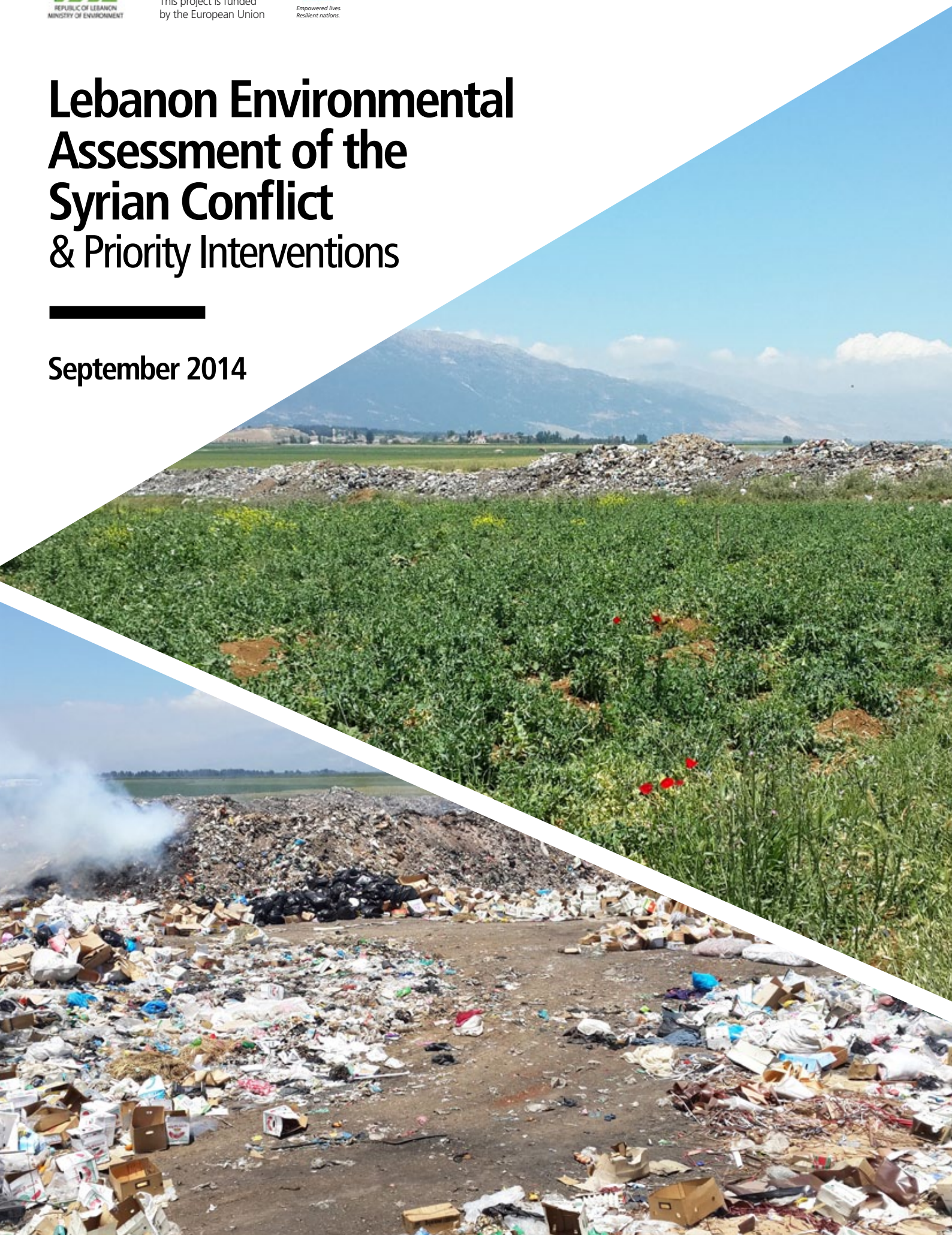
REPUBLIC OF LEBANON
MINISTRY OF ENVIRONMENT

This project is funded
by the European Union

UNDP
Empowered lives.
Resilient nations.

Lebanon Environmental Assessment of the Syrian Conflict
& Priority Interventions

September 2014



This project is funded
by the European Union

Empowered lives.
Resilient nations.

The Lebanese Ministry of Environment has commissioned and overseen the preparation of this report.

This publication was funded and prepared by the European Union through the Programme "Support to Reforms - Environmental Governance".

UNDP has provided technical support and guidance throughout the preparation of this publication.

Editing by www.scienceandink.org
Layout and design by www.nourtohme.com
Printing by Wide Expertise Group

Disclaimer

The findings, interpretations and conclusions expressed in this report are those of the authors and do not necessarily represent those of the Ministry of Environment or the European Delegation in Lebanon or the United Nations Development Programme. The Ministry of Environment does not guarantee the accuracy of the data included in this report. The boundaries, colors, denominations, and other information shown on maps and images in this work do not imply any judgment on the part of the Ministry of Environment concerning the legal status of any territory or the endorsement or acceptance of such boundaries. The Ministry of Environment, the European Delegation in Lebanon and the United Nations Development Programme assume no responsibility of any kind for the use that may be made of the information contained in this report.

PREFACE

Lebanon is the smallest country of the region surrounding Syria. With an area of 10,452 square kilometres (km2), Lebanon is 10 times smaller than Jordan, 43 times smaller than Iraq, and 78 times smaller than Turkey. Yet, in May 2014, Lebanon hosted almost 37 percent of the region's Syrian refugees.

While the Lebanese Government is aware of the dramatic consequences of this massive influx of Syrian refugees in the past two years, the humanitarian situation does not allow restricting the entry of Syrian refugees to Lebanon. However, as the conflict in Syria remains unsolved, the current trend in the increase of Lebanon's population, from 1.4 million additional people in May 2014 to an estimated 1.8 million additional people by December 2014, cannot be sustained. For a small country, with a population of 4 million, these are alarming figures. Lebanon is ringing the alarm bell on all fronts: social, economic, and environmental.

The impacts of the Syrian conflict have been a priority issue on the Lebanese government's agenda. A ministerial committee presided by Prime Minister Salam is actively seeking ways to respond to the needs of the refugees and hosting communities. The government is also closely collaborating with international organizations and donors who are in the field and who are deploying tremendous efforts on Lebanese soil to support Lebanon in facing the challenges of this situation.

While Lebanon has received support, though limited, to face the social and economic challenges resulting from the Syrian conflict, this report flags the extent to which the environmental crisis resulting from the Syrian conflict remains underestimated. Lebanon is indeed facing its bigger challenge with regards to the environmental pressure resulting from the Syrian conflict.

As long as the environmental problems remain unaccounted for, finding solutions will not be flagged as a top priority of the Lebanese government and of the international community alike. Thus, this assessment aims at highlighting the extent of damage and degradation occurring across many environmental sectors.

This report is a call for urgent action—to safeguard Lebanon's fragile natural resources and ecosystems—so that Lebanon will be able to preserve its rich and diverse natural, social, cultural, and political heritage.

By supporting the Ministry of Environment in conducting this assessment, the European Union and the United Nations Development Programme have confirmed the level of damage facing the environment in Lebanon and indicated the way forward for responding to the environmental crisis.

The Ministry of Environment is now calling upon all concerned stakeholders to join hands to remedy the environmental situation and ensure that intervention strategies and actions for the humanitarian response to the Syrian conflict have fully integrated environmental considerations.

H.E. Minister Mohamad Al Mashnouk
Minister of Environment
Beirut, 18 August 2014

ACKNOWLEDGMENTS

"Lebanon Environmental Assessment of the Syrian Conflict and Priority Interventions" is the result of condensed efforts of research, interviews, validation, writing and reviewing. We would like to acknowledge the unlimited support provided by several Governmental Institutions, Local Administrations, International Agencies, Non-Governmental Organizations and Private Sector Organizations during the preparation of this report. Their input has been significantly valuable in the tight timeframe allocated for the preparation of this report and has considerably strengthened the quality of the assessment and recommendations. The names of the contributors are provided at the end of this report. The names of all those who were involved or contributed to the report are alphabetically listed.

Report Management Team
Jihan Seoud, Officer in Charge, Energy and Environment Programme, UNDP
Lamia Mansour, Policy Expert, StREG programme, EU/MOE
Manal Moussallem, Senior Environmental Advisor, UNDP/MOE

Report Coordination
Sawsan Mehdi, Independent Consultant

Author: Solid Waste sector
Farouk Merhebi, Director, EHSRM, American University of Beirut
Reviewers: Solid Waste sector
Bassam Sabbagh, Head, Service of Urban Environment, MOE
Manal Moussallem, Senior Environmental Advisor, UNDP/MOE
Marwan Rizkallah, Project Manager, LEPAP, UNDP/MOE

Author: Water & Wastewater sectors
Samar Khalil, Environmental and Chemical Safety Officer, EHSRM, American University of Beirut
Reviewers: Water & Wastewater sectors
Jihan Seoud, Officer in Charge, Energy and Environment Programme, UNDP
Lamia Mansour, Policy Expert, StREG programme, EU/MOE
Randa Nemer, Advisor to the Minister, MOEW
Ziad Khayat, Project Manager, Groundwater Assessment and Database Project, UNDP/MOEW

Author: Air Pollution
Charbel Afif, Consultant in Air Quality Management Services
Reviewers: Air Pollution
Hassan Harajli, Project Manager, CEDRO, UNDP/MOEW
Nour Masri, Project Manager, ERML, UNDP/MOE
Samar Malek, Head, Service of Environmental Technology, MOE
Vahakn Kabakian, Project Manager, Climate Change Programme, UNDP/MOE

Author: Land Use & Ecosystems
Karim El Jisr, Director, ECODIT LIBAN
Reviewers: Land Use & Ecosystems
Edgard Chehab, Assistant Resident Representative, UNDP
Lamia Mansour, Policy Expert, StREG programme, EU/MOE
Lara Samaha, Head, Department of Ecosystems, Service of Natural Resources, MOE
Nizar Hani, Department of Ecosystems, Service of Natural Resources, MOE

GIS Support
Khalil Zein, Senior Environmental Geologist, Geoflint

TABLE OF CONTENTS

LIST OF BOXES

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

LIST OF TABLES (CONTINUED)

ACRONYMS

AD	Anaerobic Digestor
BCM	Billion Cubic Meter
BML	Beirut and Mount Lebanon
BOD	Biological Oxygen Demand
BRT	Bus Rapid Transit
CAS	Central Administration of Statistics
C&D	Construction and Demolition
CDR	Council for Development and Reconstruction
CEA	Country Environmental Analysis
CEDRO	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
CERMOC	Centre d'Etudes et Recherches sur le Moyen-Orient Contemporain
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Biological Demand
CoED	Cost of Environmental Degradation
COM	Council of Ministers
COMAP	Cadastre Organization Modernization & Automation Project
CSP	Community Supported Projects
DGUP	Directorate General of Urban Planning
EDL	Electricité du Liban
EEA	European Environment Agency
EHSRM	Environmental Health, Safety and Risk Management
EIA	Environmental Impact Assessment

ACRONYMS (CONTINUED)

EMP	Environmental Management Plan
ERML	Environmental Resource Monitoring in Lebanon
ESA	Environmentally Sensitive Areas
ESFD	Economic and Social Fund for Development
ESIA	Economic and Social Impact Assessment
EU	European Union
FAO	Food and Agriculture Organization
GBA	Greater Beirut Area
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GIS	Geographic Information System
GOL	Government of Lebanon
H_2S	Hydrogen Sulfide
HCUP	Higher Council of Urban Planning
HFO	Heavy Fuel Oil
ISWM	Integrated Solid Waste Management
ITS	Informal Tented Settlement
Kg/d	Kilogram per day
Lcd	Liters per capita per day
LCWMC	Lebanese Center for Water Management and Conservation
LEPAP	Lebanon Environmental Pollution Abatement Project
L.L.	Lebanese Lira
LMSEP	Lebanon Municipal Service Emergency Project
LRA	Litani River Authority

MCM	Million Cubic Meter
MEHE	Ministry of Education and Higher Education
MOA	Ministry of Agriculture
MOE	Ministry of Environment
MOEW	Ministry of Energy and Water
MOF	Ministry of Finance
MOI	Ministry of Industry
MOIM	Ministry of Interior and Municipalities
MOPH	Ministry of Public Health
MOPWT	Ministry of Public Works and Transport
MOSA	Ministry of Social Affairs
MOT	Ministry of Tourism
MSW	Municipal Solid Waste
MT	Metric Ton
MUFFIN	Municipal Finance Project
MUSD	Million United States Dollars
MW	Mega Watt
NCRS	National Center for Remote Sensing
NFIs	Non-Food items
NGO	Non-Governmental Organization
NH_3	Ammonia
NIMBY	Not In My Back Yard
NLWE	North Lebanon Water Establishment
NMVOC	Non-methane volatile organic compounds

ACRONYMS (CONTINUED)

NO_2	Nitrogen Dioxide
N_2O	Nitrous Oxide
NOx	Nitrogen Oxides
NWSS	National Water Sector Strategy
O_3	Ozone
O&M	Operation and Maintenance
OMSAR	Office of the Minister of State for Administrative Reform
OWL	Other Wooded Land
PA	Protected Area
PCDD	Polychlorinated Dibenzodioxins, dioxins
PCDF	Polychlorinated Dibenzofurans, furans
PCM	Presidency of the Council of Ministers
PM	Particulate Matter
PM2.5	PM with an aerodynamic diameter of less than 2.5 μm
PM10	PM with an aerodynamic diameter of less than 10 μm
PRS	Palestinian Refugees from Syria
RRP	Regional Response Plan
RSI	Risk Sensitivity Index
SDATL	Schéma Directeur pour l'Aménagement du Territoire Libanais
SHEILD	Social, Humanitarian, Economical Intervention for Local Development
SO_2	Sulfur Dioxide
SOER	State of the Environment Report
StREG	Support to Reforms - Environmental Governance
SME	Small to Medium Enterprises

SWAM	Upgrading Solid Waste Management Capacities in Bekaa and Akkar Regions in Lebanon
SWM	Solid Waste Management
t/d	Ton/day
t/y	Ton/year
TBD	To Be Determined
TEQ	Toxic equivalent
ULB	Upper Litani Basin
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
UOM	Union of Municipalities
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
USAID	United States Agency for International Development
USD	United States Dollars
WASH	Water, Sanitation and Hygiene
WB	World Bank
WE	Water Establishments
WFP	World Food Programme
WHO	World Health Organization
WTE	Waste To Energy
WW	Wastewater
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Current status of refugees resulting from the Syrian conflict in Lebanon

Since the start of the Syrian conflict in 2011, Lebanon has witnessed a massive influx of refugees. According to the United Nations High Commissioner for Refugees (UNHCR), on 31 May 2014, the total number of Syrian refugees in Lebanon was equivalent to 1,087,814 (including those which are registered and those awaiting registration). This number constituted around 37 percent of the total number of the 2.7 million Syrian refugees recorded across the region on the same date.

When the remaining refugees from the Syrian conflict are taken into account (unregistered Syrian refugees residing in Lebanon, Palestinian Refugees from Syria (PRS) and Lebanese returnees from Syria), the total number of refugees in May 2014 becomes equivalent to 1,403,718 persons, which constitutes 28.9 percent of Lebanon's pre-conflict population estimated at around four million persons in 1997. The projected increase of the number of refugees in Lebanon resulting from the Syrian conflict is 1,835,000 refugees by end of December 2014. This increase reflects an accelerated growth in the Lebanese population which was not expected until 2041 and leads to a heavy burden on already fragile environmental resources in Lebanon. Hence, it becomes imperative to measure the impact of this demographic change and its pressure on the environment, namely in the areas of solid waste, water and wastewater, air quality, land use and ecosystems.

Lebanon's response for stabilization from the Syrian conflict

Efforts to coordinate the humanitarian response in Lebanon have been deployed at central, local and interagency levels. The Prime Minister's Decision no.146/2013 (amended respectively by Decisions no. 72/2014 and no. 75/2014) established a committee to prepare an assessment of the needs for the humanitarian response for the refugees and the hosting communities, addressing in particular developmental aspects. Humanitarian response and coordination efforts are jointly led by the Prime Minister's Office, the Ministry of Social Affairs (MOSA) and UNHCR.

In November 2013, the Government of Lebanon with the support of the World Bank and the United Nations prepared the "Lebanon Roadmap of Priority Interventions for Stabilization from the Syrian Conflict" based on the "Economic and Social Impact Assessment of the Syrian Conflict" which was also prepared by the World Bank and the United Nations in September 2013. The Roadmap included a preliminary set of priority interventions intended to contribute towards qualitatively and quantitatively alleviating the impact of the Syrian conflict on Lebanon. While the Roadmap includes some environmental considerations linked to service delivery, it adopts social and economic aspects as the main drive for analysis and costing of interventions for stabilizing the Syrian conflict.

Rationale and methodology of the Environmental Assessment of the Syrian Conflict on Lebanon

The Ministry of Environment (MOE) established "An Internal Committee for the Assessment of the Environmental Impact of the Syrian Refugees in Lebanon", presided by the Minister of Environment (Ministerial decision 50/1 dated 3 April 2014). This committee called upon the European Union (EU) (through the EU-funded programme at MOE "Support to Reforms - Environmental Governance" - StREG) and the United Nations Development Programme (UNDP) to support in conducting an environmental assessment of the Syrian conflict and determine priority interventions that would complement the "Lebanon Roadmap of Priority Interventions for Stabilization from the Syrian Conflict".

The environmental assessment presented in this report highlights the already fragile state of Lebanon's natural environment and sheds light on its rapid deterioration given the dramatic increase in population and the nature of the

refugee crisis. This report proposes both field and policy measures that could be integrated within the humanitarian response and within longer-term interventions. The proposed interventions would improve the living conditions of Lebanese communities and Syrian refugees while being sustainable, equitable and in line with national policies.

The assessment was conducted between May and July 2014. The baseline years used to determine the environmental pre-crisis situation were 2010 or 2011 (depending on data available in each sector). The assessment is based on a projected refugees' population of 1,835,000 in December 2014. As such, the report determines the impact of the Syrian conflict in the year 2014 and does not account for the cumulative impacts since the onset of the conflict. The assessment looks at four impacted areas: solid waste, water and wastewater, air pollution, and land-use and ecosystems. A pre-crisis overview is presented for each area followed by an incremental impact assessment of the Syrian conflict on the specific area. Environmental Management Plans (EMP) are proposed for each of the four areas along with recommendations of priority interventions by time frame. Special consideration is given to priority geographical areas that host the largest number of refugees.

The Environmental Management Plans (EMPs) follow the guidance provided in the Decrees no.8213/2012 and 8633/2012 for establishing an EMP as part of the Environmental Assessment process. An EMP by definition is used to formulate and monitor environmental protection measures for the implementation of any project. It includes environmental safeguards and mitigation measures.

Accordingly, the EMPs presented in this assessment aim at providing guidance on how to better integrate environmental considerations in all measures being proposed to stabilize the Syrian conflict in Lebanon.

The EMPs include mitigation measures at short-, medium- and/or long-terms, their costs, and key stakeholders concerned with their implementation. Where applicable, each mitigation measure presents three forms of interventions: technical support (including infrastructural works), environmental monitoring and capacity development (including legislation, policy, awareness raising, information management, training, other).

For the sectors of solid waste, water and wastewater, and air quality, the EMPs are in line (to a certain extent) with the interventions suggested in the Roadmap. More specifically, the mitigation measures of the EMPs complement those of the Roadmap through a set of proposed environmental actions, which are considered fundamental to ensure the sustainability of the proposed measures.

SOLID WASTE MANAGEMENT

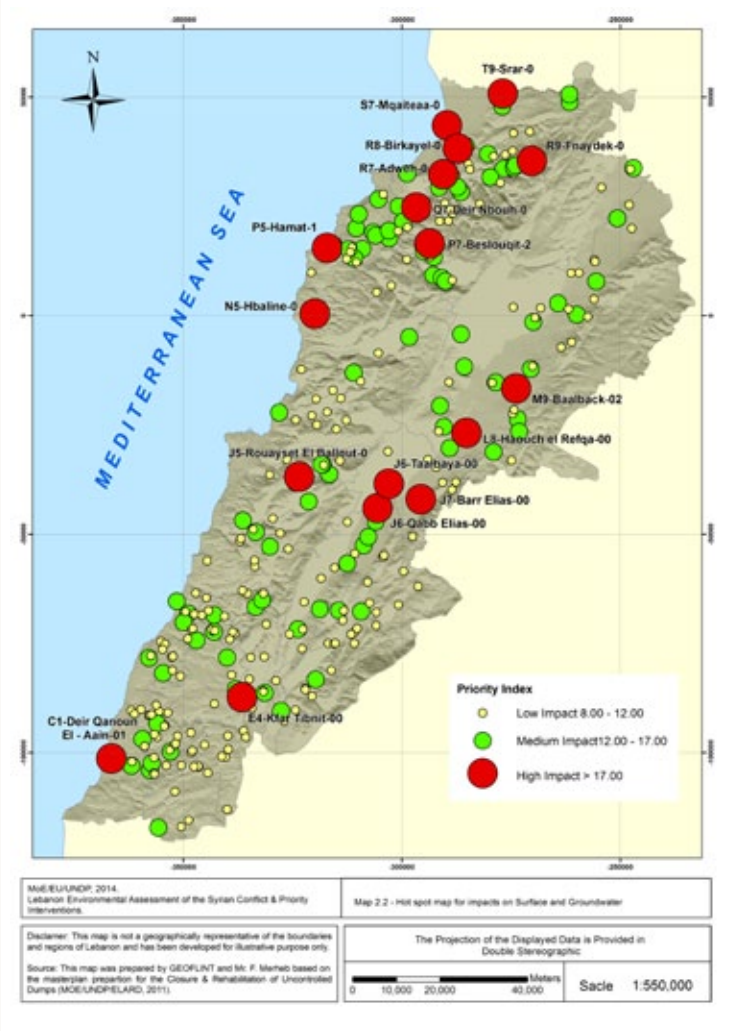
Impact of the Syrian Conflict on Solid Waste Management

The report has estimated that the incremental daily quantity of Municipal Solid Waste (MSW) attributed to refugees is expected to reach 324,568 tons per year (t/y) by end of 2014. This incremental annual waste generated by refugees is significant and is equivalent to 15.7 percent of the solid waste generated by Lebanese citizens prior to the crisis. The highest incremental quantity of solid waste generated by refugees is recorded in Mount Lebanon (Baabda, Matn, Aaley and Chouf), Zahle, Baalbeck, Akkar, Tripoli, Minieh, and West Bekaa where the highest numbers of refugees are present and in areas with the highest numbers of informal Tented Settlements (ITSs) (except for Beirut and Mount Lebanon). The incremental cost for managing and disposing of the waste generated by the refugees in 2014 was estimated to be around 24MUSD/year based on the waste management system in-place.

The report has provided detailed analysis on the following key impacts on solid waste management:

- **Overstressing of existing SWM infrastructure.** The report indicated that 48 percent of the incremental quantities of MSW generated by refugees is being managed within the existing infrastructure, leading to noticeable overstressing in existing or newly constructed SWM facilities (such as Naameh, Tripoli, Zahle, Ain Baal, Minieh) whereby design capacities are no longer adequate to treat and dispose of the generated waste. The burden on municipalities is clearly visible in terms of increase in the spending on SWM by municipalities from the national treasury; it increased by 11 percent between 2011 and 2012 and by 40 percent between 2012 and 2013.

- **Increased pollution of surface and ground water.** A prioritization decision tool through GIS modelling was used to produce a hot spot map based on risk sensitivity assessment in relation to incremental waste quantities deposited in dumps (Map 2.2). The analysis indicated that sites with the highest impact on surface water pollution include Srar, Fnaydek and Adweh in the North, Baalbeck, Barr Elias, Qabb Elias and Machghara in the Bekaa and Ras el Ain and Qana in the South. The sites with the highest impact on groundwater contamination are those located in areas with the highest soil infiltration rates or in areas where faults are densely present. These include Srar, Berkayel, Adweh, Kfarzaina and Hamat in the North, Baalbeck, Taalbaya, Saadnayel, Barr Elias, Qabb Elias and Ghazze in the Bekaa and Ras el Ain and Kfartibnit in the South.



Map 2.2 Hot spot map for MSW impacts on surface and ground water

- **Increase in open dumping and open burning.** The remaining 52 percent incremental quantity of MSW is disposed of in existing open dumps, thus leading to increased contamination of land and soil in addition to surface and groundwater pollution.
- **Deterioration of health and safety conditions around dumpsites.** The report has indicated increased risks for health and safety around dumpsites as they become insect and rodent breeding grounds that would transmit vector-borne diseases. During winter, stagnant water ponds found on such sites also increase the likelihood of vector-borne disease transmission. The most associated health risks are: eye irritation, tuberculosis, diarrhea, typhoid, dysentery, coughing, and scabies.
- **Increased risks from health care waste.** The assessment has indicated an increase of 420 t/y of infectious waste by end 2014, of which it is estimated that 18% (116.8 t/y) is being disposed of in the environment without any treatment. This is observed in hospitals across the country mainly in Tyre, Nabatiyeh, Bent Jbeil, Marjeyoun, Tripoli, and Hermel. Such improper management of medical waste causes serious environmental problems in terms of air, water and land pollution and the spread of diseases (tuberculosis, HIV, hepatitis B and C) and cytotoxic drugs in the environment.

