  Noise

  An 8 hour duration for the noise measurement was conducted from08.00 – 16.00 (represent the working hour duration during the construction Based on the proposed measurements conducted for the noise, an hour measurement during the night was identified. However, due to the restriction area (close to the border to Israel) the night hour measurement could not be performed.

- Infiltration Pond site

  At the infiltration ponds area, ambient air and noise are not expected to be generated during the operation. Moreover, the noise expected during the construction phase has been predicted and analyzed during the original ESIA study for NGESTP and the construction has been finalized and currently it is under operation (but not in a full capacity). Therefore, the ambient air and noise measurement were not conducted in this site.

- BeitLahiya WWTP site and Effluent Lake

  Ambient air

  Similar to the cemetery site, CO, CO_2, PM_5 and $PM_{2.5}$ at representative point at the effluent lake and at the nearby the existing pumping station (between pumping station and the aerated ponds that will be decommissioned) were measured to identify the current quality for representative points for remediation works activities and decommissioning activities.

  Noise

  Similar to the ambient air point's measurements, representative point at the effluent lake and the BLWWTP were based on an 8 hour duration (working hour between 8:00 – 16:00).

The 8 working hours are selected to represent the activities during the construction. During the operation phase, the management and monitoring will be prepared in accordance to their sensitivity as the project components will run for 24 hours. In addition, the ambient air management and monitoring plan during construction and the operation phase of the project components will be determined in accordance to the specific nature of the site, i.e. the prevailing wind direction, during summer and winter season, day and night as well dry or humid conditions.

The international standard methods wereapplied for both ambient air and noise measurements whenever it is applicable and practicable. The method and equipment used to measure for ambient air quality and noise is discussed in detail at the following appendix; measurement report. Table 2 .presents the Testing procedures and name of used instrument to measures the wastewater and soil for preparation of this ESIA study.

Table 2. Testing procedures & name of used instrument

Ser.	Parameter		Procedure	Name of instrument
Wastewater analysis				
1.	Temperature		Probe method	Digital TOC meter
2.	pH		Probe method	pH meter
3.	TDS		Probe method	TDS meter
4.	BOD		Oxitop method	Oxitop
5.	COD		Closed reflux method	Spectrophotometer & COD reactor
6.	TSS		2 hrImhofe cone	Imhofe cone
7.	Esi Coliform		Filtration technique	Incubator
8.	Fecal Coliform		Filtration technique	Incubator
9.	Heavy metal		Atomic method	Atomic
10.	Cations & anions	Cl	Argenometric method	Digital titration unit
11.		NO3	colorimetric method	Spectrophotometer
12.		Na	Flam photometry	Flam photometer
13.		Ca	Titration method	Digital titration unit
14.		K	Flam photometry	Flam photometer
15.		Mg	Titration method	Digital titration unit
17.		CO3	Titration method	Digital titration unit

Ser.	Parameter	Procedure	Name of instrument
18.	Detergent (mg/l)	Absorption (UV-249 nm)	Spectrophotometer
Soil analysis			
1.	ECe (µS/cm)	Soil extraction method	EC meter
2.	SAR	By calculation method	Flam photometer
3.	Organic matter (%)	Ignition method	Furnaces
4.	CaCO3 (%)	Titration method	Digital titration unit
5.	PO--4	Ascorbic acid	Spectrophotometer

B. Groundwater Analyses Verification and Modeling[2]

Perhaps the impacts on groundwater was one of the most important issues that will be associated with the project, as part of the project has been designed to prevent infiltration into the ground water by partially treated sewage. The EA of the NGEST Project estimated the water mound caused by infiltration of the partially treated sewage at the end of emergency phase will extend 700 m towards the sea, 300 m inland, 250 m north and south of the infiltration basin.

The EA has further assessed the impacts of chlorides, nitrates and pathogenic bacteria. The groundwater modeling prepared in the original EA of the project predicted that the groundwater quality will be improved after the operation of Part B as the new infiltrated plume will wash out the old plume of partially treated water. However, the EA has simulated a worst case scenario where the operation of Part B of the project is delayed and the EA recommended construction of remediation wells to pump out the effluent.

After the delay of Part B of the project, the design consultants have carried out another groundwater modeling for simulating the plume according to the recent conditions. According to this modeling practice the locations of the 27 wells were identified along with their correspondent discharge rates and depths.

