



**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) FOR AWALI-BEIRUT WATER CONVEYER PROJECT
(STUDY UPDATE)**

EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

INTRODUCTION

Greater Beirut has been facing a deficit in potable water for the past forty years. Shortage in water is estimated today at 145,000 m³/d and 275,000 m³/day for the wet and dry season respectively.

In 1970 the Lebanese Government of the day passed a decree (Presidential Decree No. 14522, May 1970) in which it allocated water from the Litani and Awali river catchments to different regions in Lebanon.

The proposed Beirut-Awali Project will secure a sustainable source of potable water to Greater Beirut to overcome the existing deficit and meet the city's potable water requirements on the short and medium term.

The CDR has initiated the Project following the request of the Ministry of Energy and Water (MoEW) and is seeking to secure financing of the project from the World Bank (WB) whereas the Beirut and Mount Lebanon Water and Wastewater Establishment (BMLWWE) will be covering the local counterpart financing needs.

The Project will be implemented on conventional contract basis with expected construction duration of four years and one year operational maintenance.

The Project has a World Bank (WB) "Category A" status and therefore a full Environmental and Social Impact Assessment (ESIA) has been required.

This report provides an updated ESIA which identifies potential environmental and social impacts associated with the proposed Project and proposes relevant mitigation measure and management plan.

LEGAL AND INSTITUTIONAL FRAMEWORK

This ESIA complies with the Lebanese Legislative requirements as well as with that international (WB/IFC) and European Union standards.

The overall control of water supply and quality is under the Beirut and Mount Lebanon Water and Wastewater Establishment acting under the Ministry of Energy and Water (MoEW) while the Ministry of Environment and various line Ministries are charged with specific regulatory duties.

Regionally the Project area is under the Governorate of Mount Lebanon and its subordinate cazas and Municipalities

PROJECT DESCRIPTION

The Project is divided into two main components:

1. The Awali-Beirut Water Conveyer
2. Improvement and rehabilitation of the water distribution network in Beirut and its suburbs

The Awali- Beirut Water Conveyer includes the following sub-components:

- **Joun Regulation Structure:** set into the hillside by the existing adit access from the Joun tunnel to the hydro-electric power station.
- **Joun to Ourdaniye Tunnel:** running underground throughout its length of 4.1 Km.

- **Wadi Abou Yabes washout:** (discharge point) for emergency discharge or routine maintenance
- **Ourdaniye Water Treatment Works:** including tunnel inlet and outlet portals and the water treatment works. Sludge treatment and disposal facilities will be associated with this works. A washout will be provided for emergency discharge.
- **Ourdaniye to Khalde tunnel:** underground throughout its length of 19.7 km.
- **Inverted Siphon:** in the Damour river with ventilation shafts at the hills to the south and north of the valley. A washout will be provided for use in emergencies and for maintenance.
- **A surge shaft in the hillside above Khalde:** 2,800 mm diameter shaft in reinforced concrete with surface venting structure 7 m diameter in reinforced concrete, including improved access road.
- **Outlet portal in the hillside above Khalde:** termination structure in reinforced concrete and upgraded access road
- **Flow measurement and sampling chamber** on the hillside above Khalde.
- **Twin Pipeline from Khalde portal to Khalde distribution chamber:** 1.9 km long and 1,400 mm diameter
- **Khalde distribution and connection chamber:** in reinforced concrete containing isolating and regulating valves. Provides washout to local stream.
- **Twin Pipeline form Khalde distribution chamber to Hadath 90 and 125 reservoirs:** 7.6 km long, 1,400mm diameter pipelines in ductile iron with connections to Hadath 90 and 125 reservoirs and local supply.
- **Hadath 125 reservoir:** Storage reservoir, two compartments, effective volume 30,000 m³ in reinforced concrete with isolating valves and small surface kiosk, including access road. Connection to local distribution system.
- **Hatdath 90 reservoir:** Storage reservoir, two compartments, effective volume 50,000 m³ in reinforced concrete with isolating valves and small surface kiosk, including access road. Connection to local distribution system.
- **Pipeline from Hadath reservoirs to Hazmieh reservoir:** 2.7 km long twin 1,300 diameter pipelines in ductile iron, with option for further extension for supply of treated water to Beirut.
- **Hazmieh 90 reservoir:** Storage reservoir, two compartments, effective volume 20,000 m³ in reinforced concrete with isolating valves and small surface kiosk, including access road. Connection to local distribution system.

Component 2 will comprise:

- The construction of 16 reservoirs (between 500 m³ and 1000 m³ storage capacity each) and associated pumping stations distributed across the various distribution zones in the project area;
- The replacement and/or installation of approximately 187 km of distribution network across the project area in Ein El Delbi, Southern Beirut and parts of the Metn area;

Installation of 200,000 household meters in portions of the project area to be selected by the GBMLWWE and to operate on a volumetric tariff basis;

- Installation of bulk meters at the reservoirs and distribution chambers;

Analysis of Alternative

The No Project Option and other scheme alternatives were addressed in this report.