Summary EMP to mitigate the environmental impacts of the Syrian conflict on solid waste management in Lebanon

Potential Impacts	Potential Mitigation Measures	Capital cost (MUSD)	O&M costs (MUSD/year)	Time frame
1.Increased littering	1.1 Provide additional waste collection bins and trucks to host communities in accordance to the distribution of refugees and the incremental quantity of waste generated by caza.	17.4	0.8	Short-term
	1.2 Reduce packaging of food items to reduce waste quantities and littering.	0.2		Short-term
2. Opportunity loss from recycling activities	2.1 Implement recycling activities in areas where refugees are present.	0.4		Short-term
3. Deterioration in health and safety conditions	3.1 Collect and treat health care waste through recognized service providers or in nationally approved treatment centers.	0.1		Short-term
4. Overstressing of existing SWM infrastructures	4.1 Reduce the burdens by alleviating the financial pressure on municipalities to dispose of waste within their premises according to the status quo situation.	0.1	24.0	Short-term
5. Contamination of land, soil, water and groundwater in priority impacted areas	5.1 Build the necessary infrastructure in priority impacted areas so that solid waste generated by refugees and host communities can be properly disposed of.	65.6	32.7	Medium-term
	5.2 Close identified priority dumps in areas of high refugees concentration where high impact of pollution to surface and groundwater was noticed.	47.3	0	Medium-term
Total		**131.1**	**57.6**	

WATER AND WASTEWATER MANAGEMENT

Impact of the Syrian Conflict on Water Resources

The report estimated the increase in domestic water demand due to the refugees between 43 to 70 Million Cubic Meter (MCM) by the end of 2014. This incremental water demand of the refugees corresponds to an increase of the national water demand between 8 and 12 percent. The report has also indicated that this increase varies across cazas and governorates, with the Bekaa having the highest share, followed by the North, Beirut, Mount Lebanon and the South.

The report has provided detailed analysis on the following key impacts on water resources:

- **Depletion of water resources.** According to the assessment, the main water sources used by refugees are the public water network (30 percent), wells (24 percent) and public reservoirs/standpipes (22 percent), noting that groundwater constitutes the largest share of the sources of the public water network and of public reservoirs. As such, the assessment confirms that the increase in water demand due to the refugees is exacerbating the current stresses on water resources in general and on groundwater resources in particular. This has been confirmed by available data from the monitoring of water table levels during the period of April 2013 to April 2014 which showed a decrease ranging between 1 and 20 meters in a number of wells in different Lebanese regions (**Figure 3.2**). Data collected from the Litani River Authority (LRA) in the Litani River basin also showed a decrease in water volume in 3 out of 4 sources in the years 2012-2013 compared to the years 2011-2012 (**Figure 3.3**).

Figure 3.2 Changes in groundwater levels in selected wells from different regions

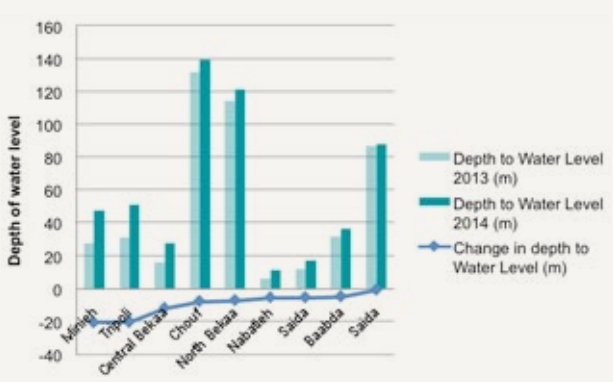
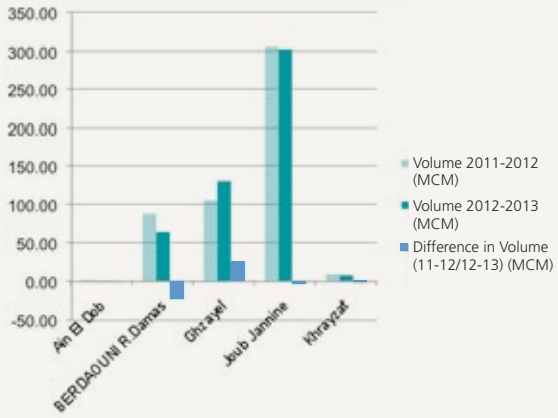


Figure 3.3 Changes in water volumes in selected water sources in the Litani River basin



- **Water quality deterioration.** Humanitarian agencies providing health interventions have attributed diarrheal diseases with the consumption of poor water quality. This was confirmed by testing the bacteriological quality of water which showed high levels of contamination (ten times higher than the WHO guideline values for some chemicals). This was also confirmed in Minieh-Dennieh and Zgharta districts where an average of 63 percent of the tested boreholes and municipality network outlets tested proved to be contaminated with fecal coliforms. The main issue affecting water quality is the low quality and poor cleanliness of the reservoirs which are not maintained regularly and lack, for the most part, of proper coverage that provides protection from external sources of contamination. Moreover, due to the lack of water, proper sanitation and hygiene, a sharp rise in communicable diseases and the emergence of previously absent diseases were reported among refugees' communities and are transmitted to close Lebanese communities.

Impact of the Syrian Conflict on Wastewater Management

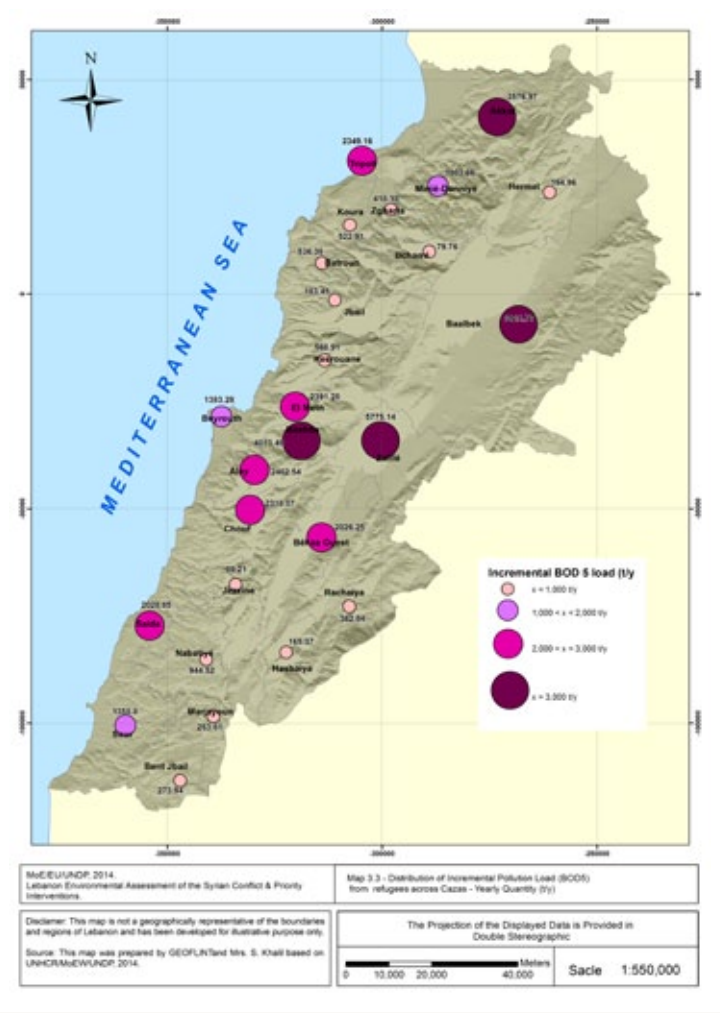
The report estimated an increase in wastewater (WW) generation between 34 and 56 MCM by the end of 2014, corresponding to an increase in the national WW generation rate between 8 and 14 percent, with the Bekaa receiving the highest share of incremental WW.

Given the lack of accurate data, it is difficult to determine the fate of the incremental WW generated by the refugees in the various Lebanese regions. However, as only eight percent of the WW generated at the national level is treated and the remaining is discharged into open lands or in watercourses, it is expected that similar trends would apply to the WW generated by the refugees.

The report has provided an analysis on the key impacts of increased WW discharges on the environment which include the following:

- **Increased pollution load from WW discharges.** The incremental pollution load of wastewater generated by refugees is estimated to produce around additional 40,000 tons of BOD5 per year, reflecting a significant increase of organic biodegradable load in the environment. This represents an increase of around 34 percent of BOD_5 load at the national level, distributed across the different cazas as shown in Map 3.3, with the higher pressure found in the Cazas of Baalbeck, Akkar, Zahleh and Baabda.

- **Increased environmental and health impacts from WW discharges.** The impacts of untreated WW in water bodies and open lands include negative effects on fish and wildlife populations due to oxygen depletion, restrictions on recreational water use as well as restrictions on drinking water consumption. In addition, disposal of wastewater on soil causes soil contamination and negatively affects agricultural crops.



Map 3.3: Distribution of incremental pollution load (BOD_5) from Syrian refugees across Cazas

Summary EMP to mitigate the environmental impacts of the Syrian conflict on water and wastewater management in Lebanon

Potential Impacts	Potential Mitigation Measures	Capital cost (MUSD)	O&M costs (MUSD/year)	Time frame
1. Depletion of water resources	1.1 Controlling groundwater usage especially in water stressed areas	TBD[1]	TBD	Short, Medium & Long-term
	1.2 Developing an emergency action plan for scarcity and drought management	TBD		Short-term
	1.3 Raising awareness on water management and conservation	TBD		Short-term
	1.4 Improving water efficiency in the productive sectors	TBD		Medium- term

1. Depletion of water resources	1.5 Improving water infrastructure storage, transmission and distribution systems especially in impacted areas (Akkar, Baalbeck, Zahle, Baabda, Minieh Dennieh, Tripoli, Aley, Chouf, West Bekaa, Saida and Tyr)	664.0	24.0	Medium to Long-term
2. Deterioration of water quality	2.1 Improving water quality for host-communities and refugees	119.0	TBD	Short-, Medium- & Long-term
3. Increased wastewater discharges	3.1 Managing sludge disposal	4.3	TBD	Short-term
	3.2 Implementing wastewater collection and treatment infrastructure projects in impacted areas (Akkar, Baalbeck, Zahle, Baabda, Minieh-Danniyeh, Tipoli, Aley, Chouf, West Bekaa, Saida and Tyr)	500.0	TBD	Short-, Medium- & Long-term
Total		**1,287.3**	**TBD**	

[1] To Be Determined (TBD)

AIR QUALITY

Impact of the Syrian Conflict on Air Quality

The report has focused on the main sectors affecting air pollution in Lebanon due to the Syrian conflict and which include on-road transport, residential heating, solid waste management practices and electricity production. The assessment did not address other sectors such as cement production which are expected to increase in post-conflict conditions.

- **Air pollution resulting from On-road Transport.** The assessment has used available studies regarding the increase of on-road transport due to the Syrian conflict and has estimated that a 5 percent increase in traffic on the main national axes will take place leading to an increase of 10 percent in Nitrogen Oxide (NOx) and 3 percent increase of Particulate Matter (PM) at the national level. This is expected to worsen the situation in some areas where the concentrations of these pollutants are already above standards. In Beirut, where chronic air pollution already exists, a 6 percent increase in NOx and PM is estimated, and will worsen the existing situation and could lead to higher rate of emergency entrances in hospitals for asthmatic people and the elderly.

- **Air pollution resulting from Residential Heating.** The assessment has estimated 5 percent increase in SO_2 emissions which will add up to already existing national SO_2 levels. Although this sector does not present an important increase of other pollutants at the national level, it will reflect a more pronounced impact at the local scale where the use of heating is concentrated in small geographical areas.

- **Air pollution resulting from Open Burning of Solid Waste.** Among the major concerns rising from open burning of waste is the release of very toxic and carcinogenic compounds including dioxins (PCDD) and furans (PCDF). These chemical compounds are regulated by the Stockholm Convention on Persistent Organic Pollutants which Lebanon ratified in 2002. PCDD/PCDF affect the health of the population living nearby open dumps. With more than 300 open dumps in Lebanon, which are characterized by open burning practices, the assessment estimated an increase of 12.05 g of Toxic Equivalents (TEQ) in PCDD/PCDF emissions. This represents a significant increase from the latest emissions inventory established for PCDD/F in Lebanon in 2004 and which estimated the release into the atmosphere of 80.2 g TEQ/yr from all sources.

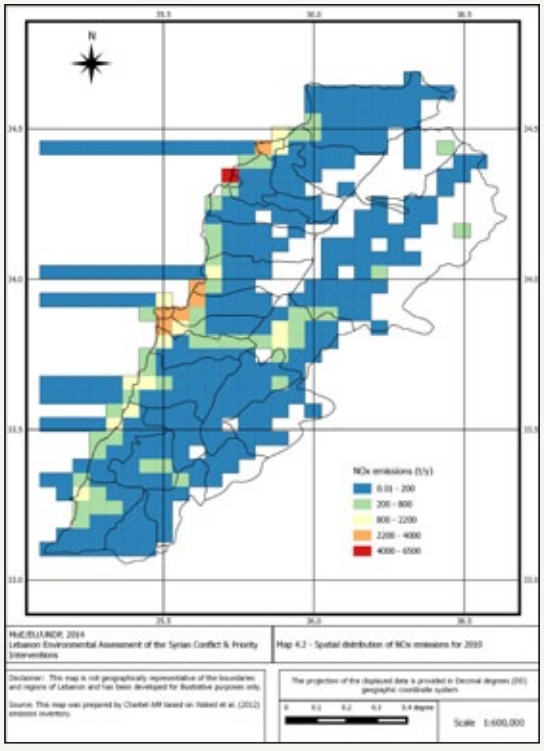
- **Air Pollution resulting from Electricity Production.** As Lebanon is unable to respond to all the electricity demand at national level, private generators are mainly used to respond to electricity shortage. The assessment has

used existing estimations of 251 Mega Watt (MW) increase in electricity demand of refugees which will result in the acquisition of private generators in residential areas. The incremental quantities of air pollutants originating from private generators have been estimated to be 10 percent for NOx and around 2 percent of the remaining pollutants. Given that private generators emit high concentrations of NO_2 and finer PM which are the most hazardous to the human health, they can pose a serious health risk on nearby communities.

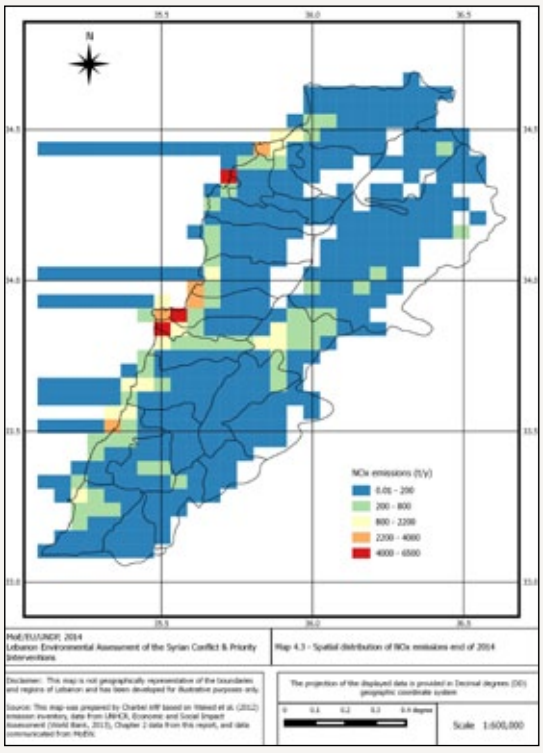
- **Assessment of Total Emissions of Air Pollutants.** Overall, it is estimated that the Syrian conflict will result in an increase of up to 20 percent in emission of air pollutants in Lebanon leading to a degradation of air quality as presented in **Table 4.3**. Further detailed analysis of the spatial distribution of the different pollutants' emissions is essential to locate areas of potential concern with regards to air pollution in Lebanon. An example of a spatial distribution conducted as part of the assessment (**Map 4.2** and **Map 4.3**) shows that GBA which already has moderate to poor air quality will suffer from an increase in air pollutants concentrations of up to 20 percent (based on the conservative approach followed in this assessment). It is also expected that other main cities such as Zahle, Baalbeck, Tripoli and Saida will also witness a significant degradation of their air quality and the health of their population, while rural areas will be affected but to lesser extent.

Table 4.3. Incremental quantities of air pollutants emissions in 2014 compared to 2010

	CO	NOx	SO_2	PM10	PM2.5
Incremental quantities of air pollutants in 2014 compared to 2010 (tons)	100,346	15,317	2,222	1,221	1,077
Percent increase in 2014 compared to 2010 (%)	18	20	4	11	13



Map 4.2. Spatial distribution of NOx emissions for 2010 in tons/year



Map 4.3. Spatial distribution of NOx emissions end of 2014 in tons/year

Summary EMP to mitigate the environmental impacts of the Syrian conflict on air quality in Lebanon				
Potential Impacts	**Potential Mitigation Measures**	**Capital cost (MUSD)**	**O&M costs (MUSD/year)**	**Time frame**
1. Transport	1.1 Implementation of a Bus Rapid Transit (BRT) system	200.3	10.0	Short- & Medium-term
	1.2 Implementation of organized mass transport systems in cities	70.0	5.0	Medium term
	1.3 Maintenance and expansion of the road network including border crossings	350.0	40.0	Short- & Medium-term
2. Energy production	2.1 Decrease effect of private generators	24.3	2.0	Short-term
	2.2 Increase access to sustainable energy	25.1	2.0	Short- & Medium-term
	2.3 Installation of control equipment	85.0	18.0	Short-term
	2.4 Changing fuel type in power plants	400.0	20.0	Medium-term
	2.5 Rehabilitation of the power plants	600.0	30.0	Short- term
	2.6 Strengthening of the electricity network	200.0	10.0	Short-term
	2.7 Support to the energy sector management	12.00		Medium-term
3. Solid waste	3.1 Closure of dumps (Refer to the EMP for SWM for further details)			Short- & Medium-term
4. Residential heating	4.1 Use of bio-energy for residential heating	20.1	2.00	Short- & Medium-term
Total		**1,986.8**	**139.0**	

LAND USE AND ECOSYSTEMS

Impact of the Syrian Conflict on Land Use and Ecosystems

The assessment has focused the impact of the Syrian conflict on land use in Lebanon specifically in terms of urban densification, rental and construction sector and the impact of Informal Tented Settlements (ITSs) on land use and agriculture.

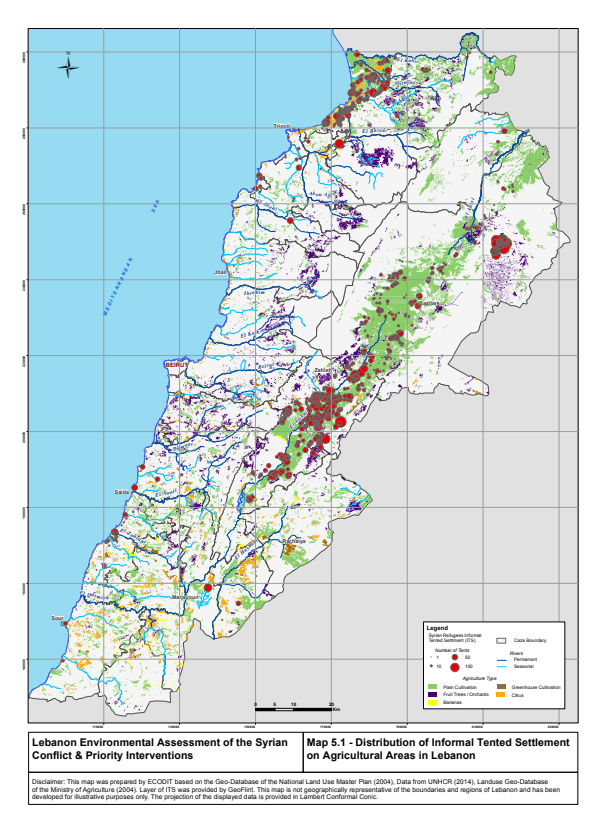
- **Impact of the Syrian conflict on Urban Densification.** The influx of Syrian refugees (formal housing, shelters, and ITSs) has increased Lebanon's population density by about 37 percent from 400 to 520 persons/km2. Lebanon is now ranking 16 on the world population density index up from 21 before the Syrian conflict. Such densification results in many environmental and social stresses on host communities including: more waste generation, water and sanitation problems, more vehicles and scooters on the roads, noise pollution, and crowdedness. Urban densification also encourages new construction. The repercussions of densification are highest in vulnerable communities, as defined by the UNHCR . According to the first vulnerability map produced in July 2013, there were about 30 most vulnerable communities in Lebanon, covering about 750 km2 (7% of the territory). By July of 2014, the number had increased to 45 and their area to about 900 km2 (8.6% of the territory). The number and extent of vulnerable communities is expected to increase further as the Syrian conflict prolongs and as the influx of Syrian refugees intensifies.

- **Impact of the Syrian conflict on the Rental and Construction Sector.** According to UNHCR, the total estimated value of rental transactions by Syrian refugees has reached 34 MUSD per month. This rapidly saturating housing market is encouraging local residents to build new homes and/or finish unfinished homes leading to haphazard and accelerated construction in all affected communities.

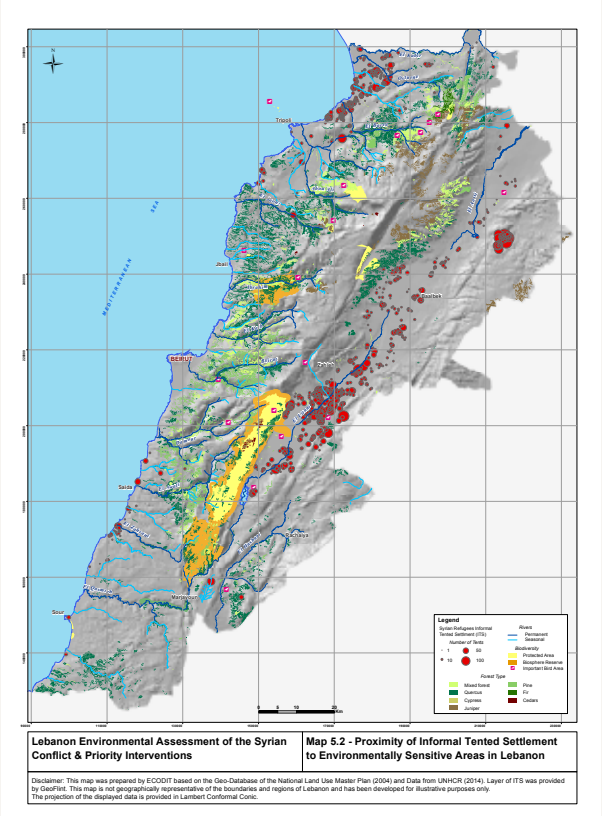
- **Impact of Informal Tented Settlements on Land Use and Agriculture.** Syrian refugees who live in ITSs occupy more land than those who live outside ITSs; tents cannot grow vertically and must also comply with UNHCR specifications related to inter-tent spacing. Even if collectively ITSs house only around 15% of the total number of refugees, the number of ITSs is increasing steadily (from 250 in June 2011 to 1,224 by May 2014), and is expected to further increase as the conflict extends. Evictions because of unpaid rent are causing a reverse migration of Syrian refugees from the cities to ITSs. The largest concentration of ITSs are located in the Beqaa (712 ITS) followed by Akkar (300), which represent Lebanon's largest agricultural regions (refer to Map 5.3 for the distribution of ITSs in agricultural areas). As the number of Syrian Refugees continues to rise, further ITSs growth will inevitably encroach on agricultural lands and put those lands out of production, unless agricultural lands are designated by the Government of Lebanon (GOL) as exclusion zones.

With regards to Ecosystems, Syrian refugees impact ecosystems either directly through ITSs encroachment on Environmentally Sensitive Areas (ESAs) and other fragile ecosystems or indirectly through the environmental impacts of refugees living in formal shelters. These include the following:

- **Impact of Informal Tented Settlements on Environmentally Sensitive Areas.** The distribution and growth of ITSs may potentially affect ESAs. Map 5.4 below presents an overlay of ITSs on Lebanon's known ESAs and highlights potential environmental stressors as presented in Table 5.2 below.



Map 5.3 Distribution of Informal Tented Settlements on Agricultural Areas



Map 5.4 Proximity of Informal Tented Settlements to Environmentally Sensitive Areas

Table 5.2 Potential Environmental Stressors from Informal Tented Settlements on Environmentally Sensitive Areas

Environmentally Sensitive Areas nearby Informal Tented Settlements concentration	**Potential Environmental Impact of Informal Tented Settlements**
Perennial rivers (Kabir, Ostouene, Bared, Litani, and Zahrani)	Risk of increased water contamination from incremental wastewater discharges, sludge disposal, and waste disposal.
In low lands or flat lands (Akkar plane, Beqaa, etc.)	Risk of flooding: 81 out of 151 assessed ITS (52%) in the Beqaa are in flood prone areas (UNHCR, 2014); increased risk of wastewater and sludge infiltration into groundwater.
Close to Quercus forests north-west of Baalbek (Yammouneh)	Risk of abusive felling during winter to provide firewood.
Inside the north-eastern fringes of the Shouf Biosphere Reserve (Qab Elias)	No immediate threat to the Reserve as the area is already impacted by Lebanon's largest quarries.

- **Impact of vulnerable communities on ESAs and other fragile ecosystems.** The assessment has undertaken an overlay of the most vulnerable communities on sectoral maps which confirmed considerable intrusion of vulnerable communities on agricultural areas, forest areas, and ESAs.
- **Impact of Syrian refugees on forest resources.** The impact of Syrian refugees on forest resources is variable, depending on the location. In north Lebanon for example, border villages historically used to thrive on illegal trade routes with Syria, including the smuggling of cheaper Diesel oil. These trade routes closed when the Syrian Conflict intensified, pushing resident populations to look for alternative energy sources including firewood. In the absence of efficient law enforcement and/or energy substitutes, the illegal felling of forest trees has become a lucrative business in some parts of the country (approximately LL350,000 per truck). High wood density (high calorific value) fruit trees including citrus, olive, and cherry are also used as firewood. Other forest areas in Mount Lebanon and the Beqaa have been less affected but the risk of increased felling in the future and as the conflict extends is very high.
- **Impact of increased abstraction on surface water resources and environmental flows.** The incremental water demand for refugees corresponds to a nationwide increase of water demand between 8 and 12 percent by the end of 2014. The extremely dry winter of 2013-2014 (total rainfall less than 50 percent of the annual mean) has already impacted springs many of which will dry up this summer. Overexploitation of springs and the construction of new wells near springs (Akroum, Anjar, etc.) will reduce environmental flows to a trickle. Environmental flows are important to maintain ecosystem health and natural habitats downstream.
- **Impact of septage disposal on lands and ecosystems.** The increase in the rates of generation of WW due to the Syrian refugees will further exacerbate the environmental pressure caused by the disposal of untreated WW as well as disludging of sceptic tanks. Sludge disposal on land and in streams contaminate ecosystems, especially in karstic terrain. The disposal of sludge on open lands, in dolines, and near streams will increase organic loads of these receptors and may alter the composition of aquatic life and riparian ecosystems.