The team carefully reviewed the available data from the groundwater modeling carried out by the project designer, verified the expected achievements and positive impacts on the groundwater and assessed the impact on abstraction wells in the region. In addition, the Consultant reviewed and verified the 4 sets of readily available data of groundwater samples and results provided by the PWA (namely water quality results, first to fourth round conducted between March 2011 and February 2012 and the baseline groundwater quality report).

The consultant prepared and run an independent groundwater modeling study taking into consideration the setup of groundwater model developed by the design consultants. This was done to reach quantifiable assessment for groundwater quality impacts, and for groundwater movements. The assessment of the impacts on groundwater was taken into consideration the abstraction rates of the recovery wells, the possible recharge in the agricultural lands and different scenarios for project implementation. In addition, the model used the most recent available data provided by the Client with the verification data measured during the preparation of this SESIA.

For the current work, the existing groundwater modeling provided during the design project and EA of the original NGESTP study will be assessed and will be used as a reference. The

[2] Groundwater modeling methodology is presented in detailed at Annex 5

design consultant used Visual Modflow (VMF) version 4.2 and its integrated modules which will be also used in the current study. Therefore, the conceptual model in the design report is considered valid; however, the Consultant approached consists of updating the conceptual model to schematize the most actual hydro geological context.

The developed numerical model consists of dividing the modeled domain in meshes (space elements) where hydro geological properties are constant, and in dividing the simulation period in time intervals was assessed. The most up-to-date data provided by the Client was used where the design project model used the input data until 2008 (the present water quality from different sources conducted by the Consultant was used to verify and compare with the available water quality data provided by the Client).

C. Secondary Data

Secondary activities involved collection of different national reports through reviewing available sources of secondary data and assess requirements for primary data collection. In addition, due to the gaps within the Palestinian standard and technical specification; especially regarding the sludge management and reuse, required lesson learned and comparison of the standard limit from regional countries around Gaza Strip, the wastewater reuse and sludge management and reuse from Jordan, Israel and Egypt were assessed.

A list of all reviewed data was prepared:

1- Palestinian Environmental Law .7, 1999
2- Health and SafetyLaw 3/2011
3- Palestinian Reform and Development Plan PRDP (2008 -2010)
4- Palestinian Environmental Assessment Policy
5- Basic Information about BeitLahia- Wikipedia
6- Standards for the re- use of treated wastewater for irrigation, www.arriyadhenv.com
7- Palestine Water Authority, organization and tasks, PWA website
8- Coastal Municipal Water Utilities, organization and tasks, CMWU website
9- The North Gaza Emergency Sewage Treatment project, World Bank website
10- Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan
11- Environmental Assessment North Gaza Emergency Sewage Treatment Plant Project
12- Literature review of factors influencing public perceptions of water reuse
13- Technical proposal for the Supplementary Environmental and Social Assessment North Gaza Emergency Treatment Project
14- Climate change and agriculture water demand: Impact and adaptation, Ziad A Mimi and Sireen Abu Jamous, African Journal of Environmental Science and Technology, 2010
15- Guidelines for municipal water reuse in the Mediterranean region, UNEP, 2005
16- Users Manual for Irrigation with treated wastewater, FAO Regional office for Near East, 2003
17- Health Risks in wastewater irrigation: Comparing estimates from quantitative microbial risk analyses epidemiological studies, D.D. Mara, P.A. Sleigh, U.J. Blumenthal and R.M. Carr, 2007
18- Guidelines for wastewater reuse in the Gaza Strip, Palestine, Part 1 – Legal and Institutional Issues
19- The Palestinian Central Bureau of Statistics (http://www.pcbs.org/populati/est_n1.aspx)

Measurement Result

Project : Supplementary Environmental and Social Impact Assessment (SESIA)

Clint : PWA

Consultant : JV of Ecoconserv & UG

The results of sampling tests

Environmental and Rural Research Center, IUG-Gaza.