The No Project alternative is considered to be not viable, as it would have severe environmental and socio-economic impacts in Beirut.

Five overall project options were identified and are illustrated in Table 1 below:

Table 1 Overall Project Options

OPTION	OPTION NAME	DESCRIPTION
1	Tunnel 1	Tunnel from Joun direct to a WTW at Khalde with pipeline transfer to reservoirs in Beirut
2	Tunnel 2	Tunnel from Joun direct to Khalde via a WTW in Ouardaniye, with pipeline transfer to reservoirs
3	Concrete Pipeline	Tunnel from Joun to a WTW at Ouardaniye thence by concrete pipeline to Khalde with pipeline transfer to reservoirs in Beirut
4	Ductile Iron Pipeline	Tunnel from Joun to a WTW at Ouardaniye thence by ductile iron pipeline to Khalde with pipeline transfer to reservoirs in Beirut
5	Steel Pipeline	Tunnel from Joun to a WTW at Ouardaniye thence by steel pipeline to Khalde with pipeline transfer to reservoirs in Beirut

Option 2, Tunnel 2 was preferred for the following reasons:

- Lowest overall cost
- Greatest security in terms of:
- Least vulnerability to deliberate damage
- Best resistance to earthquakes
- Least risk of leakage and consequential damage
- Greatest durability and design life
- Lowest maintenance requirements (and thus minimized supply disruption)
- Easier to supply the coastal strip from Ouardaniye WTW rather than a Khalde WTW
- Spare hydraulic capacity available:
- To supplement inadequate reservoir capacity in Beirut
- To allow for future expansion of required; and
- Least environmental impact during construction

ENVIRONMENTAL AND SOCIAL BASELINE STUDY

This section sheds light on the existing physical environment and socio-economic status.

The Climate conditions in the project area are those of a typical eastern Mediterranean climate; the rainfall is low and restricted to the period between November and March, and the temperatures are high in summer, but the area is not subject to the cold winter that occurs in Lebanese mountains.

The existing ambient noise levels recorded near most of the surface structure components averaged between 60 and 65 dB (A). Therefore ambient noise levels already exceed allowed noise levels as per Lebanese legislation (Decision 52/1 of 1996).

The tunnel passes mainly through the upper and the middle Sannine-Maameltein Formation of Cenomanin and Turonian ages respectively. This formation is mainly composed of hard massive limestone and dolomitic limestone rocks. Exposures of this formation cover most of the study area with a total thickness of around 800 m. Only the upper part of this formation is exposed in the study area.

Conformably overlying this formation is the Chekka Formation of Senonian age. It is mainly composed of thinly bedded soft marl and marly limestone rocks. It is mostly exposed in the areas surrounding Joun village.

Structurally the area is located few kilometers west of the Coastal Flexure which is the possible extension of the Roum Fault (Nemer, 1999). The flexure extends from Chhim in the southern part to Baawerta and Aaramoun in the central and northern parts of the study area respectively. The Flexure has steeply dipping beds which gentles as we approach the study area. The general inclination of the beds in the study area is around 20° dipping towards the west.

The Sannine-Maameltein Formation is the major coastal aquifer in the study area. It is karstic in nature with tertiary porosity meaning that groundwater is flowing mainly in fissures, fractures and conduits. There are no permanent springs issuing from this formation except close to the coastal area and mainly below sea level in the form of submarine springs (Feasibility Report, 1994).

The position of the water table is closely related to the base level which is the sea level and it gently rises inland with a mean gradient of 11.5 m/km. The depth of the water table was determined from groundwater wells (Feasibility Report, 1994).

The raw water will be delivered to the plant by the use of tunnels that belong to the existing hydroelectric system. There are two main sources of water:

1. Karaoun Lake;
2. Awali River.

Raw water quality has been analyzed several times in the past with the first one being in 1968/1972, the second one in August 1984 and the third one in 1994/1995. The most recent water quality analysis was conducted in 2001. The first two can be considered outdated as it is suspected that the condition and status of the tunnels, hydroelectric power plant and dams may have changed during the proceeding period. The analysis conducted in 1994/1995 contained some information on the most important parameters; however the feasibility report and the preliminary design report of Montgomery Watson did not cover comprehensive water quality information on a seasonal basis for both the Karaoun and Awali sources. It is not possible to immediately verify the conclusions and assumptions which were the basis of the 1994 feasibility study or the subsequent preliminary design. This is due to lack of recent detailed water quality monitoring data at the points of concern to this project, and the fact that new data would need to be collected over long periods to capture seasonal variations.