- **Impact of solid waste disposal on landscapes and water bodies.** Solid waste disposal in open dumpsites results in waste dispersion, as well as water and soil contamination. Leachate runoff from open dumpsites exhibit very high organic load, very high ammonia-Nitrogen, and also contain a variety of heavy metals including lead, zinc and copper. Leachate will percolate into the ground and eventually contaminate nearby surface and groundwater. Waste disposal in open dumpsites also consumes additional land area (an estimated 109,075 m2), potentially infringing on agricultural lands. In the absence of containment measures, waste particles carried by water and wind travel long distances and therefore degrade a much wider area.

Summary EMP to mitigate the environmental impacts of the Syrian conflict on land use and ecosystems in Lebanon

Potential Impacts	Potential Mitigation Measures	Capital cost (MUSD)	O&M costs (MUSD/year)	Time frame
1. The number of Syrian Refugees has significantly increased Lebanon's population density	1.1 Alleviate the burden on host communities by improving environmental planning at local level	2.6		Medium-term
	1.2 Support municipalities in urban planning to reduce pressure on private lands and the rate of new construction	0.1		Short-, Medium- & Long-term
2. Number of ITSs is increasing rapidly consuming more land in flood-prone areas, agricultural land and ESAs	2.1 Prevent ITS encroachment on ESAs, agriculture and flood prone areas	5.1	0.12	Short- & Medium-term
3. Illegal /unsanitary disposal of incremental solid waste and sludge is polluting rivers and other water resources	3.1 Regulate and monitor the disposal of waste and sludge in affected communities	2.6	4.6	Short- & Medium-term
4. Increased demand for fuel and firewood is exacerbating pressure on forest resources (especially in North Lebanon and border areas)	4.1 Enforce forest laws and regulations (Law 85/1991, Law 558/1996) and Protected Areas laws and management plans	1.00	1.8	Annual (fall)
	4.2 Ensure alternative sources of fuel before each winter season	4.60	72.00	Annual (fall)
Total		**16.0**	**78.5**	

الملخص التنفيذي

الواقع الحالي للنازحين في لبنان نتيجة الأزمة السورية

شهد لبنان منذ بدء النزاع السوري في العام 2011 تدفق أعداد كبيرة من النازحين. وبحسب أرقام المفوضية للأمم المتحدة السامية لشؤون اللاجئين، فقد وصل عدد النازحين السوريين في لبنان بتاريخ 31 أيار/ مايو 2014 إلى ما يعادل 814 087 1 نازحاً (مسجلين وقيد التسجيل)، ما يشكل نحو 37 في المئة من إجمالي 2.7 مليون نازح سوري مسجلين في جميع دول المنطقة في التاريخ عينه.

وإذا ما أخذنا في الإعتبار الأعداد المقدرة للسوريين المقيمين في لبنان واللاجئين الفلسطينيين من سوريا واللبنانيين العائدين من سوريا، فإن العدد الإجمالي للنازحين من سوريا خلال شهر أيار/ مايو 2014 وصل إلى 718 403 1 شخصاً، أي ما يعادل 28,9 في المئة من عدد سكان لبنان قبل اندلاع النزاع والمقدّر عددهم بنحو أربعة ملايين نسمة في عام 1997. ويتوقع أن يرتفع عدد النازحين في لبنان نتيجة الأزمة السورية إلى 000 835 1 بحلول نهاية كانون الأول/ ديسمبر 2014. وتعكس هذه الزيادة نمواً متسارعاً لسكان لبنان كان متوقعاً للعام 2041 مما يشكل عبئا ثقيلا على الموارد البيئية الهشة أصلاً في لبنان. وبالتالي، فقد أصبح من الضروري تقييم أثر هذا التغيّر الديموغرافي والضغط الناجم عنه على البيئة، وبالتحديد في قطاعات النفايات الصلبة والموارد المائية ومياه الصرف الصحي، والهواء، واستخدام الأراضي والنظم الإيكولوجية.

إستجابة لبنان لتحقيق الإستقرار إثر الأزمة السورية

تبذل الحكومة اللبنانية والمنظمات الإنسانية جهودا في إطار تنسيق عملية الإستجابة الإنسانية في لبنان وذلك على المستويين الوطني والمحلي. وفي هذا الإطار، وبموجب قرار رئيس مجلس الوزراء رقم 146/ 2013 (المعدل على التوالي بالقرارين رقم 2014/72 و2014/75) فقد تم انشاء لجنة لإجراء تقييم لاحتياجات الإستجابة الإنسانية للنازحين والمجتمعات المضيفة بشكل عام، مع التركيز على الجوانب التنموية بشكل خاص. ويتولى عملية التنسيق مجتمعا كل من مكتب رئيس مجلس الوزراء ووزارة الشؤون الإجتماعية ومفوضية الأمم المتحدة السامية لشؤون اللاجئين.

وفي شهر تشرين الثاني/ نوفمبر 2013، أطلقت الحكومة اللبنانية بدعم من البنك الدولي والأمم المتحدة «خارطة طريق للتدخلات ذات الأولوية التي من شأنها تحقيق الإستقرار نتيجة النزاع في سوريا» والتي أعدّت بناء على نتائج التقرير حول «تقييم تداعيات الأزمة السورية على الوضع الإقتصادي والإجتماعي في لبنان». تضمنت خارطة الطريق مجموعة أولية من التدخلات ذات الأولوية الهادفة إلى المساهمة نوعا وكماً في التخفيف من تأثير الأزمة السورية على لبنان. وفي حين أن خارطة الطريق تتضمن بعض الإعتبارات البيئية ذات الطبيعة الخدماتية، فإنها تتبنى الجوانب الإجتماعية والإقتصادية باعتبارها المحرك الرئيسي لتحليل التدخلات وتقدير كلفتها لتحقيق الإستقرار المهدد جرّاء النزاع السوري.

منهجية عمل التقييم البيئي لأثر الأزمة السورية على لبنان

عيّنت وزارة البيئة «لجنة لتقييم أثر النازحين السوريين على البيئة في لبنان»،وذلك برئاسة وزير البيئة (قرار وزاري رقم 1/50 الصادر بتاريخ 3 نيسان/ أبريل 2014). وقد دعت اللجنة كل من الإتحاد الأوروبي (من خلال برنامج «دعم الإصلاحات- الحوكمة البيئية»- StREG المموّل من الإتحاد الأوروبي في وزارة البيئة) وبرنامج الأمم المتحدة الإنمائي إلى توفير الدعم من أجل إجراء هذا التقييم البيئي وتحديد التدخلات ذات الأولوية التي من شأنها أن تستكمل ما تضمنته «خارطة طريق للتدخلات ذات الأولوية التي من شأنها تحقيق الإستقرار نتيجة النزاع في سوريا».

يشدد التقييم البيئي الوارد في هذا التقرير على وضع البيئة الطبيعية في لبنان، كما يسلط الضوء على التدهور السريع الذي شهدته جرّاء الزيادة الهائلة في عدد السكان وطبيعة أزمة النازحين. وعليه يقترح التقرير مجموعة من التدابير الميدانية والسياسات التي يمكن دمجها ضمن الإستجابة الإنسانية وضمن التدخلات الطويلة الأمد، علماً أن هذه التدخلات المقترحة كفيلة بتحسين الظروف المعيشية للمجتمعات اللبنانية والنازحين السوريين مع ضمان استدامتها وتماشيها مع السياسات الوطنية.

أجري التقييم بين أيار/ مايو وتموز/ يوليو 2014 واعتمد فيه العامين 2010 و2011 كسنوات أساس لتحديد الوضع البيئي ما قبل الأزمة (إستناداً إلى البيانات المتاحة في كل قطاع). ويستند هذا التقييم إلى أرقام التقرير السادس حول الاستجابة الاقليمية للأزمة السورية والذي قدّر عدد النازحين في لبنان بنحو مليون وثمانمائة وخمسة وثلاثين ألف نازح بحلول كانون الأول/ ديسمبر 2014. وعليه، يحدد التقرير تأثير الأزمة السورية خلال العام 2014 من دون أن يأخذ في الحسبان الآثار التراكمية منذ بداية الأزمة. ويتوقف التقييم عند أربعة قطاعات تأثرت سلبا، وهي: النفايات الصلبة، والمياه والصرف الصحي، ونوعية الهواء، واستخدام الأراضي والنظم الإيكولوجية.

يقدم التقرير لمحة عن واقع القطاع ما قبل الأزمة يعقبه تحليل لتقييم الأثر المتزايد للنزاع السوري على هذا القطاع. كما يقترح خطة إدارية بيئية لكل قطاع من القطاعات الأربعة بالإضافة إلى توصيات حول التدخلات ذات الأولوية وفقاً لإطار زمني. ويولي التقرير اهتماماً خاصاً للمناطق الجغرافية التي تستضيف أكبر عدد من النازحين.

إدارة النفايات الصلبة

أثر الأزمة السورية على إدارة النفايات الصلبة

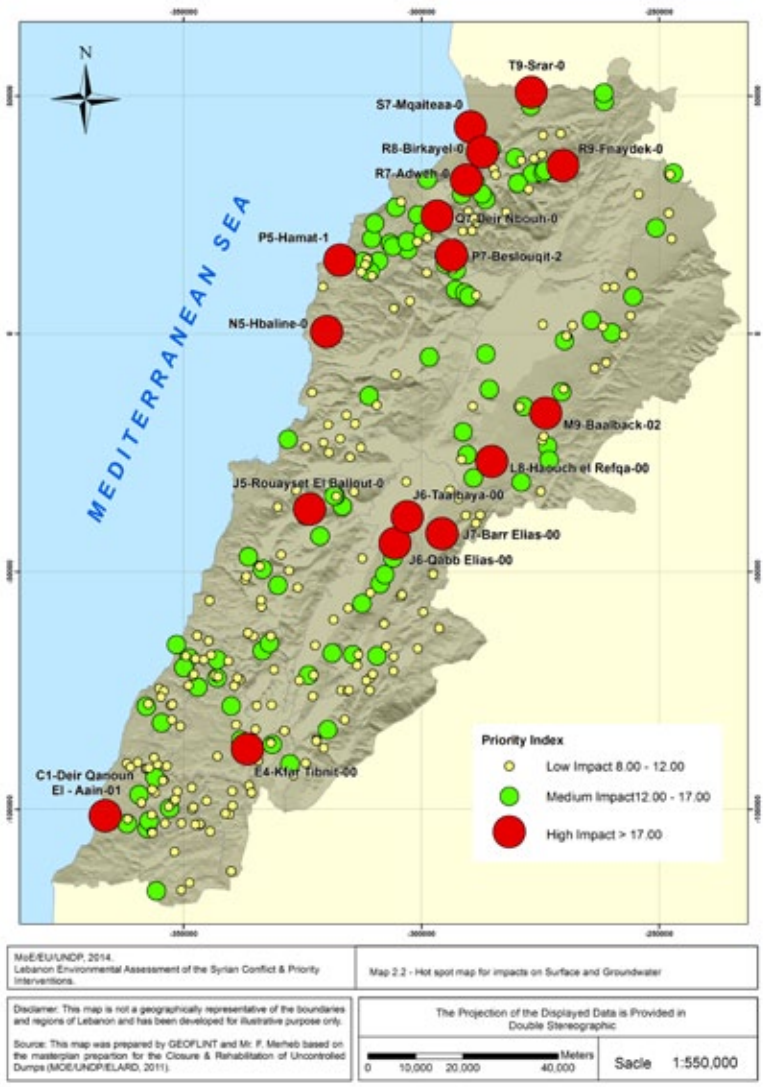
تشير الدراسة إلى أن كمية النفايات الصلبة التي ينتجها النازحون السوريون سوف تصل إلى حوالي 324.000 طن سنوياً بحلول أواخر العام 2014، ما يوازي 15.7 بالمئة من النفايات التي كان ينتجها اللبنانيون قبل بداية النزوح. وتسجل النسب الأعلى من هذه الكميات في جبل لبنان (بعبدا، المتن، عاليه والشوف)، وزحلة، وبعلبك، وعكار، وطرابلس، والمنية، والبقاع الغربي التي تستضيف العدد الأكبر من النازحين وفي المناطق التي تتضمن أكبر عدد من المخيمات غير الرسمية (باستثناء بيروت وجبل لبنان). وقُدّرت التكاليف الإضافية لإدارة النفايات التي ينتجها النازحون في عام 2014 والتخلص منها بحوالى 24 مليون دولار أمريكي في السنة على أساس تكلفة نظام إدارة النفايات القائم حالياً. ويشير التقرير إلى الآثار الرئيسية التالية على مستوى إدارة النفايات الصلبة:

- إزدياد الضغط على البنية التحتية الحالية لإدارة النفايات الصلبة. إذ يقدّر التقرير أن 48 في المئة من الكميات الإضافية من النفايات الصلبة التي ينتجها النازحون هي جزء من إدارة البنية التحتية الحالية، مما يؤدي إلى ازدياد الضغط بشكل ملحوظ على مرافق إدارة النفايات الصلبة القائمة أو المشيّدة حديثاً (مثل الناعمة، وطرابلس، وزحلة، وعين بعال، والمنية) حيث قدرات الإستيعاب الحالية لم تعد كافية لمعالجة النفايات والتخلص منها. كذلك يبيّن التقرير العبء الذي تتحمله البلديات بوضوح من خلال زيادة إنفاقها على إدارة النفايات الصلبة من خزينة الدولة، حيث ارتفع الإنفاق بنسبة 11 في المئة بين عامي 2011 و 2012 وبنسبة 40 في المئة بين عامي 2012 و2013.

- توسع المكبات وعمليات الحرق العشوائية في الهواء الطلق. حيث يتم التخلص مما نسبته 52 في المئة من النفايات الصلبة الإضافية في المكبات المكشوفة القائمة حالياً، مما يؤدي إلى زيادة تلوث الأرض والتربة بالإضافة إلى تلوث المياه السطحية والجوفية.

- زيادة تلوث المياه السطحية والجوفية. فقد تم استخدام أداة لتحديد الأولويات على صعيد القرارات من خلال نمذجة نظم المعلومات الجغرافية لوضع خريطة المناطق الساخنة على أساس تقييم درجة التأثر بالمخاطر بسبب كميات النفايات المتزايدة المودعة في المكبات (الخريطة 2.2). وأشار التحليل إلى أن المناطق الأكثر تأثراً بتلوث المياه السطحية هي صرار وفنيدق وعدوة في الشمال وبعلبك وبرّ الياس وقب الياس ومشغرة في البقاع ورأس العين وقانا في الجنوب. أما تلوث المياه الجوفية فيظهر بشكل مرتفع في المناطق التي تشهد أعلى معدلات تسرب للتلوث إلى داخل التربة أو في المناطق التي تعدّ صدوعاً كثيرة وهي صرار وبرقايل وعدوة وكفرزينا وحامات في الشمال وبعلبك وتعلبايا وسعدنايل وبرّ الياس وقب الياس وغزة في البقاع ورأس العين وكفرتبنيت في الجنوب.

- تدهور الأوضاع الصحية وشروط السلامة حول المكبات. أشار التقرير إلى زيادة المخاطر على الصحة والسلامة حول المكبات التي تتحول أرضاً خصبة للحشرات والقوارض التي تحمل الأمراض. وخلال فصل الشتاء، تزيد برك المياه الراكدة المتواجدة في هذه المواقع من احتمال انتقال الأمراض المنقولة عن طريق الحشرات. ومن أكثر المخاطر الصحية المرتبطة بذلك الحساسية في العينين والسل والإسهال والتيفوئيد والزحار والسعال والجرب.



الخريطة 2.2 تواجد المناطق الساخنة للنفايات الصلبة التي تؤثر على المياه السطحية و الجوفية

- زيادة المخاطر الناجمة عن النفايات الطبية. أشارالتقرير إلى زيادة في كمية النفايات المعدية بحلول نهاية عام 2014 تصل إلى 420 طناً في السنة. ويُقدَّر أن 18 بالمئة من هذه النفايات (ما يوازي 116.8 طن/ السنة) يتم التخلص منها بطريقة عشوائية من دون أي معالجة مسبقة. ويلاحظ ذلك في المستشفيات في جميع أنحاء البلاد ولاسيما في صور والنبطية وبنت جبيل ومرجعيون وطرابلس والهرمل. وتتسبب هذه الإدارة غير السليمة للنفايات الطبية في مشاكل بيئية خطيرة على صعيد الهواء والمياه وتلوث الأراضي وانتشار الأمراض (السل وفيروس نقص المناعة والتهاب الكبد من نوعي باء وجيم) والأدوية السامة للخلايا التي تطلق في الهواء.

ملخص الخطة الإدارية البيئية للتخفيف من الآثار البيئية للأزمة السورية على إدارة النفايات الصلبة في لبنان				
الآثار المحتملة	**الإجراءات المحتملة للتخفيف من وطأة الآثار**	**كلفة الاستثمار (مليون (دولار أمريكي**	**تكاليف التشغيل والصيانة مليون دولار أمريكي في) (السنة**	**الإطار الزمني**
1. تزايد كمية النفايات	1.1 توفير حاويات وشاحنات إضافية لجمع النفايات في المجتمعات وفقاً لتوزع النازحين والكمية الإضافية من النفايات المنتجة في كل قضاء	17,4	0,8	قصير الأجل
	1.2 الحد من تعبئة المواد الغذائية وتغليفها لخفض كميات النفايات والقمامة	0,2		قصير الأجل
2. خسارة الفرصة المتمثلة بأنشطة إعادة التدوير	2.1 تنفيذ أنشطة إعادة التدوير في مناطق تواجد النازحين	0,4		قصير الأجل
3. تدهور شروط الصحة والسلامة	3.1 جمع النفايات الطبية ومعالجتها من خلال مقدمي الخدمات المعتمدين أو في مراكز المعالجة المعتمدة على الصعيد الوطني	0,1		قصير الأجل
4. الضغط المفرط على البنى التحتية لإدارة النفايات الصلبة	4.1 تخفيف الأعباء عن طريق تخفيف الضغوط المالية على البلديات للتخلص من النفايات محلياً وفقاً لما هو سائد حالياً	0,1	24,0	قصير الأجل
5. تلوث الأرض والتربة والمياه والمياه الجوفية في المناطق الأكثر تأثراً	5.1 تشييد البنية التحتية الضرورية في المناطق الأكثر تأثراً بحيث يتمّ التخلص من النفايات الصلبة المنتجة من النازحين والمجتمعات المضيفة بطريقة صحيحة	65,6	32,7	متوسط الأجل
	5.2 إقفال المكبات المحددة ذات الأولوية في مناطق التركز العالي للنازحين حيث لوحظت نسبة عالية من تلوث المياه السطحية والجوفية	47,3	0	متوسط الأجل
المجموع		131,1	57,6	

الموارد المائية و إدارة المياه المبتذلة

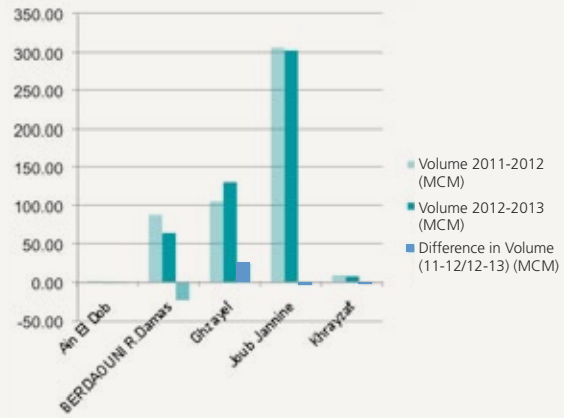
أثر الأزمة السورية على الموارد المائية

قدّر التقرير الزيادة في الطلب على المياه الناتج عن النازحين ما بين 43 إلى 70 مليون متر مكعب بحلول نهاية عام 2014، أي ما نسبته بين 8 و12 في المئة على المستوى الوطني. ويبيّن التقرير أيضاً أن هذه الزيادة تتفاوت بحسب الأقضية والمحافظات، حيث يسجل البقاع أعلى نسبة، يليه الشمال فبيروت ثم جبل لبنان والجنوب.

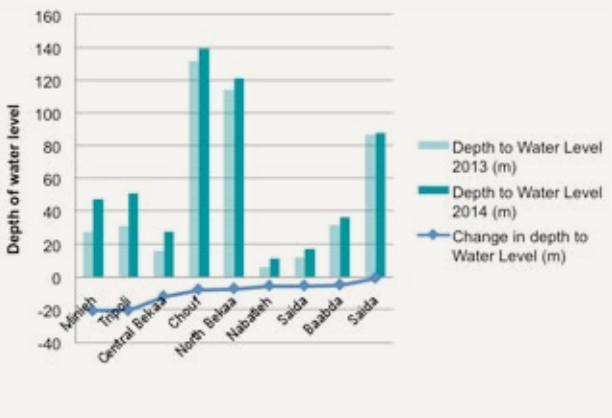
أما أهم الآثار على الموارد المائية فيمكن تلخيصها بالتالي:

- **إستنزاف الموارد المائية**. يشير التقرير إلى أن مصادر المياه الرئيسية المستخدمة من قبل النازحين هي شبكة المياه العامة (30٪)، والآبار (24٪) والخزانات العامة/ سبل المياه (22٪)، علماً أن المياه الجوفية تشكل الحصة الأكبر من المصادر التي تغذي شبكة المياه والخزانات العامة. استناداً إلى ذلك، يؤكد التقرير أن الزيادة في الطلب على المياه تفاقم الضغوط الحالية على الموارد المائية بشكل عام وعلى موارد المياه الجوفية على وجه الخصوص. وقد تأكد ذلك من خلال البيانات المتاحة من رصد مستويات المياه الجوفية خلال الفترة الممتدة بين نيسان/ أبريل 2013 ونيسان/ أبريل 2014 التي أظهرت انخفاضاً يتراوح بين مترٍ و20 متراً في منسوب عدد من الآبار في مناطق لبنانية عدة (الرسم البياني 3.3). كذلك أظهرت البيانات التي تم جمعها من المصلحة الوطنية لنهر الليطاني في حوض نهر الليطاني انخفاضاً في منسوب المياه في 3 من أصل 4 ينابيع في العامين 2012 و2013 مقارنةً بالعامين 2011-2012 (الرسم البياني 3.4).

الرسم البياني 3.4: التغيرات في كميات المياه في مجموعة مختارة من ينابيع المياه في حوض نهر الليطاني (المصلحة الوطنية لنهر الليطاني، 2014)



الرسم البياني 3.3: التغيرات في مستويات المياه الجوفية في مجموعة مختارة من الآبار في مناطق مختلفة (وزارة الطاقة والمياه، 2014)



- **تدهور جودة المياه**. عزت المنظمات الإنسانية العاملة في القطاع الصحي إلى أن أمراض الإسهال في أوساط اللاجئين ناتجة عن استهلاك مياه متدنية الجودة، وهذا ما أكدته التحاليل البكتريولوجية للمياه التي أظهرت مستويات عالية من التلوث (أعلى بعشر مرات مما ورد في الارشادات الصادرة عن منظمة الصحة العالمية لبعض المواد الكيميائية). كما تأكد ذلك في قضائي المنية الضنية وزغرتا حيث تبيّن أن متوسط 63 في المئة من الآبار ومنافذ الشبكات البلدية المشمولة في الإختبار ملوثة ببكتيريا القولون الغائطية. وتتمثل أبرز المشاكل التي

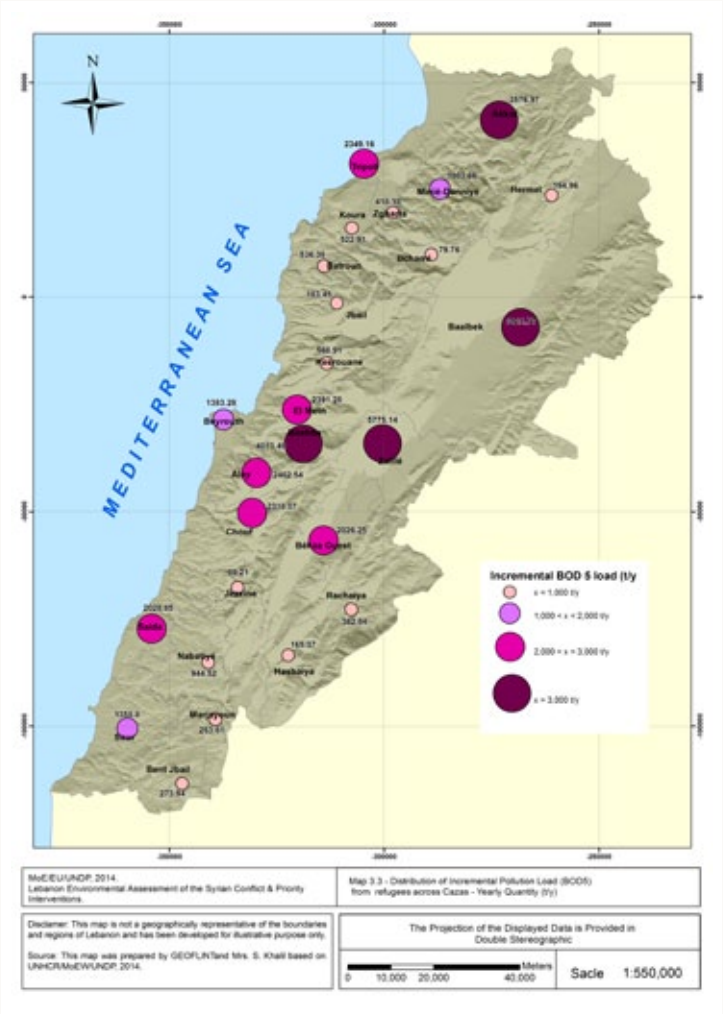
تؤثر على جودة المياه في سوء حال الخزانات وغياب النظافة فيها لعدم إمكانية صيانتها بشكل دوري ولأنها تفتقر بغالبيتها للتغطية المناسبة التي توفر الحماية من المصادر الخارجية للتلوث. علاوةً على ذلك، يؤدي نقص المياه وغياب الصرف الصحي السليم والنظافة إلى ارتفاع حاد في الأمراض المعدية وظهور أمراض جديدة في صفوف النازحين وانتقالها إلى المواطنين اللبنانيين.