September 2012

The Islamic University-Gaza
Environ. & Rural Research Center
الجامعة الإسلامية – غزة
مركز الدراسات البيئية و الريفية

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Soil Samples Analysis Results

Place : BeitLahiya – The effluent lake (Old Basin)

Parameters	Unit	Result South Basin		Result At the meddle of the Basin		Result North Basin	
		0-15cm	50cm	0-15cm	50cm	0-15cm	50cm
PH		6.97	6,97	6.96	6.99	7.02	6.97
EC	µS	821	854	800	820	531	571
OM	%	0.98	0.86	2.2	1.2	0.98	0.37
TN	%	0.11	0.06	0.08	0.08	0.086	0.05
TP	%	0. 43	0. 34	0.49	0.32	0.47	0.36
Pb	mg /kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cu	mg /kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	mg /kg	0.008	0.008	0.17	0.047	0.061	0.005
Zn	mg /kg	0.1	0.061	0.008	0.008	0.008	0.007

Sludge samples Analysis Results

Place : BeitLahiya – WW basin

Parameters	Unit	Result
PH	-	6.78
EC	µS	2400
OM	%	2.6
TN	%	0.25
TP	%	0.21
Pb	mg /kg	< 0.01
Cu	mg /kg	< 0.01
Cd	mg /kg	0.17
Zn	mg /kg	0.01

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Ref ..... الرقم .....

Results of the air test analysis

Parameters	Unit	Result BeitLahiya- WWTP Site	Result At the effluent lake	Result Close to the Cemetery
CO	ppm.	1.3	0.1	0.1
CO2	pmm.	442	380	344
Noise 8hours	dB.	54.1	40.5	43.3
PM5	Microgram/m3.	397	306	345
PM2.5	Microgram/m3.	69	53	60

Close to the Cemetery

Time	Noise/dB
09:00	43.3
11:00	43.3
01:00	43.3
03:00	43.3
05:00	43.3
Noise (AVG) :	43.3 dB

BeitLahiya- WWTP Site

Time	Noise/dB
09:00	64
11:00	63
01:00	60.5
03:00	41.5
05:00	41.5
Noise (AVG) :	54.1 dB

At the effluent lake

Time	Noise/dB
09:00	42.7
11:00	42
01:00	40
03:00	39
05:00	39
Noise (AVG) :	40.5 dB

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Appendices

Appendix A: Testing procedures & name of used instrument

Ser.	Parameter		Procedure	Name of instrument
	Seawater & wastewater analysis			
1	pH		Probe method	pH meter
2	TDS		Probe method	TDS meter
3	BOD		Oxitop method	Oxitop
4	COD		Closed reflux method	Spectrophotometer & COD reactor
5	Fecal Coliform		Filtration technique	Incubator
9.	Heavy metal		ICP method	ICP
10.		Cl	Argenometric method	Digital titration unit
11.		NO_3	colorimetric method	Spectrophotometer
12	Detergent (mg/l)		Absorption (UV-249 nm)	Spectrophotometer
13	Soil analysis			
14.	ECe (µS/cm)		Soil extraction method	EC meter
16.	Organic matter (%)		Ignition method	Furnaces
17.	PO_4		Ascorbic acid	Spectrophotometer
18	pH		Probe method	pH meter
	Heavy metal		ICP method	ICP

Appendix B: Names of Sampling collector and testing technicians

	Sampling collection team
1.	Mr. Azmu Abu-dagga
2.	Mr. Alaa Al-jubb
3.	Mr. Adelkareem Abu-hatab
4.	Mr. Rafat Sh Mortaja
	Testing technicians
3.	Mr. Azmu Abu-dagga
4.	**Mr. Alaa Al-jubb**
	Miss. Samah Abu-samra
	Miss Zynab S. Ei- sersawy

Time schedule of samples collection:

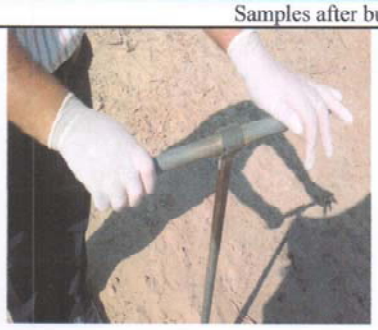
Ser.	Collection (Day-Date)	Activity
1.	11/8/2012	Soil-sludge-Air
2.	14/8/2012,	Soil-sludge-Air