The landscape along the areas of the Awali project varies between the hills and the coastal planes. A summary of nature of landscape and existing biodiversity is given in Table 2 below

Table 2 Summary of Landscape and Biodiversity

STRUCTURE	LANDSCAPE	BIODIVERSITY
Joun flow regulation	Relatively steep valley (degraded site)	very common species including <i>Calicotome villosa</i> (Vahl) Link, <i>Poterium spinosum</i> L., <i>Phlomis viscosa</i> Poir., <i>Nerium oleander</i> L., <i>Inula viscosa</i> (L.) Aiton, <i>Echinops viscosus</i> DC. and <i>Notobasis syriaca</i> (L.) Cass.
Wadi Abou Yabes Washout	Isolated hillside location	Significantly degraded environment
Ouardaniye WTW	open hillside location	Several species were found and identified, including one specimen of <i>Rhus tripartita</i> (Ucria) D.C. and one of <i>Quercus calliprinos</i> Webb, 5 species of orchids in large quantities and many species of butterflies.
Nahr Damour Siphon	Inverted Deep, narrow valley	Several types of vegetation cover composed mainly by <i>Platanus orientalis</i> L. (Oriental Plane), <i>Alnus orientalis</i> Decne (Oriental Alder), <i>Acer syriacum</i> Boiss. et Gaill. (Syrian Maple), <i>Pistacia lentiscus</i> L. (Mastic), <i>Pistacia palaestina</i> Boiss. (Wild Pistachio), <i>Quercus sp.</i> (Oak), <i>Salix acmophylla</i> Boiss. and <i>Salix alba</i> L. var. <i>micans</i> And. (Willow) were found.
Khalde surge shaft and outlet	R hillside sites having a steep slope to the west	Highly degraded and/or with no important floral biodiversity.
Khalde flow measurement and samplignchamber		This location is characterized by the richness of its flora and the aged specimens of the trees found. This was by far the most important ecosystem visited among the 12 selected sites. This site is on the <i>Pinus brutia</i> Ten series, where the conifers <i>Pinus brutia</i> Ten., <i>Pinus halepensis</i> Mill. and <i>Cupressus sempervirens</i> L. are

STRUCTURE	LANDSCAPE	BIODIVERSITY
		the most abundant formation.
Distribution Chamber	Between the new highway and the old coastal road. Offshore, the coastal beach is used for some recreational activities	Highly degraded and/or with no important floral biodiversity.
Hadath 125 reservoir	Terraced sloping valley	Highly degraded and/or with no important floral biodiversity.
Hadath 90 reservoir	Waste ground	Highly degraded and/or with no important floral biodiversity.
Hazmieh 90 reservoir	Flat to gently sloping ground	Highly degraded and/or with no important floral biodiversity.

Archaeological and historical interests are limited at the locations of surface features of the Project, and no remains were uncovered during site investigations. Khalde has yielded some archaeological finds but not directly in the project area.

A summary of social survey conducted at relevant main villages is given in Table 3 below:

Table 3 Summary of Socio-Economic situation in main villages

TOWN	GENERAL DESCRIPTION	LIVELIHOOD ACTIVITIES	EDUCATION, CULTURE, COMMUNITY & PUBLIC INFRASTRUCTURE	WATER & WASTEWATER SERVICES	OTHER INFORMATION
	<p>Residential and tourist area, It is a coastal area that is rapidly urbanizing</p> <p>Population: 7500-8000</p> <p>Altitude: 350-400 m with 15,000-20,000 residents.</p> <p>Surface area: 12 km²</p> <p>Land ownership: 20-30% publicly owned, and the remaining is privately owned</p> <p>Population: 150,000</p> <p>Land use: 80% is designated for agricultural use</p>	<p>Agriculture: Olive groves; Citrus orchards; Vegetables and Flowers in greenhouses; the majority of designated agricultural lands remain uncultivated due to the lack of irrigation water</p> <p>Industry: Agro-food (Olive oil; Orange Blossom water; Rose water; Carob molasses); Manufacture of Nylon, Tyres and concrete building blocks, towels, tiles</p> <p>Commerce: Small shops and garages</p> <p>Commerce: Banks & shops</p>	<p>High literacy rate (95%)</p> <p>Two public & two private schools</p> <p>Public Library</p> <p>Afforestation campaigns</p> <p>Sports facilities</p> <p>Many public service institutions</p> <p>Monastery of Saint Saviour</p> <p>Four public, 10 private & two archaeological features</p> <p>Three universities, including the largest Lebanese University campus</p> <p>One dispensary & resident doctors</p> <p>Two hospitals, three dispensaries and many resident doctors</p>	<p>A water distribution network runs through Khaldeh and is supplied from the Mecher village. Water pipes have all been repaired this year.</p> <p>Also several privately drilled wells exist in the village with a depth ranging from 30-60 m but water is slightly salty. A sewer network is present and is connected to the Amel in Khaldeh, well supplements the supply in addition to many private wells in privately owned lands.</p> <p>Water is supplied through the Am El-Dabeh water reservoir authority in water distributed through a municipally-owned and managed network.</p> <p>No sewage network, septic tanks are present and operational</p>	<p>resident</p> <p>OTHER INFORMATION</p> <p>rapidly</p> <p>A land</p> <p>urbaniz</p> <p>60-70</p> <p>permits</p> <p>handed</p> <p>the las</p> <p>years</p> <p>60% c</p> <p>populati</p> <p>seasona</p> <p>residents</p>
hiye	<p>Population: 4000</p> <p>Altitude: 350 m</p>	<p>Agriculture: Vegetable production in greenhouses</p> <p>Commerce: Over 10 banks and numerous offices</p> <p>Industry: A grain mill and building blocks factories</p> <p>Commerce: Restaurant/Café</p>	<p>Many public service institutions</p> <p>One public & six private schools; three universities</p> <p>Two hospitals, one dispensary</p> <p>One dispensary & resident doctors</p>	<p>Water is supplied through public wells at depths of 450m and 360m; Dabeh water authority while Dschamages distribution network through a network</p> <p>Up to 150 private wells are drilled in the village</p> <p>A sewage network is present and operational</p>	<p>No sewage network; septic tanks are used</p>
ur	<p>Population: 30,000</p> <p>Resident population: 10,000 (due to displacement & emigration)</p> <p>Land ownership: The majority of lands are privately owned</p> <p>Land use: 20% are in agricultural use</p>	<p>Agriculture: 100 ha of banana plantations and vegetable production</p> <p>Commerce: Restaurants/Cafés; Small shops and garages</p>	<p>Two public & three private schools</p> <p>Archaeological features</p> <p>One dispensary & resident doctors</p>	<p>The Damour River waters are used for irrigation</p> <p>Drinking and service water are supplied through municipal public wells and private wells</p> <p>A sewage network is present but is not operational; septic tanks are used</p>	<p>A land</p> <p>has</p> <p>carried o</p> <p>Around</p> <p>building</p> <p>were</p> <p>out in</p> <p>three ye</p>

PUBLIC CONSULTATION

Lack of consultation with the directly affected local communities in the earlier EIA report posed a necessity to target these in the updated study in aim to ensure that adequate and timely information is provided to them and other stakeholders, and that they are given the chance to voice their opinions and concerns.

Based on an agreed plan with MoE's representatives, ELARD team has consulted potentially affected local people and concerned Municipalities during the socio-economic survey. Project leaflets, prepared in Arabic, were distributed during the survey. These aimed at introducing the project while serving as an invitation to participate in a public consultation meeting.

The public participation event was held in the Lebanese University in Hadath at the Institute of Fine Arts on the 12th of May 2010.

ELARD consultants presented the project details, potential impacts and mitigation measures in a 45-minute presentation and opened the floor for one hour of open discussions with the attendees.

Various environmental impacts were discussed during the open session and some concerns rose up by the attendees. The two main serious concerns raised by the public are summarized in Table 4 with an explanation of how the concern is addressed by the project proponents.

Table 4 Main Public Concerns

CONCERN	DESCRIPTION	ACTION/ANSWER
Retrieval of 3m³/s of water	Concerns were raised regarding type and magnitude of impact that could potentially affect the natural flow of water in the Awali River section downstream the Joun HEP after retrieval of the required amount of water for the Conveyor Project	CDR representative pointed out that the impact would be negligible. ELARD to investigate the issue and address it in its Environmental and Social Impact Assessment Report
Structural impact from TBM activity	Concerns on adverse impacts on the structural stability of the St. Joseph Carmel School were expressed by the chairperson since the tunnel is passing beneath the school.	CDR to provide adequate geotechnical reports proving that there will be no direct impacts resulting from the tunnel boring activity.

A second Public Consultation covering both components of the project was held for the purpose of disclosing the results of the ESIA study on 27 July 2010 and has targeted the same audience including all related stakeholders as for the first consultation.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

A summary of the

impacts of the Project on its surrounding environment assuming no mitigation measures are undertaken is given in Table 5 in an Environmental Impact Severity Matrix (EISM) whereas Table 6 presents the EISM of the project when control and mitigation measures are adopted.