أثر الأزمة السورية على إدارة المياه المبتذلة

تشير الدراسة إلى زيادة في كمية المياه المبتذلة بين 34 و56 مليون متر مكعب بحلول نهاية عام 2014، بما يوازي ارتفاعاً في مجموع المياه المبتذلة المنتجة على الصعيد الوطني تتراوح نسبته بين 8 و14 في المئة، حيث تسجل منطقة البقاع أعلى هذه المستويات.
يصعب تحديد مصير المياه المبتذلة الإضافية الناتجة عن النازحين في مختلف المناطق اللبنانية نظراً لعدم توفر البيانات الدقيقة. غير أنه تجدر الإشارة إلى أن 8 في المئة فقط من المياه المبتذلة المنتجة على المستوى الوطني يتم معالجتها، في حين تنتهي الكمية المتبقية في الأراضي أو في مجاري المياه دون معالجة. ويُتوقع أن تلقى المياه المبتذلة الناتجة عن النازحين المصير نفسه.
يقدم التقرير تحليلاً حول التأثيرات الرئيسية لزيادة كمية المياه المبتذلة على البيئة وهي كما يلي:

- **زيادة نسبة التلوث نتيجة عمليات تصريف المياه المبتذلة**. يشير التقرير إلى أن التلوث الإضافي من المياه المبتذلة الناتجة عن النازحين سوف يؤدي إلى إنتاج حوالى 40000 طن إضافي من الطلب البيولوجي على الأوكسيجين سنوياً، مما يعكس زيادة ملحوظة في كمية المواد العضوية القابلة للتحلل في البيئة. ويمثل ذلك زيادة بنحو 34 في المئة في نسبة الطلب البيولوجي على الأوكسيجين على المستوى الوطني، موزعة على مختلف الأقضية كما هو مبيّن في الخريطة 3.3، مع التركز الأكبر في أقضية بعلبك وعكار وزحلة وبعبدا.

- **زيادة الآثار البيئية والصحية الناجمة عن تصريف المياه المبتذلة**. يسفر إطلاق المياه المبتذلة غير المعالجة في المسطحات المائية وعلى سطح الأراضي عن العديد من الآثار البيئية والصحية التي ترد بتفصيل أكبر تحت عنوان «استخدام الأراضي والنظم الإيكولوجية» في التقرير.



الخريطة 3.3 توزيع الطلب البيولوجي على الاوكسيجين الناتجة عن النازحين السوريين في مختلف الاقضية

ملخص الخطة الإدارية البيئية للتخفيف من الآثار البيئية للأزمة السورية على الموارد المائية وإدارة المياه المبتذلة في لبنان				
الآثار المحتملة	**الإجراءات المحتملة للتخفيف من وطأة الآثار**	**كلفة الاستثمار مليون دولار (أمريكي)**	**تكاليف التشغيل والصيانة (مليون دولار أمريكي في السنة)**	**الإطار الزمني**
1. إستنفاد الموارد المائية	1.1 مراقبة استخدام المياه الجوفية خاصةً في المناطق التي تعاني شحاً في المياه	يُحدد لاحقاً		قصير، متوسط وطويل الأجل
	1.2 وضع خطة عمل طارئة لمعالجة شح المياه وإدارة الجفاف	يُحدد لاحقاً		قصير الأجل
	1.3 رفع مستوى الوعي في مجال إدارة المياه والمحافظة عليها	يُحدد لاحقاً		قصير الأجل
	1.4 تحسين كفاءة استخدام المياه في القطاعات الإنتاجية	يُحدد لاحقاً		قصير الأجل
	1.5 تحسين البنية التحتية للمياه وأنظمة التخزين والنقل والتوزيع خاصةً في المناطق المتأثرة (عكار وبعلبك وزحلة وبعبدا والمنية الضنية وطرابلس وعاليه والشوف والبقاع الغربي وصيدا وصور)	664,4		متوسط إلى طويل الأجل
2. تدهور نوعية المياه	2.1 تحسين نوعية المياه للمجتمعات المضيفة والنازحين	119,1	يُحدد لاحقاً	قصير، متوسط وطويل الأجل
3. زيادة كمية المياه المبتذلة	3.2 إدارة التخلص من الحمأة	4,3	يُحدد لاحقاً	قصير الأجل
	3.3 تنفيذ مشاريع البنية التحتية الخاصة بجمع المياه المبتذلة ومعالجتها في المناطق المتأثرة (عكار وبعلبك وزحلة وبعبدا والمنية الضنية وطرابلس وعاليه والشوف والبقاع الغربي وصيدا وصور)	500,0	يُحدد لاحقاً	قصير، متوسط وطويل الأجل
المجموع		1287,3	يُحدد لاحقاً	

تلوث الهواء

أثر الأزمة السورية على نوعية الهواء

تطرّق التقرير إلى القطاعات الرئيسية التي تؤثر على نوعية الهواء في لبنان بسبب الأزمة السورية، وهي تشمل النقل البرّي، والتدفئة المنزلية، وممارسات إدارة النفايات الصلبة، وإنتاج الكهرباء. بينما لم يتطرق التقرير إلى قطاعات أخرى مثل إنتاج الإسمنت التي من المتوقع أن يرتفع شأنها في مرحلة ما بعد النزاع.

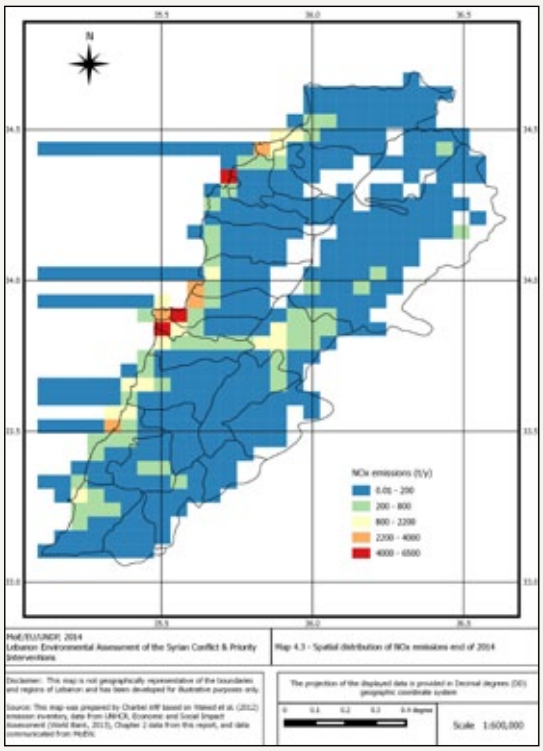
- **تلوث الهواء الناجم عن النقل البرّي.** استند التقييم إلى الدراسات المتاحة حول ارتفاع حركة النقل البرّي بسبب الأزمة السورية وتوقع زيادة بنسبة 5 في المئة في حركة المرور بين المدن اللبنانية الرئيسية مما سيؤدي إلى زيادة بنسبة 10 في المئة في انبعاثات أكاسيد النيتروجين وزيادة 3 في المئة في الجسيمات على المستوى الوطني. ومن المتوقع أن يؤدي ذلك إلى تفاقم الأوضاع في بعض المناطق التي تتجاوز فيها تركيزات هذه الملوثات أصلاً المعايير اللبنانية. ففي بيروت التي تعاني أصلاً من تلوث الهواء المزمن، تشير التقديرات إلى زيادة بنسبة 6 في المئة في انبعاثات أكاسيد النيتروجين والجسيمات العالقة، ما من شأنه أن يفاقم الأوضاع القائمة وقد يؤدي إلى ارتفاع معدل دخول الطوارئ في المستشفيات للأشخاص المصابين بالربو والمسنين.

- **تلوث الهواء الناجم عن التدفئة المنزلية.** تتوقع الدراسة ارتفاعاً بنسبة 5 في المئة في انبعاثات ثاني أوكسيد الكبريت التي سوف تضاف إلى المستويات الحالية على المستوى الوطني. وعلى الرغم من أن هذا القطاع لن يؤدي إلى ارتفاع ملحوظ في الملوثات الأخرى على الصعيد الوطني، إلا أنه سيعكس أثراً أكبر على المستوى المحلي حيث يتركز استخدام التدفئة في مناطق جغرافية صغيرة.

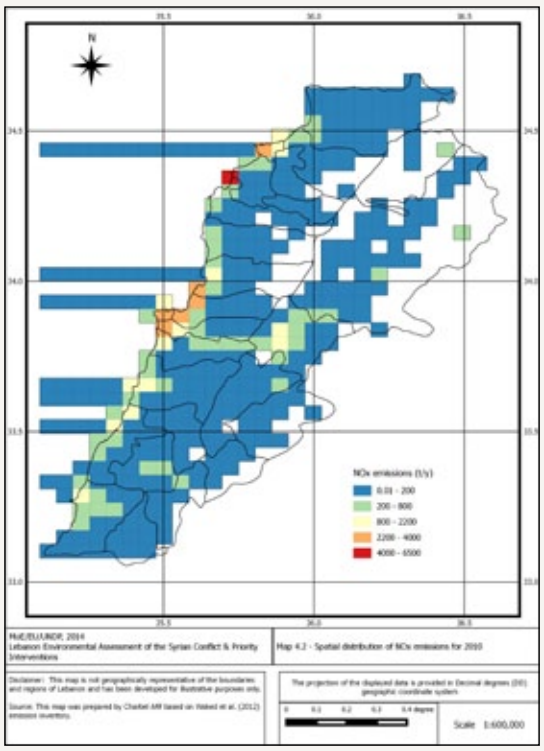
- **تلوث الهواء الناتج عن حرق النفايات الصلبة في الهواء الطلق.** من بين الشواغل الرئيسية المتصلة بحرق النفايات في الهواء الطلق تبرز مسألة إطلاق مركبات سامة للغاية والسرطانية منها الديوكسينات (PCDD) والفيوران (PCDF). وترعى هذه المركبات الكيميائية اتفاقية ستكهولم بشأن الملوثات العضوية الثابتة التي صادق عليها لبنان عام 2002. وتؤثر مواد الديوكسين والفيوران على صحة السكان الذين يعيشون على مقربة من المكبات المكشوفة. ويتضمن لبنان أكثر من 300 مكبّ مكشوف تجري فيها عمليات الحرق في الهواء الطلق، في حين يتوقع التقرير زيادة قدرها 12,05 غرام نتيجة انبعاثات الديوكسين /الفيوران. وهذا يمثل زيادة كبيرة مقارنةً بنتائج المسح الأخير لانبعاثات الديوكسين والفيوران الذي جرى في لبنان في عام 2004 والذي قدر نسبة إطلاقها في الهواء بما يعادل 80,2 غرام من مختلف المصادر.

- **تلوث الهواء الناتج عن إنتاج الكهرباء.** مع غياب القدرة الوطنية على الإستجابة للطلب المتزايد على الكهرباء على المستوى الوطني، يتم استخدام المولدات الخاصة بشكل أساسي لتأمين الحاجات من الكهرباء. وقد ارتكزت الدراسة على التقديرات الحالية التي تشير إلى زيادة متوقعة بـ251 ميجاواط في الطلب على الكهرباء من قبل النازحين، الأمر الذي سيؤدي إلى لجوئهم إلى استخدام المولدات الخاصة في المناطق السكنية. وقد قدرت الكميات الإضافية من ملوثات الهواء المنبعثة من المولدات الخاصة بنسبة 10 في المئة من أكاسيد النيتروجين ونحو 2 في المئة من الملوثات المتبقية. وتشكل المولدات الخاصة التي تنبعث منها تركيزات عالية من ثاني أوكسيد النيتروجين والجسيمات العالقة أكثر مخاطر صحية خطيرة على الإنسان والمجتمعات المجاورة.

- **تقييم مجموع انبعاثات ملوثات الهواء.** تشير التقديرات عموماً إلى أن الأزمة السورية سوف تؤدي إلى زيادة تصل إلى 20 في المئة من انبعاث ملوثات الهواء في لبنان مما يؤدي بدوره إلى تدهور نوعية الهواء على النحو الوارد في الجدول 4.3. ويتطلب تحديد المناطق المثيرة للقلق لناحية تلوث الهواء في لبنان المزيد من التحاليل المفصلة للتوزيع الجغرافي لانبعاثات الملوثات على اختلافها. وتظهر دراسة للتوزيع الجغرافي أجريت من ضمن هذا التقييم (الخريطة 4.2 والخريطة 4.3) أن منطقة بيروت الكبرى التي تعاني بالأصل من نوعية هواء متوسطة إلى رديئة سوف تتاثر من زيادة في تركيزات ملوثات الهواء تصل إلى 20 في المئة (على أساس السيناريو المحافظ المتبع في هذا التقييم). كما يُتوقع أن تشهد مدن رئيسية أخرى مثل زحلة وبعلبك وطرابلس وصيدا تدهوراً كبيراً في جودة الهواء وصحة السكان، في حين تتأثر المناطق الريفية ولكن بدرجة أقل.



الخريطة 4.3 التوزيع الجغرافي إنبعاث اوكسيد النيتروجين في كافة المناطق اللبنانية في 2014 (طن/سنة)



الخريطة 4.2 التوزيع الجغرافي إنبعاث اوكسيد النيتروجين على كافة المناطق اللبنانية في 2010 (طن/سنة)

الكميات الاضافية من انبعاثات ملوثات الهواء في عام ٢٠١٤ مقارنةً بعام ٢٠١٠

	أول أوكسيد الكربون	أكاسيد النيتروجين	ثاني أوكسيد الكبريت	الجسيمات العالقة- 10 مايكرون	الجسيمات العالقة- 2,5 مايكرون
الكميات الإضافية من ملوثات الهواء في عام ٢٠١٤ مقارنة بعام ٢٠١٠ (بالطن)	100.346	15,317	2,222	1,221	1,077
الزيادة المئوية في عام ٢٠١٤ مقارنة بعام ٢٠١٠	18	20	4	11	13

ملخص الخطة الإدارية البيئية للتخفيف من الآثار البيئية للأزمة السورية على نوعية الهواء في لبنان

الآثار المحتملة	الإجراءات المحتملة للتخفيف من وطأة الآثار	كلفة الاستثمار مليون دولار (أمريكي)	تكاليف التشغيل والصيانة (مليون دولار أمريكي في السنة)	الإطار الزمني
1. النقل	1.1 تنفيذ نظام النقل السريع بالحافلات	200,3	10	قصير ومتوسط الأجل

1. النقل	1.2 تنفيذ أنظمة النقل الجماعي المنظم في المدن	70	5	متوسط الأجل
	1.3 صيانة وتوسيع شبكة الطرق بما في ذلك المعابر الحدودية	350	40	قصير ومتوسط الأجل
2. إنتاج الطاقة	2.1 الحدّ من آثار المولدات الخاصة	24,3	2	قصير الأجل
	2.2 زيادة إمكانية الحصول على الطاقة المستدامة	25,1	2	قصير ومتوسط الأجل
	2.3 تركيب نظام معالجة الملوثات الهوائية	85	18	قصير الأجل
	2.4 تغيير نوع الوقود في محطات توليد الكهرباء	400	20	متوسط الأجل
	2.5 إعادة تأهيل محطات توليد الطاقة	600	30	قصير الأجل
	2.6 تعزيز شبكة الكهرباء	200	10	قصير الأجل
	2.7 دعم إدارة قطاع الطاقة	12		متوسط الأجل
3. النفايات الصلبة	3.1 إقفال المكبات (راجع الخطة الإدارية البيئية الخاصة بإدارة النفايات الصلبة لمزيد من التفاصيل)			قصير ومتوسط الأجل
4. التدفئة السكنية	4.1 استخدام الطاقة الحيوية لأغراض التدفئة السكنية	20,1	2	قصير ومتوسط الأجل
المجموع		**1986,8**	**139**	

استخدام الأراضي والنظم الإيكولوجية

أثر الأزمة السورية على استخدام الأراضي

اشار التقرير إلى أثر الأزمة السورية على استخدام الأراضي في لبنان، خصوصاً من حيث زيادة الكثافة السكانية في المدن ومسألة الإيجار وقطاع البناء وأثر المخيمات غير الرسمية على استخدام الأراضي والزراعة.

- **أثر الأزمة السورية على الكثافة السكانية في المدن**. أدى تدفق النازحين السوريين (مساكن رسمية، و مأوي، ومخيمات غير رسمية) إلى زيادة الكثافة السكانية في لبنان بنحو ٣٧ في المئة من ٤٠٠ إلى ٥٢٠ نسمة في الكيلومتر المربع. وأصبح لبنان يحتل الآن المرتبة ١٦ على

أساس مؤشر كثافة السكان العالمي بعد أن كان في المرتبة ٢١ قبل النزاع السوري. وتؤدي هذه الظاهرة إلى الكثير من مظاهر الإجهاد على الصعيدين البيئي والاجتماعي في المجتمعات المضيفة بما في ذلك: إزدياد إنتاج النفايات، ومشاكل المياه والصرف الصحي، وإزدياد عدد الآليات والمركبات والدراجات على الطرق، والتلوث الصوتي والإزدحام. كما تشجع زيادة الكثافة السكانية في المدن توسع عمليات البناء الجديدة. وأكثر ما يتأثر بتداعيات زيادة الكثافة السكانية هي المجتمعات الهشة، وفقاً للتعريف المعتمد من جانب مفوضية الأمم المتحدة السامية لشؤون اللاجئين. تجدر الإشارة إلى أن إجمالي مساحة المنطقة العقارية الحالية لهذه المجتمعات الهشة هي ٧٥٢ كيلومتر مربع أي ما يعادل ٧ بالمئة من المساحة الإجمالية للبنان. ومن المتوقع أن يزداد عدد هذه المجتمعات ونطاقها أكثر مع استمرار الأزمة السورية وتزايد تدفق النازحين السوريين.

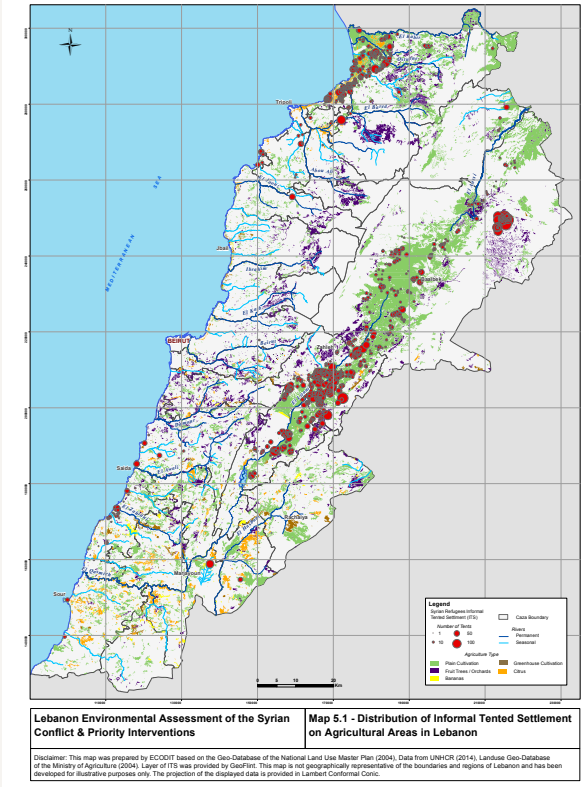
- **أثر الأزمة السورية على مسالة الايجار وقطاع البناء.** وصل مجموع القيمة المقدرة لمعاملات الإستئجار من قبل النازحين السوريين بحسب مفوضية الأمم المتحدة السامية لشؤون اللاجئين إلى ٣٤ مليون دولار أمريكي في الشهر. ويشجع سوق الإسكان المشبع بشكل سريع السكان المحليين على بناء منازل جديدة و/ أو استكمال بناء المنازل غير المكتملة مما يؤدي إلى عملية بناء عشوائية ومتسارعة في كل المجتمعات المتضررة.

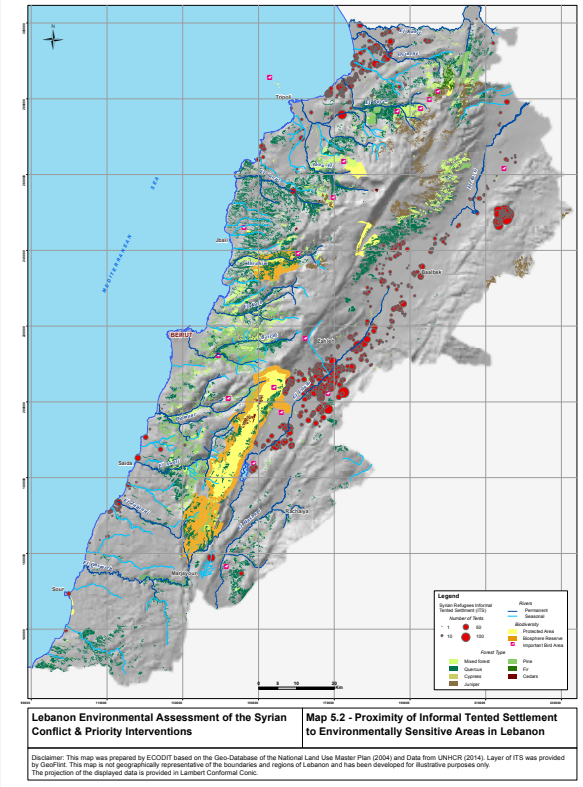
- **أثر المخيمات غير الرسمية على استخدام الأراضي والزراعة.** يحتل النازحون السوريون الذين يعيشون في المخيمات غير الرسمية مساحة أوسع من الأراضي مقارنة مع النازحين الذين يعيشون خارج المخيمات، إذ لا يمكن للخيم أن تتوسع عمودياً ويجب أن تتوافق مع مواصفات مفوضية الأمم المتحدة السامية لشؤون اللاجئين المتعلقة بالمساحة الواجب مراعاتها بين خيمة وأخرى. وحتى وإن كانت المخيمات غير الرسمية لا تأوي من الناحية الجماعية إلا حوالى ١٥ في المئة فقط من العدد الإجمالي للنازحين، غير أن عدد هذه المخيمات غير الرسمية يتزايد بشكل مطّرد (من ٢٥٠ في شهر حزيران/ يونيو ٢٠١١ إلى ١،٢٢٤ بحلول أيار/ مايو ٢٠١٤)، ومن المتوقع أن يرتفع هذا الرقم مع استمرار الأزمة. وتؤدي عمليات الإخلاء الناتجة عن عدم امكانية دفع الايجار إلى موجة هجرة معاكسة للنازحين السوريين من المدن إلى المخيمات غير الرسمية. ويتركز أكبر عدد من المخيمات غير الرسمية في البقاع (٧١٢ مخيماً غير رسمي) فعكار (٣٠٠)، وهما تمثلان أكبر المناطق الزراعية في لبنان (راجع الخريطة ٥,٣ حول توزيع المخيمات غير الرسمية في المناطق الزراعية). وفيما يستمرّ عدد النازحين السوريين في الإرتفاع، سيشكل توسع المخيمات تعدياً حتمياً على الأراضي الزراعية ويحرمها من قدرتها الإنتاجية ما لم يتم تصنيف هذه الأراضي الزراعية من قبل الحكومة اللبنانية كمناطق حظر. كذلك ثمة ما يدلّ أيضاً على أن بعض وحدات الإيواء التي بناها مالكو الأراضي داخل المناطق الزراعية بدأت تشبه أماكن سكن شبه دائمة.

فيما يتعلق بالنظم الإيكولوجية، يتبيّن أن النازحين السوريين يؤثّرون على البيئة مباشرةً من خلال المخيمات غير الرسمية التي تتعدى على المناطق الحساسة بيئياً والنظم الإيكولوجية الهشة الأخرى وبشكل غير مباشر من خلال الآثار البيئية للنازحين الذين يعيشون في المآوي. وتشمل هذه الآثار ما يلي:

- **أثر المخيمات غير الرسمية على المناطق الحساسة بيئياً.** قد يؤثر توزيع المخيمات غير الرسمية وتوسعها على المناطق الحساسة بيئياً. وتظهر الخريطة ٥,٤ أدناه توزع المخيمات غير الرسمية في المناطق الحساسة بيئياً المعروفة في لبنان وتسلّط الضوء على الضغوطات البيئية المحتملة على النحو الوارد في الجدول ٥,٢ أدناه. ويتأكد ذلك أيضاً من خلال مسح للمجتمعات الأكثر هشاشة على الخرائط القطاعية مما يدل على تعدٍّ كبير على المناطق الزراعية والمناطق الحرجية والمناطق الحساسة بيئياً.

- **أثر المجتمعات الاكثر هشاشة على المناطق الحساسة بيئياً.** اشار التقييم الى وجود تعديات للمجتمعات الاكثر هشاشة على المناطق الحساسة بيئياً وذلك بعد أن تمَ مسح للمجتمعات الأكثر هشاشة وذلك بناء على مسح لمواقع هذه المجتمعات ومطابقتها مع الخرائط البيئية القطاعية .