Appendix B: Photos for sampling at site and analyze it in the lab

Vibrate device for mixing samples

Samples inside the oven

Samples after burning in the oven



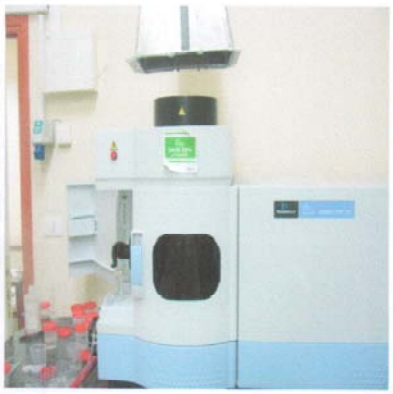
During soil sampling

Depth of excavation

Sludge sampling

Weight of the soil

Sludge sampling



ICP Device for testing minerals

TN testing

Measuring air pollution Place : close to the Cemetery area	Measuring air pollution Place : BeitLahiya WWTP site

Quotation for Soil, Sludge and water analysis

Institute of Water and Environment

Al Azhar University, Gaza

September, 2012

Analytical Methods

Groundwater and wastewater effluent samples were analyzed according to the WHO recommended methods, that is the Standard Methods for the Examination of Water and Wastewater, 20th edition 1998.
Methods used are presented in the following table:

Table (1): Analytical methods used in water and wastewater analysis.

Parameter	Method
pH	St. Method 20TH, 1998, 4500-H^+ B. Electrometric Method; p (4-87)
Electrical Conductivity.	St. Method 20TH, 1998, 2510 B. Laboratory Method; p (2-46)
TDS	St. Method 20TH, 1998, 2540C. Total Dissolved Solids Dried at 180C; p(2-56)
Nitrate	St. Method 20TH, 1998, 4500-NO_3^- B. Ultraviolet Spect. Screening Method; p (4-115)
Chloride	St. Method 20TH, 1998, 4500-Cl^- B. Argenotometric Method; p (4-67)
Phosphorus	St. Method 20TH, 1998 4500-P-B: Ascorbic Acid Method.
Ammonia	St. Method 20TH. 1998, 4500-NH_3 F. Phonate Method; p (4-108).
Kjeldahl-N	St. Method 20TH, 1998 4500-N_{org} C: Kjeldahl Method.
Biochemical Oxygen Demand	St. Method 20TH, 1998 5210-B: 5 Respirometric method, OXI TOP, FTD250 refrigerator(incubator)
Chemical Oxygen Demand	St. Method 20TH, 19985220-D: Close Reflux, Colorimetric Method.
Total Coliform	St. Method 20TH, 1998 9222: Membrane Technique.

Water and wastewater results

Table (2): Chemical analysis of groundwater and wastewater samples.

Well no.	pH	TDS mg/L	BOD5 mg O_2/L	COD mg O_2/L	Nitrate mg/L	TN mg/L	Chloride mg/L	P mg/L	Faecal coliform cfu /100mL
MW2	7.13	1310	< 5	6	48	11.5	653	<1	6
MW3	7.19	1125	< 5	5	78	17.01	370	<1	4
Q52	7.34	990	< 5	8	72	16.30	320	<1	12
Wastewater	7.36	1420	85	195	60	23.26	340	5.2	>1000

Soil and sludge samples were analyzed according to the hand book of soil analysis.

Methods used are presented in the following table.

Table (3): Analytical methods used in soil analysis

Parameter	Method
pH	Handbook of Soil Analysis, 2006. Soil solution ratio 1/1. Measurement on Aqueous Soil Suspensions; pH Meters; p (565-567)
Electrical Conductivity.	Handbook of Soil Analysis, 2006. Soil solution ratio 1/1, Electrical Conductivity of the Extracts; p (610-614).
Organic Matter	Handbook of Soil Analysis, 2006. Organic Carbon by Wet Oxidation at the Temperature of Reaction; p (335-340).
Total Nitrogen	Handbook of Soil Analysis, 2006. Total Nitrogen by Kjeldahl Method and Titrimetric; p (344 – 348).
Total Coliform	St. Method 20TH, 1998 9222: Membrane Technique.

Soil and sludge samples analysis

No	pH	EC µs/cm	O.M g/Kg	T.N g/Kg	Faecal coliform cfu /1 gm
Soil (1)	7.04	565	9.91	0.33	$1*10^3$
Soil (2	7.57	1476	12.94	0.73	Neg.
Soil (3)	8.07	351	11.11	0.51	Neg.
Soil (4)	7.31	377	12.25	0.72	Neg.
Sludge	7.91	2540	420	-	-

For quality control, analytical blanks prepared and analyzed using the same procedures and reagents. Standard reference materials were used for determination of element in ground water, wastewater and soil samples.

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