With no mitigation measures being implemented, significant impacts would be attributed to the following activities:

- Dust generation
- Construction works
- Excavation and tunneling
- Blasting
- Solid and Liquid waster generation
- Accidental fuel and chemical spills
- Traffic (during construction phase)
- Land Expropriation

Table 5 Impacts of the Project on its surrounding with no mitigation measures

Activity / Source of the Impact	Unmitigated Impacts						
	Receptor						
	Air Quality	Landscape and Soil QUALITY	water RESOURCES	Biodiversity	Noise	Archeological	Socio-Economic & Public health
Construction Phase							C
Combustion and Exhaust Emissions	3C						3C
Dust Generation	4C						4C
Open Burning of solid waste	2A						2A
Project Footprint		2C				1A	2B
Construction works	4C				2C		2B
Excavation and tunneling works	4C	4C	4C	3C	2C	1A	2B
Blasting		4C		4C	4C		
Solid and Liquid waste generation		4C					4C
Accidental Spill of Fuel, Oil and Chemicals		4B	4C				
Land Expropriation							4C
Traffic					4C		4C
Operation Phase							C
Combustion and Exhaust Emissions							
Open Burning of solid waste							
Solid and Liquid waste generation		4C	3C				4C
Accidental Spill of Fuel, Oil and Chemicals			3C				
Sludge Generation			1C				
Water Pumps					3C		3C
Retrieval of 3m³/s of water upstream Joun			1C				1C
HEP							
Traffic					2B		2B

LEGEND

Consequences		Likelihood	Acceptability
1 - Negligible	4 - Significant	A - Low	Beneficial
2 - Minor	5 - Catastrophic	B - Medium	Negligible with minor mitigation
3 - Moderate	Beneficial	C - High	Minimize Impacts
			Unacceptable

Table 6 Impacts of the Project on its surrounding with mitigation measures

Activity / Source of the Impact	Mitigated Impacts						
	Air Quality	Landscapes and Soil QUALITY	water RESOURCES	Biodiversity	Noise	Archeological	Socio-Economic & Public health
Construction Phase							C
Combustion and Exhaust Emissions	2C						2C
Dust Generation	2C						2C
Open Burning of solid waste	2A						2A
Project Footprint		1C				1A	1B
Construction works	2C				1B		1B
Excavation and tunneling works	2C	2C	2B	2B	1B	1A	1B
Blasting		2C	2C		2B		
Solid and Liquid waste generation		2A					2A
Accidental Spill of Fuel, Oil and Chemicals		2A	2B				
Land Expropriation							3B
Traffic					3B		3B
Operation Phase							C
Combustion and Exhaust Emissions							
Open Burning of solid waste							
Solid and Liquid waste generation		2A	1C				2A
Accidental Spill of Fuel, Oil and Chemicals			1C				
Sludge Generation			1C				
Water Pumps					1B		1B
Retrieval of 3m ³ /s of water upstream Joun			1C				1C
HEP							
Traffic			1C				1C

LEGEND

Consequences		Likelihood	Acceptability
1 - Negligible	4 - Significant	A - Low	Beneficial
2 - Minor	5 - Catastrophic	B - Medium	Negligible with minor mitigation
3 - Moderate	Beneficial	C - High	Minimize Impacts
			Unacceptable

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Table 7 Summary of Environmental and Social Management Plan

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
CONSTRUCTION ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (CESMP)				
Site Clearance/ Excavation	Disturbance to land/landscape (Land scaring from Project Footprint)	Limiting the land clearance area required for pipelines in the vicinity of forested areas of Khalde; Planning and marking access routes and adopting minimum safe operating width	Implementation: Contractor. Supervision: ESM	No cost incurred
Drilling/blasting, pipeline construction and tunnel boring works (<i>to a lesser extent</i>)	Compromised Visual Amenity Contamination of soil quality.	Using existing tracks/ routes to reduce the size of the impacted area; Minimizing (whenever possible) the time and space of heavy machinery use and constructing intensive activities and using whenever possible existing and previously disturbed land and roads to access site and avoiding off-road driving, areas crossing wadis or that are prone to erosion;		
Solid and liquid waste generation from camp operations (such as sanitary facilities and kitchen) and pipelines pressure testing)		Avoiding excessive removal of topsoil and minimizing grading and clearing of vegetation; Stabilization of topsoil and spoil stockpiles along the pipelines previously removed during excavation works and using it as cover material whenever possible during backfilling and site restoration;		
Accidental chemical / oil spills or leaks (from excavators and tunnel boring machine)		A preliminary project handover and restoration plan should be developed that identifies disposal options for all equipment and materials, including products used and wastes generated on site; Project handover (end of Construction) should comprise the complete closure of the labor camps including the removal of all equipments and vehicles and other fixtures and infrastructures and covering of trenches and restoring of all sites to original state. Reduce the use of blasted debris as much as possible and allow backfilling and site restoration from topsoil and spoil excavated by conventional methods (such as drilling) and generated by the tunnel boring works;		