الخريطة 5.3 توزع المخيمات غير الرسمية في المناطق الزراعية

الخريطة 5.4 توزع المخيمات غير الرسمية في المناطق الحساسة بيئياً

الجدول 5.2 عوامل الإجهاد البيئي المحتملة جرّاء المخيمات غير الرسمية في المناطق الحساسة بيئياً

المناطق الحساسة بيئياً قرب تجمعات المخيمات غير الرسمية	الأثر البيئي المحتمل للمخيمات غير الرسمية
الأنهار الدائمة الجريان (نهر الكبير، نهر الأسطوان، نهر البارد، نهر الليطاني ونهر الزهراني)	خطر زيادة تلوث المياه بسبب زيادة تصريف المياه المبتذلة والتخلص من الحمأة ومن النفايات
في السهول أو الأراضي المسطحة (سهل عكار، البقاع، إلخ.)	مخاطر الفيضانات: ٨١ من أصل ١٥١ مخيماً غير رسمي (٥٢٪) في البقاع تقع في المناطق المعرضة للفيضانات (مفوضية الأمم المتحدة السامية لشؤون اللاجئين، ٢٠١٤). زيادة خطر تسرّب مياه الصرف الصحي والحمأة إلى المياه الجوفية
قرب غابات السنديان شمال غرب بعلبك (اليمونة)	خطر القطع الجائر للأشجار خلال فصل الشتاء لتوفير الحطب
داخل الحدود الشمالية الشرقية لمحمية الشوف الطبيعية (قبّ الياس)	لا يوجد تهديد فوري على المحمية بما أن المنطقة متضررة أصلاً بوجود أكبر مقالع لبنان قربها

- **أثر النازحين السوريين على الموارد الحرجية**. يتفاوت أثر النازحين السوريين على الموارد الحرجية بحسب المناطق. ففي شمال لبنان على سبيل المثال، ازدهرت القرى الحدودية تاريخياً من خلال طرق التجارة غير الشرعية مع سوريا، بما في ذلك تهريب وقود الديزل الزهيد الكلفة. وقد أُغلقت هذه الطرقات التجارية عند اشتداد الأزمة السورية، مما دفع السكان المقيمين للبحث عن مصادر بديلة للطاقة بما في ذلك الحطب. وفي غياب إنفاذ القانون الفعال و/ أو بدائل الطاقة، تحوّل قطع أشجار الغابات غير القانوني إلى تجارة مربحة في بعض أنحاء البلاد (٣٥٠,٠٠٠ ليرة لبنانية لكل شاحنة تقريباً). كما تستخدم أشجار الفاكهة ذات الأخشاب العالية الكثافة (ذات قيمة حرارية عالية) بما في أشجارالحمضيات والزيتون والكرز كمصدر لحطب الوقود. وقد تضررت المناطق الحرجية الأخرى في جبل لبنان والبقاع بنسبة أقل غير أن خطر زيادة قطع الأشجار في المستقبل مع تمدّد الأزمة مرتفع للغاية.

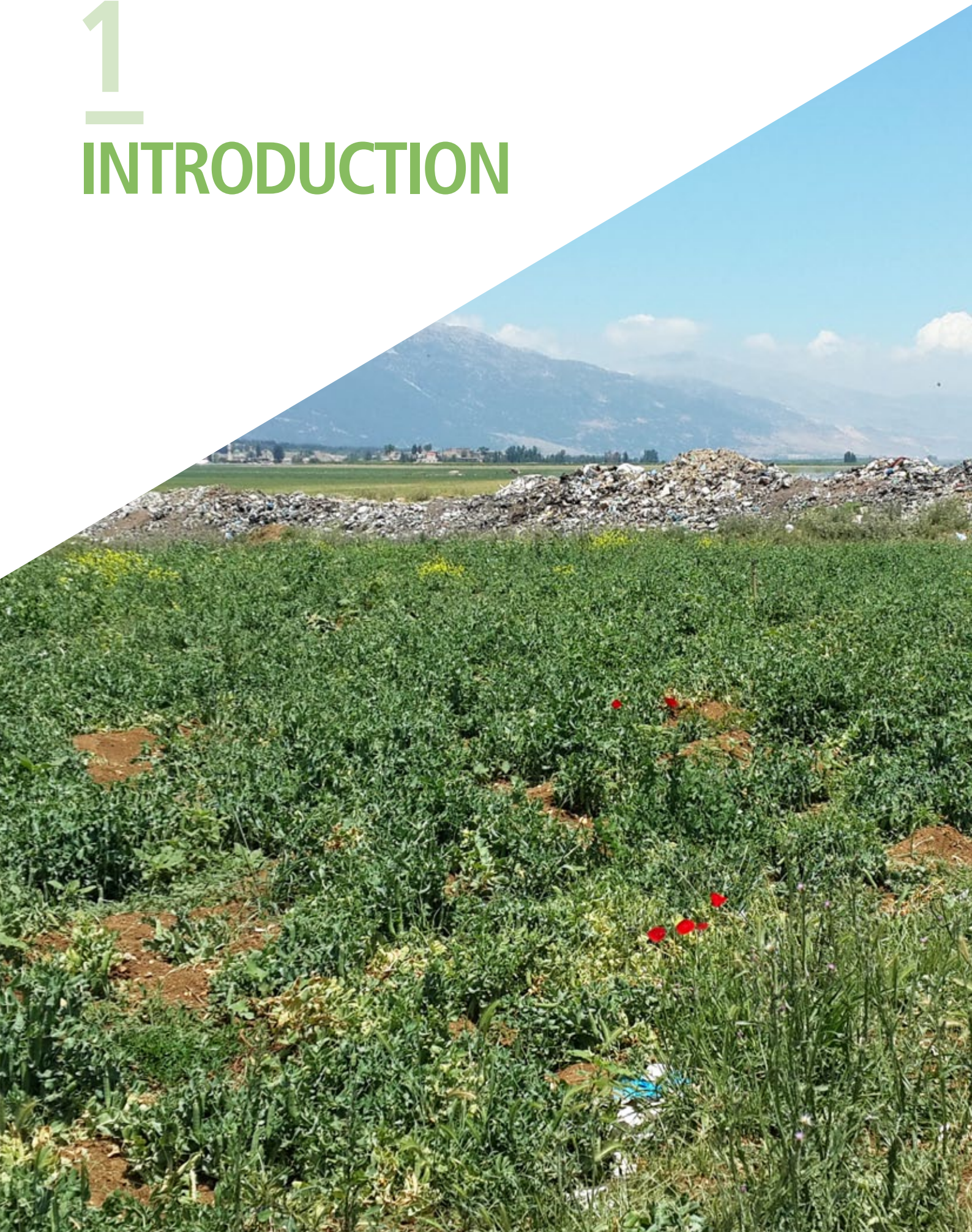
- **أثر زيادة الإستخراج على موارد المياه السطحية والتدفقات البيئية**. يؤدي تزايد الطلب على المياه بسبب وجود النازحين إلى زيادة الطلب على المياه على الصعيد الوطني بنسبة تتراوح بين ٨ و ١٢ في المئة بحلول نهاية عام ٢٠١٤. وقد أثر الشتاء الجاف للغاية في العامين ٢٠١٣-٢٠١٤ (حيث لم تتعدى نسبة هطول الأمطار ٥٠ بالمائة من المعدل السنوي) على العديد من الينابيع التي أصيبت بالجفاف خلال موسم الصيف من هذا العام. ولا شك في أن الإفراط في استغلال الينابيع وبناء آبار جديدة بالقرب من الينابيع (أكروم، وعنجر، وغيرها) سوف يخفضان من مستوى التدفقات المائية الى حدّ كبير مع العلم بأنها مهمة للحفاظ على صحة النظم الإيكولوجية والموائل الطبيعية عند المصب.

- **أثر التخلص من المياه العادمة في الأراضي والنظم الإيكولوجية**. مع زيادة معدلات إنتاج المياه المبتذلة بسبب الأزمة السورية، أشار التقرير الى تفاقم المشاكل البيئية بسبب ارتفاع كمية مياه الصرف الصحي غير المعالجة بالاضافة الى الوحول الناتجة عن تفريغ الجور الصحية. كذلك، إن التخلص من الحمأة في البرّ أو في المجاري المائية يلوث النظم الإيكولوجية، وخصوصاً في المساحات الكارستية ومن شأنه أن يزيد الأحمال العضوية في النقاط التي تصبّ فيها و يغير تركيبة الحياة المائية والنظم البيئية النهرية. وفي الوقت نفسه، يتبين أن عدداً من محطات معالجة مياه الصرف الصحي في لبنان لا تعمل بشكل فعال نظراً لغياب الموارد المالية اللازمة.

- **أثر التخلص من النفايات الصلبة على المناظر الطبيعية والمسطحات المائية**. يؤدي التخلص من النفايات الصلبة في مكبات النفايات المكشوفة إلى تبعثر النفايات، فضلاً عن تلوث المياه والتربة، إذ تحتوي المواد المرتشحة عن مكبات النفايات المكشوفة على نسب مرتفعة للغاية من المواد العضوية، ومن الأمونيا والنيتروجين، ناهيك عن مجموعة متنوعة من المعادن الثقيلة مثل الرصاص والزنك والنحاس. فتتسرب هذه السوائل المرتشحة إلى الأرض ويلوث المياه السطحية والجوفية في نهاية المطاف. كما أن التخلص من النفايات في مكبات مكشوفة يستهلك مساحة إضافية من الأراضي (ما يقدر بـ١٠٩,٠٧٥ متراً مربعاً)، ما قد يضرّ بالأراضي الزراعية. وفي غياب تدابير لاحتواء الوضع، فقد تنتقل جزيئات النفايات عبر المياه والرياح إلى مسافات طويلة ما يسفر عن المزيد من تدهور المساحات الإيكولوجية.

ملخص الخطة الإدارية البيئية للتخفيف من الآثار البيئية للأزمة السورية على استخدام الأراضي والنظم البيئية في لبنان				
الآثار المحتملة	**الإجراءات المحتملة للتخفيف من وطأة الآثار**	**كلفة الاستثمار مليون دولار (أمريكي**	**تكاليف التشغيل والصيانة (مليون دولار أمريكي في السنة)**	**الإطار الزمني**
1. أدى توافد النازحين السوريين إلى زيادة كثافة سكان لبنان بشكل ملحوظ	1.1 تخفيف العبء على المجتمعات المضيفة من خلال تحسين التخطيط البيئي على المستوى المحلي	2,6		متوسط الأجل
	1.2 دعم البلديات في التخطيط المدني للحد من الضغط على الأراضي الخاصة ومعدل البناء الجديد	0,1		قصير، متوسط وطويل الأجل
2. يتزايد عدد المخيمات غير الرسمية بسرعة مستولياً على المزيد من الأراضي في المناطق المعرضة للفيضانات والأراضي الزراعية والمناطق الحساسة بيئياً	2.1 منع تعدي المخيمات غير الرسمية على المناطق الحساسة بيئياً والمناطق المعرضة للفيضانات	5,1	0,12	قصير ومتوسط الأجل
3. يؤدي التخلص غير القانوني وغير الصحي من النفايات الصلبة الإضافية والحمأة إلى تلويث الأنهار والموارد المائية الأخرى	3.1 تنظيم ومراقبة التخلص من النفايات والحمأة في المجتمعات المتضررة	2,6	4,6	قصير ومتوسط الأجل
4. يفاقم ارتفاع الطلب على الوقود وحطب الوقود الضغوط على الموارد الحرجية (لا سيما في شمال لبنان والمناطق الحدودية)	4.1 إنفاذ قوانين الغابات وأنظمتها (القانون 85/1991، القانون 558/1996) وقوانين المحميات الطبيعية والخطط الإدارية	1	1,8	سنوي (في الخريف)
	4.2 ضمان مصادر بديلة للوقود قبل حلول موسم الشتاء من كل عام	4,60	72	سنوي (في الخريف)
المجموع		16	78,5	

1
INTRODUCTION



1.1 CURRENT STATUS OF REFUGEES FROM THE SYRIAN CONFLICT IN LEBANON

The Syrian conflict began in 2011 leading to a massive influx of refugees to nearby countries. According to United Nations High Commissioner for Refugees (UNHCR) statistics of 31 May 2014, there are now more than one million registered Syrian refugees in Lebanon, the equivalent of 241,513 households, and more than 57,000 additional Syrian refugees awaiting registration. Based on these data, Lebanon hosts currently more than 37 percent of the region's 2.7 million Syrian refugees (UNHCR, 2014)[1]. Moreover, the Lebanese Government estimates that another 230,000 Syrians are residing in Lebanon[2].

The May 2014 records of the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) show there are more than 52,000 Palestinian Refugees from Syria (PRS)[3] in Lebanon, and it is estimated that there are approximately 33,000 Lebanese returnees from Syria[4]. As such, in 31 May 2014, Lebanon has accounted an additional population increase equivalent to 1,403,718 persons, which constitutes 28.9 percent of its pre-conflict population estimated at around four million persons in 1997[5]. (Refer to **Table 1.1**)

Table 1.1 Estimated numbers of refugees in Lebanon due to the Syrian conflict

Population influx due to Syrian conflict	31 May 2014	December 2014 (RRP6 Forecast)
Syrian refugees	1,087,814 total including 1,030,413 registered and 57,401 awaiting registration (UNHCR)	1,500,000
Unregistered Syrians	230,000 (Government estimates/ RRP6)	230,000 (Government estimates)
Palestinian Refugees from Syria	52,335 (UNRWA/ UNHCR)	55,000 (RRP6 mid-term review)
Lebanese Returnees	33,569 persons (RRP6 planning projection for May 2014)	50,000 persons
TOTAL	**1,403,718**	**1,835,000**

The projected increase in population density in Lebanon, resulting from a foreseen rise in refugee numbers to around 1,835,000 refugees by end of December 2014, reflects an accelerated growth in the Lebanese population which was not expected until 2041. This large influx of people in Lebanon constitutes a heavy burden on already fragile environmental resources. Hence, it becomes imperative to measure the impact of this demographic change and its pressure on solid waste management, air quality, water and wastewater, land use, and ecosystems.

While exact information on the distribution of the total number of Syrian refugees—registered and unregistered—at municipality/village level is lacking, UNHCR's database (May 2014) refers to the presence of registered refugees across 1,811 villages and localities in Lebanon[6]. Along with these statistics, registered refugees are located respectively in the governorates of the Bekaa (34.62 percent); the North (26.33 percent); the Mount Lebanon (23.89 percent); the South (12.38 percent); and, Beirut (2.78 percent). At caza (provincial subdivision) level, the highest concentrations of refugees are in Zahle (16 percent), Baalbeck (11 percent), Akkar (10.1 percent), Baabda (7.8 percent), Tripoli (6.1 percent) and West Bekaa (5.9 percent)[7], as shown in **Map 1.1**.

---

[1] UNHCR, Interagency information sharing Portal, regional overview, registered Syrian refugees, 30 May 2014

[2] Media sources estimated that there are about half a million of non-registered Syrians, some of these may register at UNHCR soon (www.assafir.com, dated 17 April 2014). Other informal sources reported that non registered Syrians exceeded 300.000 persons. For consistency purposes, the present report will adopt a figure equal to 230.000 persons as referred to in the Syria Regional Response Plan (RRP6, Lebanon section, Lebanese Government estimates, page 3)

[3] Communication with Vincent Dupin, Inter-Agency Team, 19 June 2014

[4] The total number of Lebanese returnees from Syria for 31 May 2014 is calculated based on RRP6 planning projection, which indicates that the number of Lebanese returnees will reach 50,000 persons by December 2014.

[5] The demographic increase in 2014 is calculated based on the assumption that Lebanon population was four million persons in 1997 with a demographic increase of 1.7 percent per year

[6] UNHCR, Statistics of registered Syrian refugees of 31 May 2014.

[7] Idem reference 6

1.2 CURRENT RESPONSE TO THE SYRIAN CONFLICT

Efforts to coordinate the humanitarian response have been deployed at central, local, and interagency levels.

The Prime Minister's Decision no.146/2013 (amended respectively by Decisions no. 72/2014 and no. 75/2014) established a committee[8] which mandate includes:

- the preparation of a needs assessment for the humanitarian response for the refugees and the hosting communities, addressing in particular developmental aspects (including the infrastructure's carrying capacity) and the macroeconomic and financial implications of the influx to Lebanon, and,
- the development of a financing mechanism intended to become a multi-donor trust fund (to be used as a bilateral financing mechanism as well).

The committee is also mandated to guide and supervise the support provided to refugees.

In July 2013, the Council of Ministers (COM) promulgated the Decision no. 1, dated 13/1/2013 which entrusted the Minister of Interior and Municipalities (MOIM) to establish a Central Security Unit (Central Unit) that follows up on the situation of Syrian refugees. Regional security cells that report back to the Central Unit were also formed at the District Commissioner (Qaem Maqam) level (MOIM Decision no.242 2013). These regional cells include representaives of military and security bodies in addition to ministries of Social Affairs (MOSA), Public Health (MOPH), and, Education and Higher Education (MEHE). These cells update periodically the numbers of Syrian refugees residing in municipalities and villages at the caza level, manage and control overall assistance and supervise the distribution process, coordinate with municipalities and nongovernmental organizations involved in sheltering/hosting Syrian refugees, and report weekly on the condition of the refugees and the difficulties they face. It is to be noted that the cells' meetings were used by municipalities and unions of municipalities as an opportunity to communicate their needs to address gaps in service delivery (Refer to **Box 1.1**).

Box 1.1 Coordination at local level: Example of South Lebanon

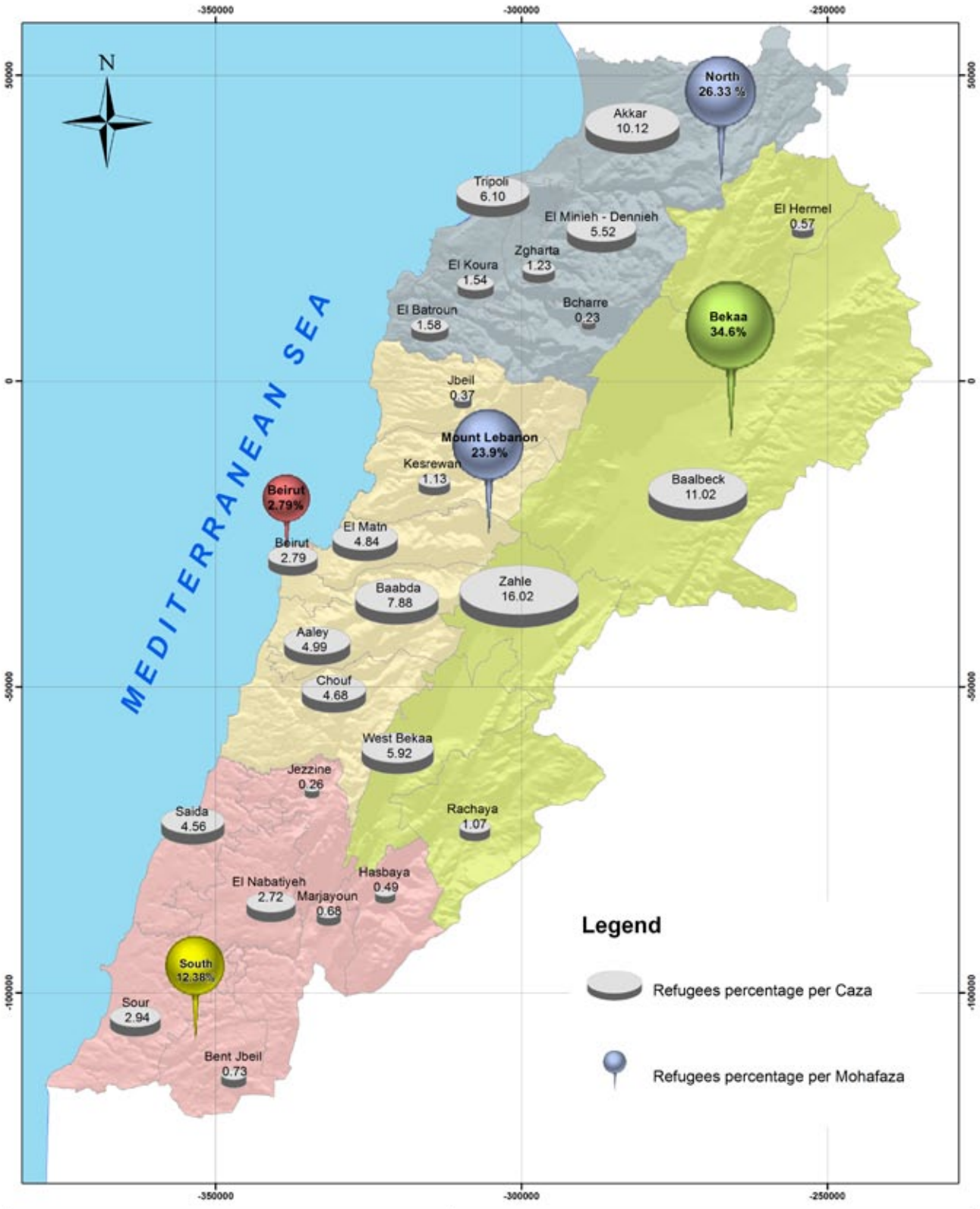
Following the Ministry of Interior and Municipalities (MOIM) Decision no.242/2013, bi-weekly local coordination meetings take place in the Cazas of Nabatiyeh, Bent Jbeil and Sour. Beside the security considerations, meetings are held to provide updates on the numbers of Syrian refugees in the municipalities and villages; to discuss the difficulties facing the unions of municipalities and municipalities in delivering their services; and, to examine Community Support Projects (CSP) submitted by local authorities for potential funding. Environmental issues have become a key municipal concern as CSP proposals indicate, particularly since early 2014. It is estimated that 50 percent of the proposals submitted by local authorities are environment related, mostly solid waste collection, streets' sweep-up, and water increase options to address the forthcoming drought. This interest in environmental projects is attributed to the likely financial pressures confronting local administrations to handle expenses related to service delivery, including labour, maintenance and/or equipment, due to growing population pressures on already torn out local infrastructures.

A number of challenges facing these local coordination meetings are highlighted, predominantly the shortcoming of the solutions offered to address the concerns of local administrations; the irregular attendance of international and national non-governmental organizations to these meetings; the inconsistency observed between the size and type of CSP proposals submitted and the funding made available per region; and, the lack of a tangible operational mechanism that may contribute towards boosting up the "developmental" side of the local coordination process. It is believed that donors can greatly benefit from the developmental discussions of these meetings if they are better structured.

Local committees do not discuss issues related to PRS, although some Palestinian camps face dire conditions due to further demographic pressure exerted on the existing stressed environmental and socioeconomic camps' contexts.

Interview with Samer Haydar, Director of "Social, Humanitarian, Economical Intervention for Local Development" (SHEILD).

[8] The committee is composed of the Ministers of Economy and Trade, Education and Higher Education, Environment, Finance, Foreign Affairs and Immigrants, Interior and Municipalities, Justice, Labor, National Defence, Public Health, Social Affairs, and Telecommunications; in addition to the Governor of the Central Bank of Lebanon, the President of the CDR, the Economic Advisor to the President of the Republic, and the Prime Minister's Advisor for economic and development affairs.



MoE/EU/UNDP, 2014. Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.	Map x- Distribution of Syrian refugees in Lebanon as per 31 May 2014

Disclaimer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only. Source: This map was prepared by GEOFLINT based on UNHCR May 31, 2014.	The Projection of the Displayed Data is Provided in Double Stereographic 0 10,000 20,000 40,000 Meters Sacle 1:550,000

Map 1.1 Distribution of Syrian refugees as per 31 May 2014

Humanitarian response and coordination efforts are jointly led by the Prime Minister's Office, the Ministry of Social Affairs (MOSA) and UNHCR. MOSA is the government entity in charge of the overall coordination of the refugee response in Lebanon[9]. National and regional technical working groups led by UNHCR are established to ensure a coordinated response in the following sectors:

- education,
- distribution of non-food items (NFIs),
- food security,
- health,
- information management,
- protection (including child protection in emergencies and gender-based violence),
- shelter,
- social cohesion, and,
- water, sanitation and hygiene (WASH).

In 2013, an independent interagency coordination team was established to improve the coordination efforts of the response.

With the participation of the Government of Lebanon, UN organizations, international and national nongovernmental organizations, the RRP6 was prepared in January 2014 and anticipated the need for urgent assistance to Lebanon equivalent to US$1.7 billion to respond to needs in the fore-mentioned sectors; information management is being addressed as part of all the sectors. By end of May 2014, the overall contribution to funding RRP6 reached approximately 390 MUSD, equivalent to 23 percent of the total funding requirements[10].

1.3 LEBANON'S RESPONSE FOR STABILIZATION FROM THE SYRIAN CONFLICT

In order to respond to the impact of the Syrian refugees, the Government of Lebanon with the support of the World Bank and the United Nations prepared the "Economic and Social Impact Assessment of the Syrian Conflict" (ESIA) in September 2013 and the "Lebanon Roadmap of Priority Interventions for Stabilization from the Syrian Conflict" (the Lebanon Roadmap) in November 2013. While they included some environmental considerations linked to service delivery, both reports adopted social and economic aspects as the main drive for analysis and costing of interventions for stabilizing the Syrian conflict.

Based on a quantification of the cumulative impact assessment of the Syrian conflict spillover from mid-2012 through 2014, the ESIA report estimated the need for US$7.5 billion to revert Lebanon's pre-Syrian-conflict conditions of 2011, in the human development and social sectors (including education, health, employment and livelihoods, and social safety nets) and infrastructure (electricity, water and sanitation, solid waste management and municipal services, and transportation infrastructure).

Based on the findings and recommendations of the ESIA Report, the Lebanon Roadmap was prepared and included a preliminary set of priority interventions, organized into four *Track* levels, intended to contribute towards qualitatively and quantitatively alleviating the impact of the Syrian conflict on Lebanon. More specifically, Track 1 to Track 3 propose interventions that aim at reducing the impact on the government's budget and deteriorating public services to host communities, whereas Track 4 aims to mitigate the impact on the private sector. It is important to note that the institutional and community support interventions of RRP6 correspond to the Track 1 interventions of the Lebanon Roadmap (rapid delivery and immediate impact)[11].

Table 1.2 summarizes the costs of the interventions in the sectors related to basic service provision as foreseen in the Lebanon Roadmap (Refer to tables A-1 to A-4 of Annex A for full details).

1.4 RATIONALE OF THE ENVIRONMENTAL ASSESSMENT

The MOE established an internal committee for the Assessment of the Environmental Impact of the Syrian Refugees in Lebanon, presided by the Minister of Environment (Ministerial decision 50/1 dated 3 April 2014). This committee called upon the EU (through the EU-funded programme at MOE "Support to Reforms - Environmental Governance" –StREG) and the United Nations Development Programme (UNDP) to help conduct an environmental assessment of the Syrian conflict and determine priority interventions that would complement the Lebanon Roadmap.

This report highlights the already fragile state of Lebanon's natural environment and sheds light on its rapid deterioration given the dramatic increase in population

[9] RRP6 Report, page 10
[10] UNHCR Portal, funding requirements.
[11] RRP6, 2014

Table 1.2 Summary related to basic service provision within the Lebanon Roadmap

Sector	Track 1 interventions (MUSD)	Track 2 interventions (MUSD)	Track 3 interventions (MUSD)	Track 4 interventions (MUSD)
Water and sanitation	60	330	Cross-referenced in Track 2	Cross-referenced in Track 2
Solid waste management and municipal services		190 (costs specific to Solid Waste Management (SWM) are not indicated within the municipal emergency services)	Some interventions are cross-referenced in Track 2	Some interventions are cross-referenced in Tracks 3 and 4
Electricity		10	340	Some interventions are cross-referenced in Track 3
Transportation	300	100		

and the nature of the refugee crisis (refugees being hosted within existing communities). Although tremendous efforts have been put into the humanitarian response so far, if environmental concerns are not taken into consideration, the crisis can aggravate already existing problems and exacerbate risk and vulnerability.

This report proposes both field and policy measures that could be integrated within the humanitarian response and within longer-term interventions. The proposed interventions would improve the living conditions of Lebanese communities and Syrian refugees while being sustainable, equitable and in line with national policies.

1.5 METHODOLOGY OF THE ENVIRONMENTAL ASSESSMENT

The report was based on the review of national legislation and reports, consultations with various individuals, and selected field visits. Data used in the assessment derives from the following sources:

- Government strategies, plans, reports, and data made available by the MOE, MOEW, MOF, MOPH, and MOSA, in addition to the Council for Development and Reconstruction (CDR), etc.,
- secondary data collected from EU and UN organizations [Food and Agriculture Organization (FAO), UNDP, UN-HABITAT, UNHCR, United Nations Children's Fund (UNICEF), World Food Programme (WFP), and World Health Organization (WHO)] through UNHCR portal or via direct contacts made with these organizations,
- sectoral maps illustrating refugees' concentration or presence (generated mainly by UNHCR),
- meetings held with staff from MOEW, CDR, Water Establishments (WE), FAO, UNDP, UNHCR, UNICEF (WASH sector), WFP, and the UN interagency coordination body (shelter and WASH sectors),
- interviews conducted with five unions of municipalities (three in the North, one in the Bekaa, and one in the South) and two municipalities located in the Caza of Zahle in the Bekaa (see **Annex A- Table A-5**), and,
- four field visits in the Bekaa and the North, which included visits to Informal Tented Settlements (ITSs) and meetings with UNHCR regional staff.

The assessment was conducted between May and July 2014. The baseline years used to determine the environmental pre-crisis situation were 2010 or 2011 (depending on data available in each sector). The calculated incremental impact identified is based on the refugees' population number in 31 May 2014 (according to UNHCR's figures) as well as that projected in December 2014 (according to RRP6 forecast). As such, the report determines the impact of the Syrian conflict in the year

2014 and does not account for the cumulative impacts since the onset of the conflict.

The assessment looks at four impacted areas: solid waste, water and wastewater, air pollution, and land-use and ecosystems. A pre-crisis overview is presented for each area followed by an incremental impact assessment. Environmental management plans (EMP) are proposed for the four areas along with recommendations of priority interventions by time frame. Special consideration is given to priority geographical areas that host the largest number of refugees.

The sectoral EMPs follow the guidance provided in the Decrees no.8213/2012 and 8633/ 2012 for establishing an Environmental Management Plan (EMP) as part of the Environmental Assessment (EA) process (Refer to **Box 1.2**).

Box 1.2 Environmental Management Plan

An EMP by definition is used to formulate and monitor environmental protection measures for the implementation of any project. It includes environmental safeguards and mitigation measures.

The proposed EMP for each sector includes mitigation measures at short-, medium- and/or long-terms, their costs, and key stakeholders concerned with their implementation. Where applicable, each mitigation measure presents three forms of interventions: technical support (including infrastructural works); environmental monitoring; and capacity development (including legislation, policy, awareness raising, information management, training, other).

For the sectors of solid waste, water and wastewater, and air quality, the EMPs are in line (to a certain extent) with the interventions suggested in the Roadmap. More specifically, the mitigation measures of the EMPs complement those of the Lebanon Roadmap through a set of proposed environmental actions, which are considered fundamental to ensure the sustainability of the proposed measures.

It must be noted that data availability in the field of environment is limited in Lebanon. Therefore, there are limitations in the quantification of impacts across the four areas. All calculations are mentioned within the different chapters, and where adequate data are not found, qualitative impacts and recommendations are proposed.

The specific limitation in the methodology for the assessment of each sector is also included in Annex A-2, while a complete list of references is attached to the report.

2

IMPACT ON THE SOLID WASTE SECTOR

2.1 SOLID WASTE MANAGEMENT BASELINE CONDITIONS

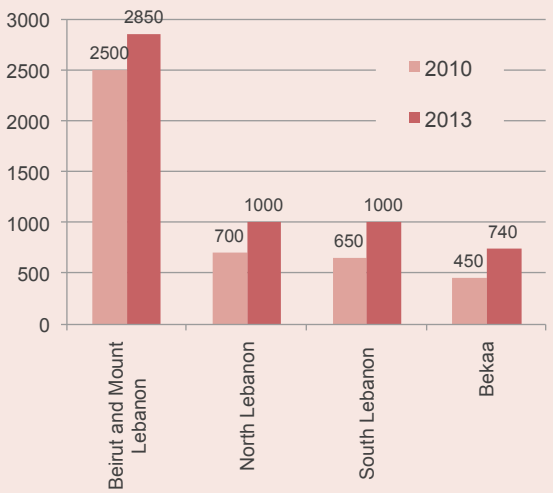
2.1.1 Waste generation rates and characteristics

Lebanon generated 1.6 and 2.0 million tons of municipal solid waste (MSW) in 2010 and 2013 respectively, as shown in **Figure 2.1**. In both years, MSW generated in Beirut and Mount Lebanon (BML) accounted for nearly 60 percent of the total MSW generated nationally (SWEEPNET 2014).

In 2010, the waste generation rate varied from around 0.7 kilograms per person per day (kg/p/d) in rural areas to around 0.9 to 1.1 kg/p/d in urban areas, with a national weighted average estimated at around 1.0 kg/p/d. The national average increased to 1.05 kg/p/d in 2013. The forecasted increase in waste generation is estimated at 1.7 percent per year across the country.

The composition of the waste is in majority organic (varying between 50 and 55 percent in urban and rural areas respectively), followed by paper and cardboard (17 to 15 percent), plastics (13 to 10 percent), metals (6 to 5 percent), glass (4 to 3 percent), and others, such as textile, wood, and miscellaneous (12 to 10 percent). MSW is characterized by high moisture content, often exceeding 60 percent (MOE/UNDP/ECODIT 2011).

Figure 2.1 MSW generation by Mohafaza



2.1.2 Infrastructure

Almost all of the MSW generated in Lebanon is collected by public or private haulers (99 percent in rural areas, 100 percent in urban areas); however management varies from one area to another. Nationally, 8 percent of MSW is recycled, 9 percent is composted, 51 percent is landfilled and 32 percent is disposed of in open dumps (MOE/UNDP/ECODIT 2011).

In BML (excluding Jbeil), a relatively advanced solid waste management (SWM) system was put in place in1997. The system is mainly based on manual and mechanical sorting, baling and wrapping (at Karantina and Amrousiyeh sorting facilities), composting (at Coral), and landfilling (of waste rejects at Naameh and inert materials at Bsalim). Since its inception, the system faced several challenges; most notable of which is the limited capacity of available sites compared to the large amount of waste generated. As a result, more than 85 percent of the waste is being disposed of at the Naameh sanitary landfill (CDR/LACECO 2011).

Outside BML, full or partial waste management systems exist, such as:

- a sorting plant and sanitary landfill in Zahle,
- a semi controlled dump in Tripoli,
- a sorting facility and an anaerobic digester (AD) in Saida that were put in place through private sector financing,
- 11 small- and medium sized sorting and composting plants (varying from 10 to 150 metric tons (t) per day) that have been or are being constructed by the Office of the Minister of State for Administrative Reform (OMSAR) with EU financing, and,
- small community based composting plants built in selected villages through the United States Agency for International Development (USAID) financing.

In the remaining parts of the country, waste management is characterized by rudimentary collect and dump practices. The location of all existing waste management facilities is presented in Annex B, map B1— Existing solid waste management infrastructure in Lebanon.

In 2011, MOE in coordination with UNDP prepared a master plan for the closure and rehabilitation of uncontrolled dumps. For that purpose, a comprehensive geographic information system (GIS) database of uncontrolled dumps was established to determine their locations and develop an action plan for their rehabilitation and/or closure. An in-depth multi-criteria risk sensitivity analysis, taking into

consideration all major physical, geological, environmental, legal, and socio-economic factors, was used to prioritize the dumps and identify the most suitable rehabilitation option. The survey showed that the total number of MSW dumps was 504 and that the cost of their closure or rehabilitation was US$52 million; of which US$35 million is for the closure of the 20 priority dumps (MOE/UNDP/ELARD 2011). The master plan also identified 166 construction and demolition (C&D) dumps distributed across the country and proposed measures and costing for their closure or rehabilitation.

Explicit fee and cost recovery systems for SWM do not exist in Lebanon, which suffers from major budget deficits in this sector. Collection and treatment or disposal of SWM often takes up a large portion of municipal budgets, leaving little for community development projects. Financing of waste management infrastructure is currently achieved through three mechanisms: allocation of budget from the Independent Municipal Fund, fees paid directly by municipalities, and international loans and grants.

Waste management costs incurred by municipalities vary greatly across the country and depend on the level of service provided. In the BML area, the unit rate for the collection, transport, treatment, and disposal of MSW is estimated at around US$130/ton of which about US$30 to USD35/ton is related to collection and transport (SWEEPNET 2014). This cost is substantially high to the point that municipalities that are part of this system are being starved of funds for other municipal services. Outside BML, waste management costs (collection and disposal) are substantially low. They are around US$45–52/ton in Zahle and Tripoli (with disposal amounting to US$20–29/ton), and around US$20–30/ton in some rural areas relying on disposal in open dumps (with collection amounting to US$10–18/ton) (SWEEPNET 2014). In most OMSAR constructed facilities, the cost for treatment (sorting and composting) is around US$25/ton.

Health care waste quantities in Lebanon were estimated in 2010 at 69 tons per day (t/d)—13.8 t/d for hazardous infectious waste and 55.2 t/d for non-hazardous infectious waste (SWEEPNET 2014). Around 60 percent of the infectious waste is being treated by shredding and autoclaving while the remaining part is mixed with the municipal waste and disposed of in the environment. In terms of infrastructure for treatment of health care waste, there are currently two on-site and five off-site operating autoclaving/microwaving centers distributed all over the country.

2.1.3 Strategies

Management of MSW in the country does not yet benefit from a well-delineated national policy to define the overall tools or means for achieving goals and for combining forces between the key stakeholders (mainly MOE, MOIM, MOF, OMSAR, and CDR). Major difficulties have been encountered with the implementation of the strategies (2003, 2006, and 2010) due to the objection of the population as well as funding constraints.

The September 2010 Plan that was endorsed by COM Decision 55 (dated 1 September 2010) favored the waste-to-energy (WTE) option in large cities (due to absence of land to build landfills) and builds on the 2006 plan for the rest of the Lebanese territories. In February 2013, MOE, MOIM, and CDR proposed a draft plan based on the earlier strategies of 2006 and 2010 and on the latest RAMBOLL feasibility study (RAMBOLL 2012) for the adoption of WTE in major coastal cities. The proposed plan included a combination of sorting, composting, WTE, and, landfilling facilities. Lately, an inter-ministerial task force was formed by COM Decision 74 (dated 27 March 2014) to prepare recommendations for a national strategy for SWM and propose alternative solutions for Naameh sanitary landfill and Tripoli semi-controlled dump. These draft plans are still being debated while the Naameh sanitary landfill contract is scheduled to expire by mid-January 2015—putting the fate of waste management in BML at great risk.

2.1.4 Legislation

To date, no legislative text deals directly with SWM in Lebanon. Small fragments of legal texts exist and provide general guidelines and unclear roles and responsibilities for entities to act with respect to MSW. Enforcement is practically non-existent due mostly to staffing constraints, lack of training, low level of fines, and political interferences. In 2005, the MOE prepared a draft law on Integrated SWM that was submitted to COM in October 2005. The draft law was approved by the COM in January 2012 and sent to the parliament for ratification in March 2012, where it is being reviewed by the various committees.

2.2 ENVIRONMENTAL ASSESSMENT

The incremental daily quantity of MSW attributed to refugees reached 683 t/d based on May 2014 estimates and is expected to reach 889 t/d or 324,568 tons per year (t/y) by end of 2014 (**Table 2.1**). This was estimated by calculating the waste generation rates of refugees in each area (varying between 0.43 to 0.53 kg/refugee/day) and multiplying them by the number of refugees distributed in each caza (refer to the methodology presented in **Annex B – Box B1** for details).

Table 2.1 Distribution of incremental quantities of MSW by end 2014

Mohafaza	Incremental daily quantity (t/d)	Daily capacity before crisis (t/d)	Increased burdens (%)
BML	321	2,950	10.9
North Lebanon	198	1,100	18.0
Bekaa	253	670	37.7
South Lebanon	117	940	12.4
TOTAL	**889**	**5,660**	**15.7**

The estimated quantities generated by end of 2014 will be used for assessing the environmental impacts and analysis throughout this chapter. The incremental annual waste generated by refugees is significant and is equivalent to 15.7 percent of the solid waste generated by Lebanese citizens prior to the crisis.

The methodology used to calculate the waste generation rates and the incremental waste quantities attributed to refugees in different areas is provided in **Annex B – Box B1.**

Map 2.1 shows that the highest incremental quantity of solid waste generated by refugees will be recorded in Mount Lebanon (Baabda, Matn, Aaley and Chouf), Zahle, Baalbeck, Akkar, Tripoli, Minieh, and West Bekaa where the highest numbers of refugees are present and in areas with the highest numbers of ITSs (except for BML). The highest burden on the existing infrastructure will be noted in the Bekaa (37.7 percent) and North Lebanon (18 percent) where the infrastructure was facing severe difficulties prior to the crisis.

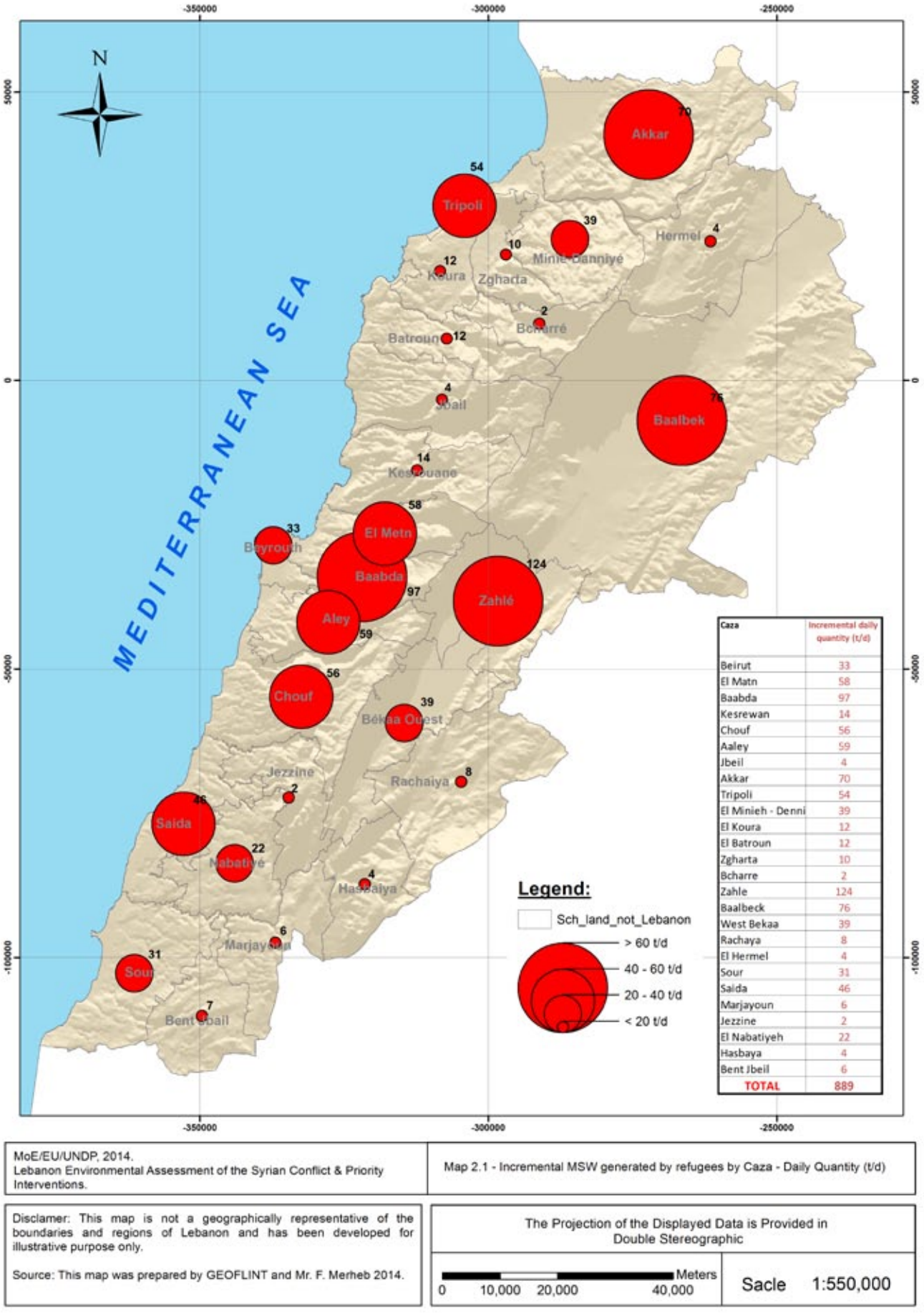
The incremental cost for managing and disposing of the waste generated by the refugees based on end of 2014 estimates was calculated to be US$23.8 million/year according to the in-place waste management system (refer to **Annex B – Table B-1**).

2.2.1 Overstressing of existing SWM infrastructure

Incremental quantities of MSW generated by refugees are being managed within the existing infrastructure present in the caza or the municipality. The destination of these incremental quantities is presented in Annex B, map B-2. For instance, the incremental quantity of waste generated in BML (317 t/d by end of 2014) is being directed to the existing sorting and composting facilities for processing and then sent to the Naameh sanitary landfill. This incremental quantity, which constitutes 11 percent of the existing current capacity, is adding stress on the equipment at the sorting facilities (more wear and tear) and speeding up the filling of the Naameh sanitary landfill. This is also resulting in an incremental generation of around 37,000 tons of leachate per year (CDR/LACECO Supervision of Greater Beirut Sanitary Landfills- Progress Report No. 1999, 2014) that need to be disposed of and additional release of methane gases that need to be flared.

The same overstressing is noticeable in existing or newly constructed SWM facilities (Tripoli, Zahle, Ain Baal, Minieh) whereby design capacities are no longer adequate to treat and dispose of the generated waste in the caza.

Stress on the collection infrastructure is also observed. Municipalities are finding it difficult to collect the increased quantities of waste with their existing vehicles. In some regions (Union of Municipalities of Tyre and Akkar), trucks that collected waste twice per week prior to the crisis are being used more frequently now to collect the additional quantities of waste (Refer to **Annex A, Table A-5: Summary of interviews with municipalities and unions of municipalities**). Trash and littering are often noticeable along roadsides ditches and channels, which puts more pressure on municipalities to clean up the area.



Caza	Incremental daily quantity (t/d)
Beirut	33
El Matn	58
Baabda	97
Kesrewan	14
Chouf	56
Aaley	59
Jbeil	4
Akkar	70
Tripoli	54
El Minieh - Denni	39
El Koura	12
El Batroun	12
Zgharta	10
Bcharre	2
Zahle	124
Baalbeck	76
West Bekaa	39
Rachaya	8
El Hermel	4
Sour	31
Saida	46
Marjayoun	6
Jezzine	2
El Nabatiyeh	22
Hasbaya	4
Bent Jbeil	6
TOTAL	889

MoE/EU/UNDP, 2014.
Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.

Map 2.1 - Incremental MSW generated by refugees by Caza - Daily Quantity (t/d)

Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only.

Source: This map was prepared by GEOFLINT and Mr. F. Merheb 2014.

The Projection of the Displayed Data is Provided in Double Stereographic

0 10,000 20,000 40,000 Meters

Sacle 1:550,000

Map 2.1 Incremental MSW generated by refugees by Caza

The burden on municipalities is clearly visible in terms of increase in the spending on SWM by municipalities from the national treasury, which increased by 11 percent between 2011 and 2012 and by 40 percent between 2012 and 2013 (MOF 2013).

2.2.2 Increase in open dumping and open burning

Apart from BML, Zahle, Tripoli, Minieh, Saida, and Tyre where full (treatment and disposal) or partial (either treatment or disposal) SWM solutions exist (fate of 48.4 percent of incremental MSW quantities), the remaining incremental quantities of MSW (51.6 percent) will be disposed of in existing open dumps along with the waste generated by Lebanese residents (refer to **Table 2.2**).

Of the 459 t/d incremental quantities disposed of in open dumps, it is estimated (based on calculations adopted from MOE/UNDP/ELARD 2011, presented in Annex B, table B2), that 290 t/d will be open-burned while 169 t/d will be deposited into existing dumps. This will result in the increase in the volumes of leachate generated in open dumps that will seep into the ground (at a rate of 0.25 to 0.35 tons of leachate/ton of waste per year based on Naameh sanitary landfill data) and in the release of air pollutants that will increase odor and air pollution. A detailed analysis of the impact of open burning on air pollution and odor is presented in **Chapter 4 – Impact on Air Quality.**

2.2.3 Increase in the contamination of land and soil

Open dumping of MSW and runoff of leachate from dumps causes soil contamination and soil condition deterioration and ultimately affects land use. This is particularly seen in areas where Informal Tented Settlements (ITS) prevail. Littering and disposal of waste in open channels and on river banks can be seen close to ITSs. The incremental volume of waste disposed of in dumps is estimated at 478,612 m3/yr by end of 2014 (density used is 0.35 tons/m3). Part of this waste is burned while the other part is deposited in existing dumps. This increases the area of contamination of land and soil surrounding the existing dumps. Using an average height of waste of 1.41 m in dumps practicing open burning and 2.3 m for waste deposited in dumps [based on statistics from (MOE/UNDP/ELARD 2011)], and noting that only a partial amount of the waste is going to occupy a new space in existing dumps, the incremental land contaminated areas close to dumps is estimated to increase by a total of 109,075 m2.