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
		Perform a soil sampling campaign in the Project affected areas, specifically where blasting activities took place, in order to document the soil conditions (physic-chemical characteristics, petroleum contamination, etc.) following the cessation of construction works	Environmental Consultant (to be hired by CDR)	1500
<p>Loading and Unloading operations (at construction sites and spoil handling facilities)</p> <p>Truck transportation (haulage)</p> <p>Operation of on-site diesel-fuelled generators</p>	<p>Increase in ambient dust levels (fugitive dust emissions)</p> <p>Increase in combustion/exhaust emissions (release of combustion gases, NOx, CO2, SO2, CO)</p>	<p>All vehicles, plant and equipment engines shall be properly maintained in accordance with the manufacturer's instructions to maximize combustion efficiency and minimize emissions;</p> <p>Usage of vehicles/machines equipped with exhaust emission control units;</p> <p>All trucks transporting material likely to generate dust should be properly covered according to Lebanese requirements;</p> <p>Maintenance and reporting of monthly fuel consumption records;</p> <p>Any machinery, which is intermittent in use, should be shut off in periods of non use or, where this is impracticable to be throttled back to a minimum;</p> <p>Small combustion source emissions (with a capacity of up to 50 megawatt hours thermal (MWth)) should adhere to the IFC emission standards for exhaust emissions in the General EHS Guidelines and MoE Decision 8/1 of 2001, whichever stricter;</p> <p>Combustion source emissions with a capacity of greater than 50 MWth should comply with the IFC EHS Guidelines for Thermal Power;</p> <p>Implement proper dust control measures. Measures will include the damping down of dust if excavations are occurring in high winds, rig dust suppression units and the covering piles of excavated material to prevent mobilization (with nets or matting);</p> <p>Efficient scheduling of deliveries as well as establishing and enforcing appropriate speed limits over all paved and unpaved surfaces (< 40 km/h) via a Traffic Management Plan (TMP) approved by the Project Proponent.</p>	<p>Implementation: Contractor.</p> <p>Supervision: ESM</p>	No cost incurred

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
<p>Drilling/blasting, pipeline construction</p> <p>Vehicular movement and Equipment operation</p>	<p>Increase in ambient noise level</p>	<p>Fitting all machinery and vehicles with effective exhaust silencers;</p> <p>Maintaining all machinery and vehicles in good repair and in accordance with the manufacturer's instructions;</p> <p>Limit the working hours when near sensitive sites (schools, health care unit, etc.);</p> <p>Proper selection of equipment for the specific tasks considering the lowest sound power level;</p> <p>Maintenance of equipment as not to create unnecessary noise owing to mechanical problems;</p> <p>Operation of equipment in a manner considerate to the ambient noise background;</p> <p>Avoidance of leaving equipment idling unnecessary;</p> <p>Elimination of tonal, impulsive or low frequency noise through noise control engineering techniques where feasible (e.g. dampers, fitting of mufflers, etc.)</p> <p>Provision of alternative methods if necessary (substituting hammering actions with hydraulics);</p> <p>Provision by the Contractor of adequate buffer zone with sensitive populations in the Project Area;</p> <p>Mandatory use of noise plugs during noisy activities and</p> <p>Proper communication with receptors whenever highly noisy events are planned</p>	<p>Implementation: Contractor.</p> <p>Supervision: ESM</p>	<p>No cost incurred</p>
<p>Vehicular movement & Truck Trips/Haulage</p>	<p>Traffic congestion</p>	<p>Liaising with community and government by a dedicated resource in the field throughout the duration of the project (i.e. establishing a complaint register to document potential public complaints.</p> <p>Clearly identify the project footprint to avoid accidents during further development of the area particularly in the designated and construction sites.</p> <p>Having a Traffic Management Plan (TMP);</p>	<p>Implementation: Contractor.</p> <p>Supervision: ESM</p>	<p>No cost incurred</p>

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
		<p>Allowing only certified and trained drivers to carry out transportation related activities;</p> <p>Having an Emergency Response Procedures in place; and</p> <p>Having a maintenance program to all vehicles associated with construction activities.</p>		
Fuel, Oil and Chemical Handling and Storage	Contamination of soil quality and groundwater resources	<p>Storage</p> <p>Where appropriate, fuel, oil and chemicals stores will be sited in specific designated areas on site on an impervious base within a suitably contained area;</p> <p>The fuel storage facilities will have a secondary containment, such as a berm, capable of holding the capacity of the largest container plus 10% to accommodate rainfall;</p> <p>Fresh oil and waste oil will be segregated and stored separately to prevent a potential risk of mixing;</p> <p>All storage tanks will be positioned to minimize the risks of damage by impact; All storage tanks will be of sufficient strength and structural integrity; No storage tank will be used for the storage of fuel, oil or chemicals unless its material and construction are compatible with the type of materials to be stored and storage conditions (e.g. pressure and temperature);</p> <p>Drip trays will be installed underneath equipment such as diesel generators, transformers to contain leakage. The drip trays will be maintained and kept drained of rainwater; and</p> <p>All fuel and oil will be inventoried and use recorded.</p> <p>Refueling</p> <p>Supervision of refueling at all times by appropriate personnel: Checks to fill hoses, valves and nozzles for signs of wear and tear prior to operation;</p> <p>Checks to tank levels prior to delivery to prevent overfilling through side glass</p>	Implementation: Contractor. Supervision: ESM	No cost incurred