Table 2.2 Destination of incremental MSW quantities

Destination	Incremental quantity (t/d)	(%)
Existing and managed (full or partial) facilities	430	48.4
In dumps	459	51.6
TOTAL	**889**	**100**

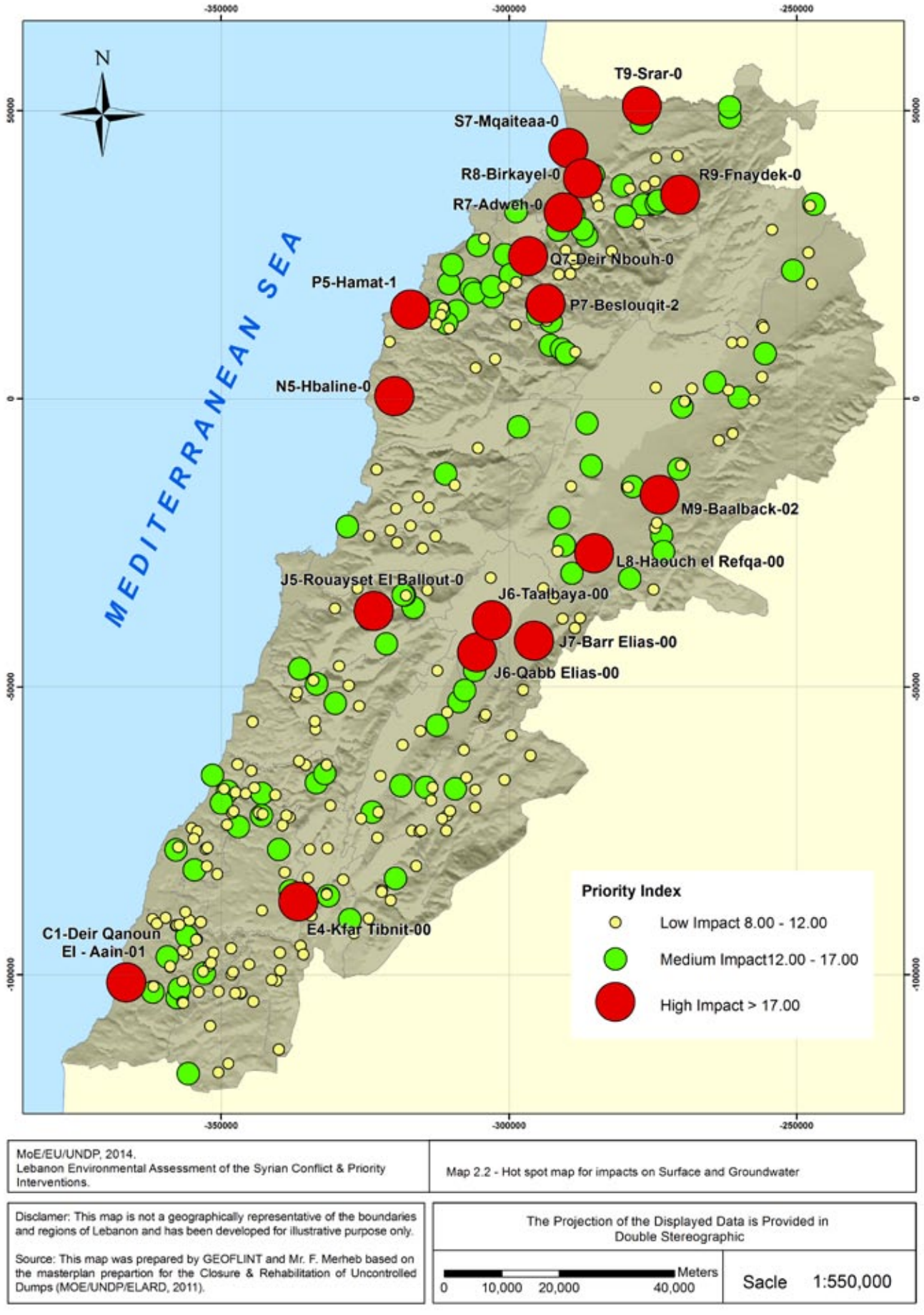
The impact of contaminated soil on landscapes and water bodies is assessed in **Chapter 5 – Impact on Land Use and Ecosystems.**

2.2.4 Increase in the contamination of surface and groundwater

Disposal of MSW in open dumps and on river banks adversely affects surface and groundwater resources depending on soil permeability of the site. A prioritization decision tool through GIS modeling was used to produce a hot spot map based on risk sensitivity assessment in relation to incremental waste quantities deposited in dumps, and the geology and hydrogeology of the sites (MOE/UNDP/ELARD 2011). A detailed methodology for the prioritization of impacts on surface and groundwater is presented in **Annex B, Box B2**.

For surface water pollution, an overlay of the incremental quantity of waste over hydrology data (distance to drainage line and distance to springs) resulted in a hot spot map for high priority areas (see Annex B, maps B3 and B4). The sites with the highest impact on surface water contamination were mainly in Srar, Fnaydek, Adweh in the North; Baalbeck, Barr Elias, Qabb Elias and Machghara in the Bekaa; Ras el Ain and Qana in the South. These sites are either sitting on aquifers, or are very close to drainage lines, springs or major rivers.

For ground water pollution, an overlay of the incremental quantity of waste over geological data (both lithology and faults density) produced a high priority area map in relation to groundwater contamination. The sites



MoE/EU/UNDP, 2014.
Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.

Map 2.2 - Hot spot map for impacts on Surface and Groundwater

Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only.

Source: This map was prepared by GEOFLINT and Mr. F. Merheb based on the masterplan prepartion for the Closure & Rehabilitation of Uncontrolled Dumps (MOE/UNDP/ELARD, 2011).

The Projection of the Displayed Data is Provided in Double Stereographic

0 10,000 20,000 40,000 Meters

Sacle 1:550,000

Map 2.2 Hot spot map for MSW impacts on surface and ground water

with the highest impact on groundwater contamination are mainly Srar, Berkayel, Adweh, Kfarzaina and Hamat in the North; Baalbeck, Taalbaya, Saadnayel, Barr Elias, Qabb Elias, Ghazze in the Bekaa; Ras el Ain and Kfartibnit in the South. These are mainly located in areas with the highest soil infiltration rates or in areas where faults are densely present.

A combination hot spot map showing the impact of incremental SW quantities on both surface and groundwater is presented in **Map 2.2**. The hot spot map indicates that most of the sites listed above (17 sites marked with red dots) present the highest impact on surface and groundwater. These are mainly located in Akkar and the Bekaa. Medium impact sites (around 87 sites marked by green dots on the map) are spread all over the country.

2.2.5 Deterioration of health and safety conditions

Open burning of waste will result in the release of toxic air pollutants such as dioxins and furans that are carcinogens and negatively impact the health and safety of humans. These impacts are further discussed in **Chapter 4 – Impact on Air Quality.**

Dumpsites could also become insect and rodent breeding grounds that would transmit vector-borne diseases. During winter, stagnant water ponds are commonly found on such sites and increase the likelihood of vector-borne disease transmission. The most common health risks are: eye irritation, tuberculosis, diarrhea, typhoid, dysentery, coughing, and scabies.

The harsh weather and the tough living conditions that refugees are facing are having a direct impact on their health. This increases the burden on the health care centers in Lebanon and results in an increase in the quantity of infectious medical waste that requires proper treatment before disposal. Based on health data collected through UNHCR for referrals to hospitals in 2013 (MOPH/UNHCR 2014), and based on an average stay of 3.1 days /case in hospitals (Hamandi 2013), the incremental quantity of health care waste generated from hospitals and primary health care centers was calculated in **Annex B, Table B-5**: The results showed an increase of 420 t/y of infectious waste (based on end 2014 estimates). Review of records for the quantity of infectious waste collected and treated at arcenciel facilities in year 2013 revealed that 72.2 percent of the waste (303.4 t/y) are being collected and treated by autoclaving and shredding while the remaining (116.8 t/y) are being disposed of in the environment (arcenciel 2013). This was seen in some hospitals across the country mainly in Tyre, Nabatiyeh, Bent Jbeil, Marjeyoun, Tripoli, and Hermel. Such improper management of medical waste causes serious environmental problems in terms of air, water and land pollution such as spread of disease from biological and infectious waste (tuberculosis, HIV, hepatitis B and C) or the spread of cytotoxic wastes or drugs in the environment.

2.2.6 Opportunity loss from recycling of waste

Recycling of waste has the potential of reducing wastage in terms of recyclable materials and space needed for landfilling. Dumping MSW without segregation of recyclables and organic matter creates an opportunity loss.

Based on the composition of solid waste in Lebanon, the incremental quantity of dumped recyclables was estimated, and the incremental opportunity loss was calculated (based on a recycling capability of 60 % out of the recyclable materials present in the waste stream) according to the prices of recyclables in the Lebanese market (refer to **Table 2.3**).

Table 2.3 Basis for the calculation of incremental dumped recyclables

Incremental quantity of waste generated by refugees	324,568 t/yr
Incremental quantity of waste burned	105,701 t/yr
Incremental quantity of waste deposited in dumps	61,813 t/yr
Incremental quantity that can be recycled (theoretical value)	167,514 t/yr
Opportunity loss is calculated based on recycling capability of 60 % of recyclables	

The results indicated that the opportunity loss of potentially recyclable materials is around 79,000 tons per year with a net economic loss of US$3.4 Million (refer to **Table 2.4**).

Table 2.4 Opportunity loss from lost recycling activities

Material	Percentage (%)	Quantity that can be recycled (tons/yr)	Market Price (USD)	Opportunity loss (USD/yr)
Organic material	53	88,783	0	0
Paper & cardboard	16	26,802	40	643,254
Plastics	12	20,102	110	1,326,712
Metals	5	8,376	260	1,306,610
Glass	4	6,701	30	120,610
Textile, wood and others	10	16,751	0	0
TOTAL OPPORTUNITY LOSS/year (USD)		**167,514**		**3,397,187**

2.3 ENVIRONMENTAL MANAGEMENT PLAN FOR THE SOLID WASTE SECTOR

The impacts of the Syrian conflict on the solid waste sector were found to be significant, with an estimated increase of 15.7 percent of the total solid waste quantities generated by Lebanese citizens prior to the crisis. The identified impacts include the overstressing of existing SWM infrastructure, increase in littering, deterioration in health and safety conditions, contamination of land, soil, water and groundwater in priority impacted areas, and opportunity loss from recycling activities.

Accordingly, an EMP for the SWM sector is proposed and includes potential mitigation measures along with planned and proposed actions, responsible parties, capital and O&M costs, and a timeframe (short and medium term) for implementation. The complete EMP is presented in **Table 2.5**.

2.3.1 Potential mitigations measures

2.3.1.1 Short-term mitigation measures:

- Providing additional waste collection bins and trucks (of different types and sizes) to cater for the collection of the incremental quantities of solid waste (889 t/d by end of 2014) generated across the host communities, and to reduce waste littering. The exact number of additional bins and trucks needed to cater for the incremental waste quantities is provided in Annex B, table B-6. It should be noted that the number of bins and trucks already provided by international agencies as part of their support (under the WASH sector) to some host communities should be deducted from the total numbers indicated in the above-mentioned table.
- Reducing packaging of food items to minimize waste quantities and littering. This can be accomplished by changing the distribution mode of food adopted by some of the donor agencies from food boxes to electronic cards or vouchers as commonly adopted in other areas.
- Promoting waste sorting at source and implementing recycling projects and activities in host communities. This can be accomplished by organizing the collection and selling of source separated recyclable items to local Lebanese industries once collected recyclable quantities and costs justify the economies involved.
- Collecting and treating health care wastes through recognized service providers or in nationally approved treatment centers. International agencies and NGOs working in the health sector should be directed to provide health referrals only to health care centers that have the proper means for the treatment and disposal of their medical wastes.

- Reducing the financial burdens on host communities by paying them the O&M fees incurred for the treatment and disposal of the incremental quantities of generated wastes in accordance with the status quo situation. This will alleviate the burdens imposed on municipalities and help them direct funds to implement other municipal development projects.
- Banning the burning of waste in open dumps in order to reduce air pollution and the release of toxic contaminants in host communities.

2.3.1.2 Medium-term mitigation measures

- Building the necessary SWM infrastructure (sorting and composting facilities, as well as sanitary landfills) in priority impacted areas so that solid waste generated by refugees and host communities can be properly disposed of. Building this infrastructure will help reduce the environmental impact of land and soil contamination, as well as surface and ground water pollution. This infrastructure includes building the facilities identified in the EU financed projects that will be implemented with the Office of the Minister of State for Administrative Reform (OMSAR) (Upgrading Solid Waste Management Capacities in Bekaa and Akkar Regions in Lebanon - SWAM 1 and SWAM 2), EU financed project that will be implemented through the ESFD (Municipal Finance project- MUFFIN), CDR projects financed either through the Kuwait Fund in Tripoli or World Bank (the Lebanon Municipal Service Emergency Project (LMSEP)). One identified project not included in any of these potentially donor funded projects is the construction of a sanitary landfill to serve Tripoli, Minieh and Dannieh. The construction of all of these projects will help alleviate the environmental impacts of the incremental waste generated by refugees, as well as by the Lebanese host communities. **Map 2.3** shows that once these projects become operational, the majority of the areas where refugees are present will be served by a SWM system and consequently, the damage to the environment will be greatly reduced. These mitigation measures exclude the proposed WTE plans for the BML and other regions.
- Securing the financing for the O&M of these facilities from the national budget once construction is completed.
- Closing and/or rehabilitating identified priority dumps in areas of high refugee concentration and where high impact of pollution to surface and groundwater was identified in section 2.2.4. These include the closure of 17 high impact priority dumps (listed in **Table 2.5**) in North Lebanon, Bekaa and South Lebanon, and 87 medium priority dumps identified in **Map 2.2**.

2.3.2 Environmental monitoring and capacity development

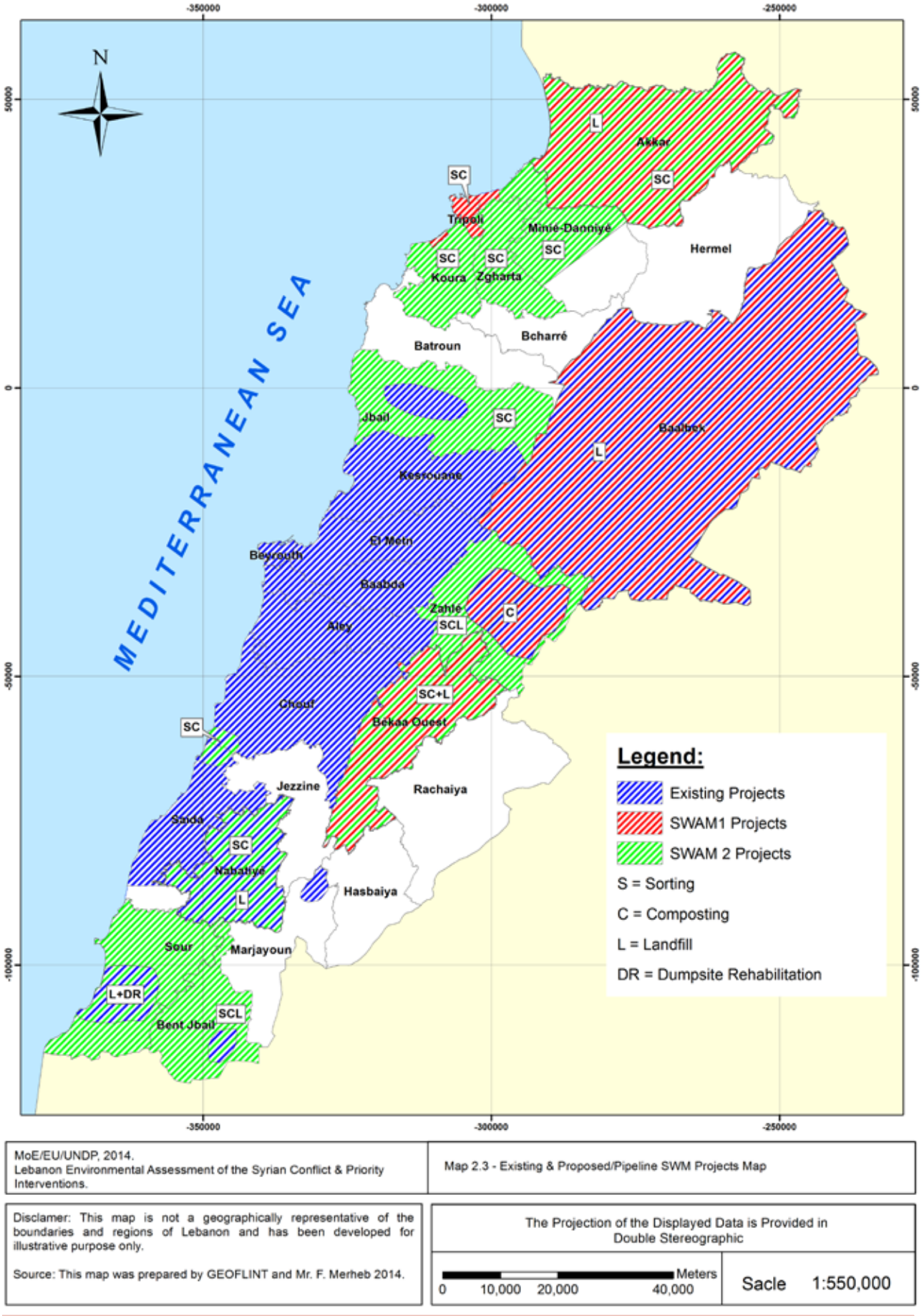
For each set of mitigation measures, an environmental monitoring plan and a capacity development plan are proposed.

Environmental monitoring for short-term mitigation measures include field observations and monitoring by municipalities and active NGOs of open burning, reduction of waste littering, reduction in packaging waste quantities, increase in the quantity of recyclables, and increase in income from selling of recyclables. Additional measures include monitoring the quantity of properly managed infectious waste, reviewing and evaluation by MOE of health care service providers' reports and monitoring environmental spending of municipalities. For medium-term mitigations which include the construction of the needed SWM infrastructure (excluding the proposed WTE plans for BML and other regions) and the closure/rehabilitation of existing dumps, environmental monitoring measures include the preparation of EIAs for all proposed projects and their approval by MOE, including the EMPs in the tender documents and ensuring their implementation by the supervising consultants, supervision of daily operations, monitoring health and safety conditions and monitoring gases and leachate in dumps rehabilitation projects.

Capacity development plans should be led by MOE and should be mainly targeted to host communities, active NGOs, and International Agencies. Capacity development plans should address the following:

- training of municipal police and staff on the SWM principles and on enforcement of legislation,
- raising awareness on the impact of packaging wastes on the environment and on waste sorting at source, as well as on the proper management of health care waste, and,
- promoting hygiene among refugees to prevent spread of diseases.

For measures including construction of infrastructure, capacity development plans should include training of municipal staff on tendering procedures, procurement of services for the O&M of facilities, principles of integrated waste management and the proper procedure for the closure and/or rehabilitation of dumps.



Map 2.3 Existing and proposed pipeline SWM projects

2.3.3 Environmental management plan costs

The total capital cost for the implementation of the proposed mitigation measures over the short and medium terms (i.e. until 2020) including environmental monitoring and capacity development reached 131 MUSD. A substantial amount (32.1 MUSD) is already secured from several funded projects (SWAM1 and MUFFIN through EU, LMSEP through World Bank, expansion of Tripoli facility through the Kuwait Fund) while another 28.6 MUSD are earmarked by the EU for the SWAM 2 project. The remaining amount (70.3 MUSD) should be secured mainly from International Agencies/Donors and National Government for the closure and rehabilitation of dumps and the provision of the necessary collection infrastructure to facilitate the collection and disposal of the incremental quantities of waste generated by refugees. Other capacity development and environmental monitoring costs can either be secured from MOE budget, municipal budgets, active NGOs or humanitarian aid agencies budgets.

The incurred costs for O&M of the SWM infrastructure and other components of the EMP amounted to 24.9 MUSD/year in the short term and will increase gradually to 32.7 MUSD/year in the medium term with the advancement in the construction of the needed infrastructure. These O&M costs exclude the amounts that will be incurred by the potential change of the waste management system in BML and other regions in the medium term.

Table 2.5 - Environmental management plan to mitigate the potential impacts of the Syrian conflict on solid waste s

Potential Impacts	Potential Mitigation Measures	Nature of Measures	Planned/proposed actions
1. Increased littering	**1.1 Provide additional waste collection bins and trucks to host communities in accordance to the distribution of refugees and the incremental quantity of waste generated by cazas**	Technical	Provision of 16,800 bins (240 liters) and 2,500 bins (1100 liters) to host communities in areas where refugees are present in order to contain the incremental quantities (refer to Annex B-table B6).
		Technical	Provision of 225 waste collection pickup trucks (volume 5 m3) and 100 compactor trucks (volume 10 m3) to host communities in order to collect and transport the incremental quantities (refer to Annex B-table B6).
		Environmental monitoring	Monitoring the extent of reduced littering in areas where refugees are present through field visits and observations.
		Capacity development	• Training of municipal police and municipal staff on SWM principles. • Training on enforcement of legislation.
	1.2 Reduce packaging of food items to reduce waste quantities and littering	Technical	Changing all food aid distribution mode from food boxes to refugees e-cards in all areas across Lebanon to reduce packaging wastes.
		Environmental monitoring	Monitoring reduction of packaging wastes in the waste stream.
		Capacity development	Raising awareness among NGOs and Humanitarian aid agencies on impacts of packaging waste on the environment and how to reduce packaging waste.
2. Opportunity loss from recycling activities	**2.1 Implement recycling activities in areas where refugees are present**	Technical	Implementing sorting at source projects and activities in areas where refugees are present and sell collected recyclables.
		Environmental monitoring	Monitoring the increase in the quantity of recyclables sold and the increased income from selling of recyclables.
		Capacity development	• Raising awareness on waste sorting at source through a national campaign. • Including environmental awareness in educational plans in ISs and other substandard areas. • Providing contact details of the recycling industries operating in Lebanon (refer to management of recyclable material for Lebanese municipalities booklet produced by OMSAR, MOE and the Italian Cooperation for Development).

sector in Lebanon

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/year)	Timeframe	Remarks
Municipalities, NGOs	1.84	0	Short term	A number of bins and trucks has already been offered by International Agencies
Municipalities, NGOs	15.375	0.80	Short term	A number of bins and trucks has already been offered by International Agencies
Municipalities, NGOs	0	0	Short term	
MOE, Municipalities, NGOs	0.20	0	Short term	
Arab donors, NGOs, WFP	0.10	0	Short term	
Municipalities, NGOs	0	0	Short term	
MOE, Humanitarian aid agencies, NGOs	0.05	0	Short term	
Humanitarian aid agencies, Municipalities, NGOs	0.20	0	Short term	
Municipalities, NGOs	0	0	Short term	
MOE, Municipalities, NGOs, Media	0.20	0	Short term	

Potential Impacts	Potential Mitigation Measures	Nature of Measures	Planned/proposed actions
3. Deterioration in health and safety conditions	**3.1 Collect and treat health care waste through recognized service providers or in nationally approved treatment centers**	Technical	Refugee health programs to provide referrals only to health care centers that have a contract or a facility for the proper treatment and disposal of their infectious medical waste.
		Environmental monitoring	• Monitoring the proper management of the quantity of infectious waste generated by refugees. • Reviewing and monitoring private sector service operators reports and data.
		Capacity development	• Raising awareness on proper management of HC waste • Communicating to humanitarian NGOs information on Health care institutions that are properly managing their waste. • Increasing awareness and promoting hygiene among refugees to prevent spread of diseases.
4. Overstressing of existing SWM infrastructures	**4.1 Reduce the burdens by alleviating the financial pressure on municipalities to dispose of waste within their premises according to the status quo situation**	Technical	Paying O&M fees to municipalities for the treatment and disposal of the incremental waste quantities generated by refugees (889 t/d) in accordance to the status quo situation.
		Environmental monitoring	• Monitoring expenses of municipalities on SWM and ensuring that the burdens are reduced. • Monitoring environmental spending of municipalities.
		Capacity development	Raising awareness among international agencies on the existing SWM situation and communicating current costs of treatment/ disposal as per status quo.
5. Contamination of land, soil, water and groundwater in priority impacted areas	**5.1 Build the necessary infrastructure in priority impacted areas so that solid waste generated by refugees and host communities can be properly disposed of**	Technical	Implementing SWAM 1 project include: • Consultancy services and capacity building • Build SL in Srar and close existing dump • Expand Zahle SC facility • Build SL in Baalbeck • Build SC in Joub Jannine
		Technical	Implementing SWAM-2 project include: • Consultancy services and capacity building • Upgrade SC (150 t/d) in Hbaline and in Minieh(100 t/d) • Build SC in Srar (200 t/d), Koura (80 t/d), and Zgharta (120 t/d) • Build SL for Joub Jannine and Nabatiyeh (200 t/d) • Build SL in Tyre (250 t/d) and rehabilitate Ras El Ain • Build SCL for Zahrani Union (100 t/d) and Bint Jbeil (150 t/d)

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/year)	Timeframe	Remarks
NGOs (Health)	0	0.10	Short term	O&M fees for the treatment and disposal of healthcare wastes should be paid by the health-care centers
MOE, Private sector service operators	0	0	Short term	
MOE, MOPH, Private sector service operators	0.10	0	Short term	
Municipalities, Humanitarian Aid Agencies	0	24.00	Short term	O&M fees to be secured through International Agencies and Donors
MOF, Municipalities, MOE	0	0	Short term	
MOE, NGOs, Humanitarian Aid Agencies	0.05	0	Short term	
OMSAR, Union of Municipalities	19.04	6.75	Medium Term	Capital secured from EU to OMSAR, O&M to be secured from national budget
OMSAR, Union of Municipalities	28.56	16.7	Medium Term	Capital earmarked by EU to OMSAR, O&M to be secured from national budget

Potential Impacts	Potential Mitigation Measures	Nature of Measures	Planned/proposed actions
5. Contamination of land, soil, water and groundwater in priority impacted areas	**5.1 Build the necessary infrastructure in priority impacted areas so that solid waste generated by refugees and host communities can be properly disposed of**	Technical	Implementing the SWM component of the Municipal Finance (MUFFIN) project which includes: • Providing bins and vehicles in Minnieh-Dennieh and in Hermel. • Building a SCL in Qabb Elias, Barr Elias and El Marj.
		Technical	Implementing CDR financed project in Tripoli: Increase the capacity of Tripoli Sorting and composting facilities to 420 t/d.
		Technical	• Implementing SWM components of the Lebanon Municipal Service Emergency Project (LMSEP) by CDR. • Implementing SWM activities and projects in 11 Union of Municipalities.
		Technical	Building a sanitary Landfill to serve Minieh-Dennieh and Tripoli.
		Environmental monitoring	• Preparing EIAs for all proposed projects and securing their approval by MOE. • Including EMP in tender documents. • Supervising consultants to ensure that EMPs of EIAs are followed. • Monitoring of daily operations.
		Capacity development	Training of municipal staff on tendering procedures and procurement of services (for O&M of SWM facilities) and on the basic principles of ISWM.
	5.2 Close identified priority dumps in areas of high refugees concentration where high impact of pollution to surface and groundwater was noticed	Technical	Banning the open burning of waste in existing dumps to reduce air pollution.
		Technical	Closing the 17 priority dumps having a high impact on surface and groundwater in: • North: Srar, Fnaydek, Mquaitaa, Berkayel, Adweh, Deir Nbouh, Beslouqit. • Bekaa: Baalbeck, Hawch el Refqa, Barr Elias, Qabb Elias, Taalbaya, Machghara. • South: Deir Qanoun el Nahr, KfarTibnit, Qana.
		Technical	Closing all medium priority dumps in areas of high concentration of Syrian refugees (around 87 dumps shown in **Map 2.2**)
		Environmental monitoring	• Preparing EIAs for the closure of all dumps Including EMP in tender documents (monitoring of gases and leachate) • Ensuring reporting to MOE. • Supervising consultants to ensure that EMPs are followed. • Monitoring health and safety during closure operations. • Monitoring the ban on open burning of waste by municipal police.
		Capacity development	National awareness campaigns on the environmental impacts of dumps and on the proper procedures for their closure/rehabilitation.
TOTAL			

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/year)	Timeframe	Remarks
ESFD, Municipalities	4.95	1.65	Medium Term	Capital secured by EU through ESFD, O&M to be secured from national budget
OMSAR, CDR, Union of Municipalities of Al Fayhaa	4.08	3.90	Medium Term	Capital secured by Kuwait Fund to CDR, O&M to be secured from national budget
CDR, Union of Municipalities	4.00	1.20	Medium Term	Capital secured from World Bank, O&M to be secured from national budget
MOE, OMSAR, CDR, Union of Municipalities	5.0	2.5	Medium Term	Project requires funding
MOE, Supervising Consultants, Municipalities	0	0	Medium Term	Budget included as part of the different projects components financed by EU, World Bank and Kuwait Fund
MOE, Supervising Consultants, Municipalities	0	0	Medium Term	
MOE, Municipalities	0	0	Short term	
MOE, Municipalities	26.5	0	Medium Term	
MOE, Municipalities	20	0	Medium Term	
MOE, Municipalities, Supervising Consultants	0.595	0	Medium Term	
MOE, Municipalities	0.2	0	Medium Term	
	131.04	**57.6**		

3

IMPACT ON THE WATER AND WASTEWATER SECTORS

3.1 WATER SECTOR

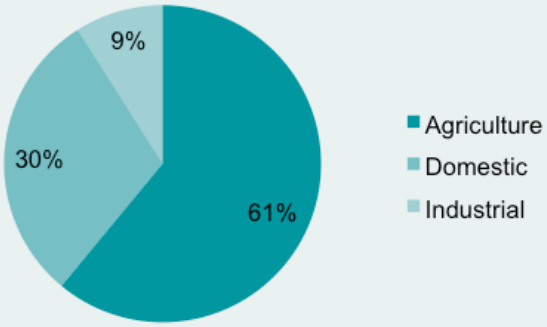
3.1.1 Baseline conditions of the water sector

3.1.1.1 Water supply and demand

Lebanon's renewable water resources are estimated at around 926 m3/capita/year (MOEW 2010).