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
		<p>or manually by dipstick logs;</p> <p>Locating fill pipes within the containment (unless shut-off valves are fitted);</p> <p>Grounding of tanks and grounding of vehicles during fuel transfers; and</p> <p>Ensuring a supply of suitable absorbent materials is available at re-fuelling points for use in dealing with minor spills. If a leak or spill occurs during loading or offloading operations, the operations will be stopped and the spill will be contained, cleaned up and collected based on the Spill Response Plan.</p> <p>Chemicals</p> <p>Personnel handling chemicals will be trained in their handling and use and aware of the associated hazards including the personnel protective equipment (PPE) requirements through pre-task instruction.</p> <p>Material Safety Data Sheets (MSDS) for all chemicals supplied will be held at the storage area, the point of use and by the site medical staff and site ES&SR representative; Safety signage will be in place;</p> <p>All chemical deliveries (loading and unloading operations) will be supervised at all times and will be transferred to a secure storage area without delay;</p> <p>Storage of chemicals will be sited on designated areas at the site; an inventory of all chemicals on site will be kept and use will be recorded.</p> <p>Chemicals will be properly packaged, labeled and stored;</p> <p>Dangerous/hazard chemicals will be stored separately;</p> <p>Chemical storage drums will be in good condition and with sealed bungs. All used drums will be washed / flushed with water and pierced before leaving the site to prevent local use and subsequent exposure to contaminants if they are not able to be returned to the original supplier.</p> <p>All tanks and containers will be clearly labeled with the nature of the contents and placarded with the MSDS. The storage of chemical products in containers or on palettes equipped with plastic dust cover against severe weather. Chemicals will be shaded. Chemical storage drums and</p>		

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		packaging are to be returned to the original supplier in an orderly fashion i.e. palletized and shrink wrapped.		
Waste Management	Contamination of soil quality and groundwater resources	<p>CDR shall promote the use of a Licensed Municipal Waste Facility in coordination with MoE.</p> <p>All personnel shall be responsible for ensuring that standards of "good housekeeping" are maintained. This will include clearance of all rubbish and work associated debris;</p> <p>Contractors to include a waste management plan as part of CEMP.</p> <p>And CDR to ensure that solid waste management is included in the contractor's agreement.</p>	<p>Implementation: CDR/Contractor.</p> <p>Supervision: ESM</p>	No cost incurred
OPERATION ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (OESMP)				
Site clearance /excavation and spoil stockpiling activities	Contamination of groundwater Quality	Clean up spills if any with an absorbent material such as cat litter.	<p>Implementation: Contractor.</p> <p>SUPERVISION: ESM</p>	No cost incurred
Accidental spills		<p>Develop a contingency plan to prevent potential groundwater contamination.</p> <p>Passing water resulting from tunneling and excavation through oil separator prior to discharge in the event that it has been contaminated with oily residues.</p> <p>Minimize the planned amount of land to be disturbed as much as possible.</p> <p>Use special construction techniques in areas of steep slopes, erodible soils, and stream crossings.</p>		
Tunneling activities		<p>Reclaim or apply protective covering (e.g., vegetative cover) on disturbed soils as quickly as possible.</p> <p>Avoid creating excessive slopes during excavation and blasting operations since these activities accelerate water percolation into ground.</p> <p>Monitor construction near aquifer recharge areas to reduce potential contamination of the aquifer.</p>		
		Disposal of excess excavation materials in approved areas to control erosion		

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		and minimize leaching of hazardous materials. Impose site-specific Best Management Practices, potentially including silt fences, hay bales, vegetative covers, and diversions, to reduce impacts to surface water from the deposition of sediments beyond the construction areas. Immediate implementation of the Oil spill response plan in case of accidental events.		
Site clearance /Excavation	Destruction of natural habitat (loss of forested areas and few native flora species)	Develop a detailed plants inventory at the 3 identified sensitive sites (Ouardaniye WTW, Nahr Damour Siphon/Washout and Khalde Flow measurement and sampling chamber) prior and post construction activities commencement as part of CEMP; Developing an ecosystem rehabilitation plan to regenerate and reintroduce some of the native species of trees (especially at the most degraded areas) present in the studied area, therefore leading to positive impacts on biodiversity.	Implementation: Biodiversity expert	1200
Vehicular movement		Special effort and attention should be given to the 4 sensitive sites Limiting vehicular transport to defined roads as to prevent unnecessary damage to vegetation; Preserving top soil excavated by conventional methods (such as drilling); Avoiding introducing invasive plant species (e.g. weeds). All affected areas must be replanted with indigenous species appropriate to the respective sites; and	Implementation: Contractor. Supervision: ESM Biodiversity expert	No cost incurred
Physical excavation (blasting, site clearance, trenching)	Demolition, alteration of or damage to archaeological resources, whether on surface or below-ground	Prepare a brochure to help crew members recognize any discovery of buried antiquities; and Direct reporting to local authorities (DGA) in case of new findings during Construction and proper documentation of historic sites.	Archaeologist Implementation: Contractor. Supervision: ESM	500 No cost incurred

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
Land Expropriation	Permanent and irreversible loss of land and some loss of agricultural greenhouses (agricultural business)	<p>Consultation with potentially affected communities prior to expropriation procedures.</p> <p>Fair and full compensation for land and other assets expropriated for the project in the public interest as stated in the Lebanese expropriation law (Law No. 58/1991 and its amendments (2006))..</p>	ESM	No cost incurred
	Temporary severance / disturbance of public rights-of-way and access to community resources and services.	<p>Compensation to local farmers who lost their agricultural lands (loss of livelihood);</p> <p>Preparation of a Resettlement Action Plan (RAP) (ongoing) as per the World Bank standards.</p>		
Fuel and Chemicals handling & storage	Contamination of soil quality and groundwater resources	<p>Selecting appropriate locations for septic tanks installation as to avoid leakage and contamination of groundwater.</p> <p>Immediate cleaning of a spill by removing affected top soil layer by trained employees</p>	<p>Implementation: WTW operator</p> <p>Supervision: During the first year of operation: ESM</p> <p>After project handover: Environmental representative from BMLWWA</p>	No cost incurred
		<p>Continuous in-situ sampling of soil in the vicinity and underneath the spill for potential contaminant; and</p> <p>Stopping the source of spill (close valve, seal pipe, seal hole etc...);</p> <p>Refueling in a designated fueling area that includes a temporary berm to limit, if not prevent, the spread of any spill.</p>		
Wastewater generation (sanitary/processes)	Contamination of soil quality and groundwater resources	CDR should commission local contractor for the collection of domestic wastewater and disposal to nearest public sewerage network (Frequency will be based on septic tank volume)	<p>Implementation: Local contractor</p> <p>Supervision year of operation: ESM</p> <p>After project handover.</p>	200 (unit cost)

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
			Environmental representative from BMLWWA	
		Adopting as much as possible dry cleaning techniques to decrease resultant wastewater, and to avoid flushing of spills to deeper soil layers. Develop a stormwater management plan to ensure compliance with regulations and prevent off-site migration of contaminated stormwater.	Implementation: WTW Operator Supervision: During the first year of operation: ESM After project handover: Environmental representative from BMLWWA	No cost incurred
Leaching from Naameh landfill	Contamination of groundwater quality	Regular monitoring wells data inspection for the section of the tunnel lying downstream the land fill Giving additional consideration for the subject strip during maintenance of the tunnel Checking for any fissures or fractures in the tunnel wall during maintenance	During the first year of operation: ESM After project handover: Environmental representative from BMLWA	
Sludge handling and disposal	Contamination of groundwater resources	Design considerations for sludge management include dewatering and thickening processes prior to disposal. Re-use of separated water at the inlet of the WTW instead of discharge of liquid effluent to wadis. In the event of effluent discharge into the Wadi (following sludge dewatering), the former should comply with the Lebanese new standards for discharge into receiving water bodies (Decision No. 8/1). Investigate the disposal of sludge cake to the Naameh landfill instead of quarry rehabilitation. <i>(In the latter case, potential for percolation/leaching into groundwater).</i>	Implementation: WTW Operator Supervision: During the first year of operation: ESM After project handover: Environmental representative from	No cost incurred

PROJECT ACTIVITY	POTENTIAL ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	INSTITUTIONAL RESPONSIBILITIES (INCL. ENFORCEMENT & COORDINATION)	COST ESTIMATE
			BMLWWA	
Operation of pumping stations	Nuisance to noise-sensitive receptors	Fitting all equipment and pumps with effective exhaust silencers Proper selection of pumps for the specific task considering the lowest sound power level; and, Maintenance of pumping stations as not to create unnecessary noise owing to mechanical problems Insulating generator rooms and engines.	Implementation: WTW Contractor Supervision: During the first year of operation: ESM After project handover: Environmental representative from BMLWWA	No cost incurred