Current domestic water demand varies between 160 liters per capita per day (lcd) in rural areas and 180 (lcd) in urban areas. As for water consumption, agriculture is the largest water consumer (**Figure 3.1**) in a country where farmers still use inefficient flood irrigation methods fed by open water channels (MOEW 2010).

Figure 3.1 Water consumption across different sectors (MOEW, 2010)



In 2010, total water supply reached 1,377 Million Cubic Meters (MCM)/year originating from surface water (46 percent), groundwater (51 percent), and used storage (three percent) (MOEW 2010).

Groundwater is over-extracted (0.7 BCM against total recharge of 0.5 BCM). In 2012, Lebanon was already using two thirds of its available water resources. This rate of water withdrawal is very high compared to global standards (averaging 10-30 percent for other regions), and includes a substantial component of resource mining, depleting Lebanon's water capital (World Bank 2012). A survey conducted by MOEW/UNDP showed that there are around 21,000 licensed private wells and 59,124 unlicensed private wells in Lebanon (MOEW/UNDP 2014).

The risk of water deficit is aggravated by the seasonal discrepancy between supply (peaking in the winter) and demand (peaking in the summer). Factors contributing to this seasonal water imbalance are the very low water storage capacity (6 percent of total resources) and the consequent high rate of losses to the sea, combined with the deficiency of water supply networks (World Bank 2012).

At the national level, the rate of household connections to the public water supply systems is around 79 percent with discrepancies at the regional level. The total unaccounted for water reached 48 percent. In the BML service area, where more than half of the population lives, water supply scarcity is exacerbated by poor public water networks as well as severe water rationing; water is supplied for no more than 3 hours daily in the summer (World Bank 2012; MOEW 2010). The absence of volumetric charges is limiting incentives for water conservation at the consumer level, as well as production at the Water Establishment (WE) level (MOEW 2010). The four regional WEs show significant weaknesses in non-revenue water and bill collection, which are crucial to financial sustainability (World Bank 2010). The rationing of public water supply for domestic consumption has led to significant proliferation of private sources of water supply. Private water supply accounts for 65 percent of total water expenditure of connected households and reaches 75 percent of total water expenditure of unconnected households (World Bank 2010).

"Recurring dry years have been common in Lebanon's recent history, with frequent occurrence of 2 to 3 consecutive dry years. Lebanon's water sector has planned to face a moderate dry year scenario (≥70 percent of average year precipitation). This current year (2013-2014) represents a particular case of a severe dry year, with more than 50 years recurrence interval and a precipitation level forecasted to be 48 percent less than an average year. A preliminary estimation of this year's water deficit amounts to 728 MCM. The impact of water scarcity will be more significant on surface water springs, and variably, to lesser extents, on groundwater wells" (Tayar 2014).

3.1.1.2 Water quality

Water quality monitoring remains a major challenge in Lebanon as water quality data is not published. Two government institutions are responsible for water testing and quality monitoring. The MOEW monitors the quality of water resources at the meter/gauge level whereas the Ministry of Public Health (MOPH) monitors the drinking water at the tap level and in some cases also the source.

Domestic water supply is below capacity and sometimes below water drinking standards which prompts consumers to augment (bottled water, wells, etc.) and/or treat their water supply (EU 2011).

3.1.1.3 Legal and institutional framework

Existing legislation for the protection of water resources in Lebanon dates back to the 1920s and even to the Ottoman era (World Bank 2011). Law 221/2000 initiated the reform of the water sector and delegated the responsibility for the delivery of potable water, including water for irrigation as well as the operations and management of wastewater, to the WEs and to one pre-existing river basin agency (The Litani River Authority - LRA) with a clear separation between policy-making and service provision (World Bank 2010).

The CDR is in charge of planning and executing donor-funded water and wastewater infrastructures on behalf of the concerned ministries. The MOE is responsible for controlling pollution and regulating all activities that impact the environment. The MOPH has the responsibility of monitoring drinking water to ensure compliance with local and international standards and monitoring the incidence of waterborne diseases (MOE/UNDP/ECODIT 2011).

The GOL has made the reform for the water sector a national priority and has prepared a National Water Sector Strategy (NWSS), which was adopted by the COM in March 2012. The NWSS goal is 'to ensure water supply, irrigation and sanitation services throughout Lebanon on a continuous basis and at optimal service levels, with a commitment to environmental, economic and social sustainability'. This goal is to be attained through a combination of infrastructure, policy and institutional initiatives (World Bank 2012). The capital expenditure requirement for Lebanon's water sector for the years extending from 2011 to 2020 was estimated at USD7.74 billion and the operational expenditure requirement at USD2.1 billion (MOEW 2010).

3.1.2 Environmental impacts in the water sector

3.1.2.1 Depletion of water resources

The average daily per capita water consumption of refugees was calculated based on a survey conducted by Solidarités International for water consumption according to the refugees' and type of shelter[12] (UNHCR 2014), and was estimated between 64 and 104 liters. The incremental increase in domestic water demand for refugees is estimated between 33 and 53 MCM based on 31 May 2014 estimates of number of refugees; and, it is expected to reach 43 to 70 MCM by the end of year 2014, which corresponds to an increase ranging between 8 and 12 percent of the national water demand[13]. This increase varies across cazas and governorates, with the Bekaa having the highest share, followed by the North, Beirut, Mount Lebanon and the South. **Map 3.1** shows the distribution of the incremental refugees' water demand across the cazas.

The detailed methodology for the calculation of water demand can be found in **Annex C, Box C-1**.

Main water sources used by refugees are the public water network, wells and public reservoirs/standpipes as shown in **Table 3.1** below[14]. It should be noted that groundwater constitutes the largest share of the sources of the public network and public reservoirs/ standpipes.

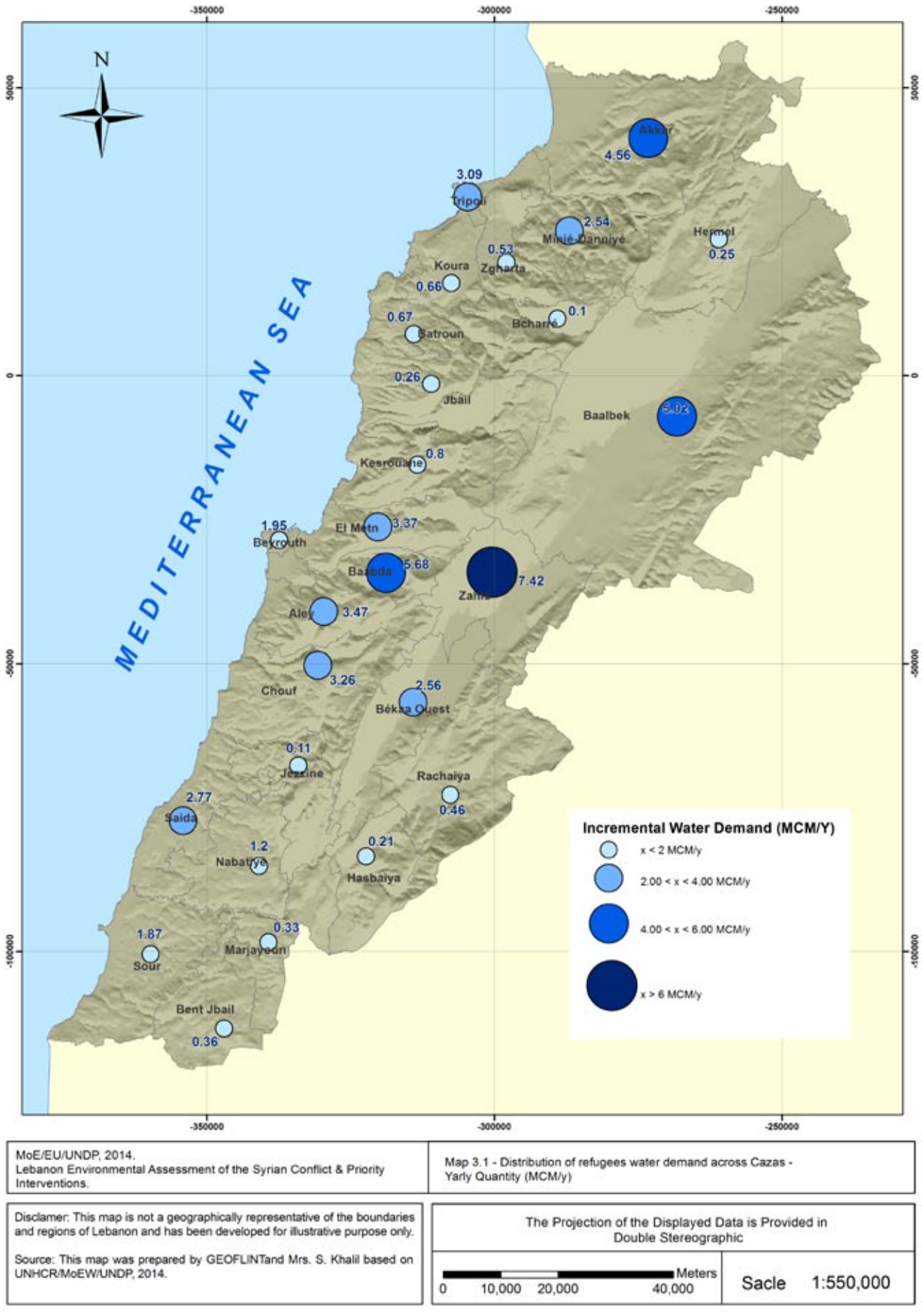
Table 3.1 Sources of water used by Syrian refugees

Sources of water	Percent
Public water network	30
Wells	24
Public reservoirs/Standpipes	22
Springs	12
Purchased	10
Mineral	1
Other	1

[12] The survey classified water consumption into 3 categories (<15 litres, between 15 and 35 litres and > 35 litres). Weighted average water consumption per type of shelter was calculated assuming that the consumption categories are: 15 litres, 35 litres, and 2 scenarios were adopted for the 3rd category: a high estimate of 145 litres and low estimate of 85 litres were considered. Then, a national weighted average was calculated taking into account percentage distribution of refugees according to shelters (57 percent in apartments, 15 percent in informal settlements and 28 percent in substandard buildings and collective shelters).

[13] Due to the lack of data, this estimate did not include increase in water demand in the agricultural and industrial sectors due to refugees.

[14] The percentage of water sources used by Syrian refugees was estimated based on data presented in the report on the vulnerability assessment of Syrian Refugees in Lebanon (WFP, UNICEF, UNHCR, 2013).



Map 3.1 Distribution of refugees' water demand across cazas

As such, it can be concluded that the increase in water demand caused by the refugees is exacerbating the existing stresses on water resources in general and to groundwater resources in particular. This is confirmed by available data from the monitoring of water table levels during the period of April 2013 to April 2014. A decrease ranging between 1 and 20 meters was reported in a number of wells in different Lebanese regions (**Figure 3.2**) (MOEW/ UNDP 2014). Moreover, data collected from LRA related to the flow of some rivers and springs in the Litani River basin showed a decrease in water flows and volumes between 2012 and 2013 (**Figure 3.3**) (LRA 2014).

Figure 3.2 Changes in groundwater levels in selected wells from different regions

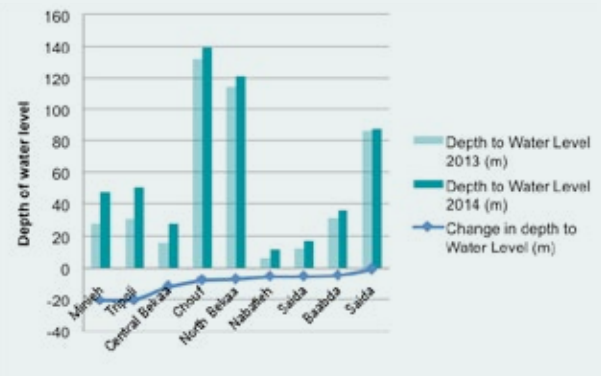
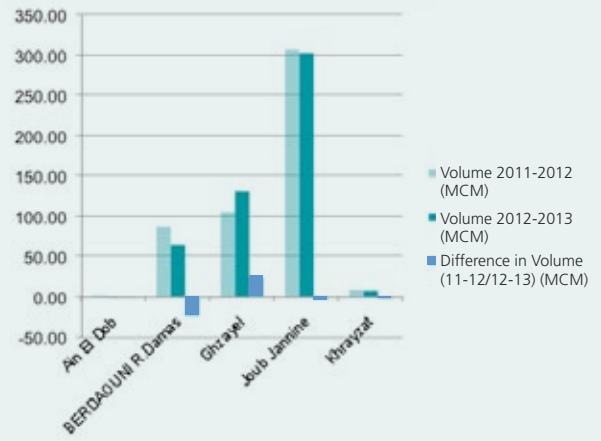


Figure 3.3 Changes in water volumes in selected water sources in the Litani River basin



This data indicates an increased pressure on water resources, which is due to several factors including low precipitation rates and the increase in water demand from Syrian refugees as shown in **Annex C, figure C-1**. This pressure will have an impact on ecosystems, as presented in **Chapter 5 (Land Use and Ecosystems).**

3.1.2.2 Water quality deterioration

Humanitarian agencies providing health interventions are attributing high importance to diarrheal diseases associated with the consumption of poor water quality, noting particular concerns for pregnant and lactating women, and for children under the age of five (Inter-agency WASH working group-Lebanon 2014). Tests on the bacteriological quality of water that have been performed by Solidarités International showed high levels of contamination (ten times higher than the WHO guideline values for some chemicals). In Minieh-Dennieh and Zgharta districts, an average of 63 percent of the tested boreholes and municipality network outlets proved to be contaminated with fecal coliforms.

According to the WASH working group, the main issue affecting water quality is the low quality and poor cleanliness of the reservoirs which are not maintained regularly and lack, for the most part, proper coverage that provides protection from external sources of contamination.

Moreover, due to the lack of water, proper sanitation and hygiene, a sharp rise in communicable diseases and the emergence of previously absent diseases were reported among refugees' communities and are transmitted to close Lebanese communities (World Bank 2013). MOPH worked with partners to contain an outbreak of measles affecting a total of 1,700 children in 2013, 88 percent of which were Lebanese. Over 750 cases of Leishmaniasis were reported, a disease that was previously unknown among the Lebanese population (UN 2014).

3.2 WASTEWATER SECTOR

3.2.1 Baseline conditions of the wastewater sector

3.2.1.1 Characteristics of the sector

Wastewater management is considered a high priority issue in Lebanon. In 2010, the estimated municipal wastewater load was estimated at 248 MCM per year, equivalent to 119,348 tons of Biological Oxygen Demand $(BOD)_5$ as presented in **Table 3.2** (World Bank 2011).

Table 3.2 Estimated domestic wastewater generation across the regions (2010)

Region	Population 2007 (million)	Population equivalent 2010 (million)	Domestic WW generation 2010 (MCM/yr)	WW BOD_5 Load 2010 (tons per year)
BML	1.85	2.68	146.7	58,603
South Lebanon	0.66	0.96	35.0	20,945
North Lebanon	0.76	1.11	40.5	24,247
Bekaa	0.49	0.71	25.9	15,553
Total	3.76	5.45	248.2	119,348

Source: (World Bank 2011)

Wastewater network coverage was around 66 percent in 2007 as shown in **Table 3.3**. The remaining households which are not yet connected to the wastewater (WW) network still rely on open sewers, septic tanks, cesspools, or simply discharge wastewater directly into the environment (World Bank 2011). Less than 8 percent of wastewater generated at the national level is currently treated (MOEW 2010).

Table 3.3 Households connections to WW networks and other WW disposal options (2007)

Region	**WW network connection (%)**	**Septic tanks (%)**	**Other (%)**
BML	79.2	21.1	0.7
South Lebanon	50.1	45.9	3.9
North Lebanon	67.4	27.3	4.8
Bekaa	49.3	50.5	0.2
Purchased	10	32.1	2.2

Source: (World Bank 2011)

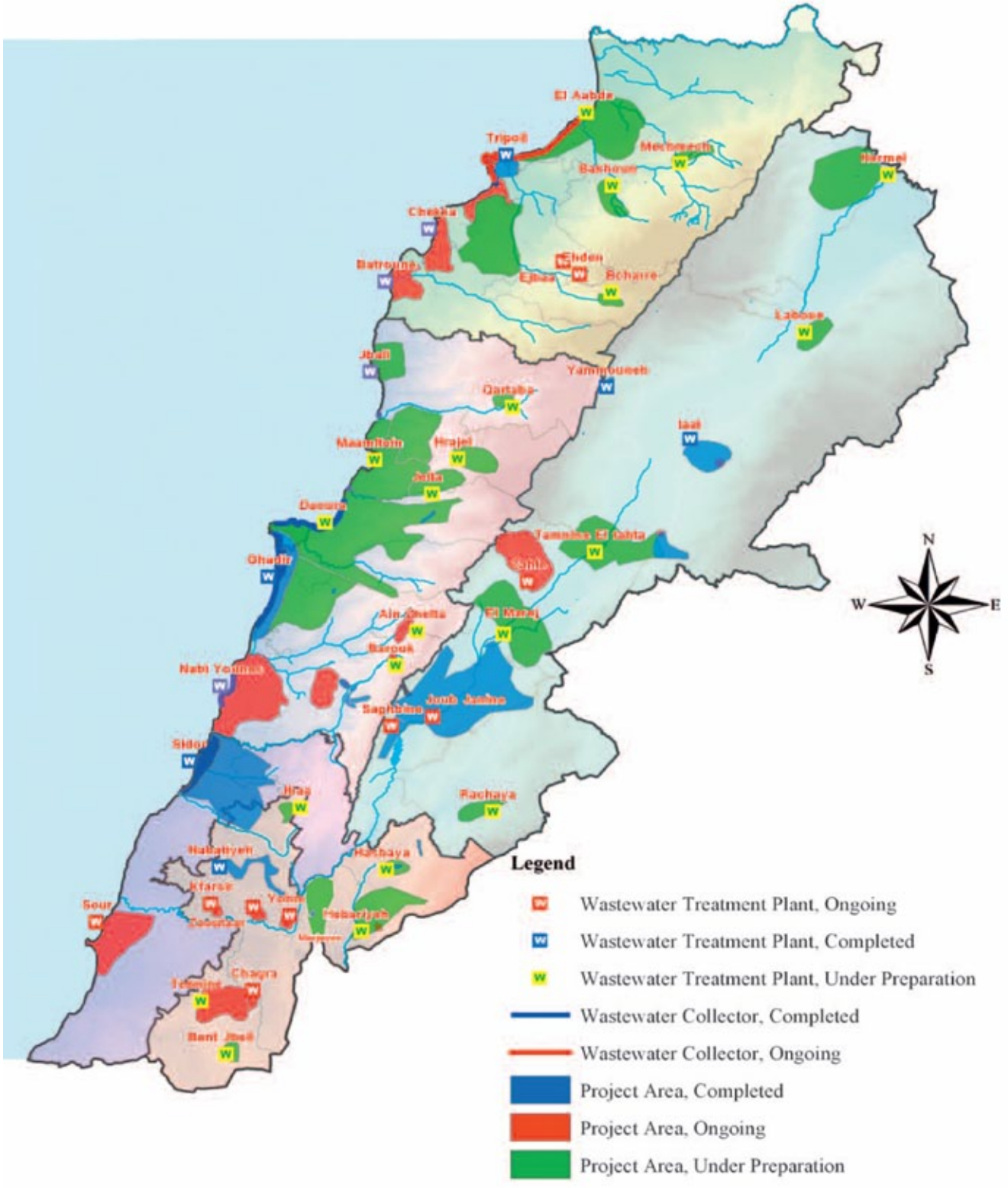
The GOL developed the National Strategy for the Wastewater sector (NWSS) in 2012, which is structured around five strategic initiatives targeting the increase in wastewater collection, treatment, and reuse rates (MOEW 2012) as follows:

- An integrated and prioritized investment program for wastewater collection, treatment and reuse,
- Legal, regulatory and policy measures,
- Institutional measures to define responsibilities and to create capacity for service delivery,
- Financial measures for viability and affordable services,
- Measures to optimize private sector participation in the wastewater sector.

In line with the third strategic initiative, the WEs have already taken over responsibility for service delivery. On a case by case, WEs may agree with municipalities that municipalities will operate facilities by delegation.

In 2011, about 11 WWTPs were operational and 5 major WWTPs contructed (Tripoli, Batroun, Chekka, Ras Nabi Younes, and Nabatiyeh) but not yet connected to the network. The BOD_5 were reduced by 5.9 percent compared to 2010 (World Bank 2011). Also, some 44 small scale WWTPs, of which about 50 percent were located on the Hasbani and Wazzani catchments, were totally or partially constructed (World Bank 2011). **Map 3.2** shows the completed WWTPs and those planned by the CDR.

Coastal waters in Lebanon receive untreated WW from at least 53 major sewage outfalls spread along Lebanon's 240 km coastline, 16 of which lie within the Beirut area. Coastal waters receive an estimated 162 MCM/year of untreated sewage (equivalent to 276,000 m_3/day), which is equivalent to 65 percent of the total sewage load in Lebanon (MOE/UNDP/ECODIT 2011).



Map 3.2 WWTP completed, on-going and under preparation projects (CDR, November 2013)

3.2.1.2 Legal & institutional framework

There are several government agencies involved to various degrees in WW management in Lebanon, sometimes with overlapping functions. The main agencies are the MOEW, the WEs, and CDR (upon request from concerned ministries). WW collection is legally under the jurisdiction of the WEs; however, some responsibilities are still being carried out by the municipalities. Moreover, the O&M of WWTPs is gradually handed over from MOEW to WEs.

MOE is responsible for controlling pollution including prevention. For example, the EIA decree 8633 dated 7/8/2012 requires that all sewage treatment plants undergo full EIA studies. The MOE has set standards for treated wastewater discharged into sewers and surface waters (Decision 8/1 dated 30/1/2001). To protect rivers and riverbanks from unlicensed developments and authorized discharge, the MOE has prepared environmental conditions for construction permits located at river-banks (MOE Decision 90/1 dated 17/10/2000) (MOE/UNDP/ECODIT 2011).

Guidelines for the reuse of treated wastewater and sewage sludge for agricultural purposes were proposed by FAO in collaboration with MOEW, MOE, MOA, and MOPH in 2010. The proposal is currently being reviewed by the concerned ministries.

Before the NWSS, Lebanon did not have an agreed national policy for wastewater, but existing and largely informal strategies and plans that have been updated by MOEW, MOE, and CDR to comply with Lebanon's international commitments, specifically the Barcelona Convention for the Protection of the Mediterranean Sea against Pollution and the EU Horizon 2020 the Framework Programme for Research and Innovation.

3.2.2 Environmental impact of the wastewater sector

3.2.2.1 Increased pollution load from wastewater discharges

Refugees contribute to an increase in wastewater generation between 26 and 43 MCM based on 31 May 2014 estimates of number of refugees, which is expected to reach 34 and 56 MCM by the end of year 2014, corresponding to an increase in national wastewater generation rates between 8 and 14 percent with the Bekaa having the highest share. The detailed methodology for the calculation of wastewater generation rates and pollution load can be found in **Annex C, Box C-1**.

The incremental pollution load of wastewater generated by refugees is estimated to produce around additional 40,000 tons of BOD_5 per year, reflecting a significant increase of organic biodegradable load in the environment. This represents an increase of around 34 percent of BOD_5 load at the national level, distributed across the different cazas as shown in **Map 3.3**, with the higher pressure posed in the Cazas of Baalbeck, Akkar, Zahleh and Baabda.

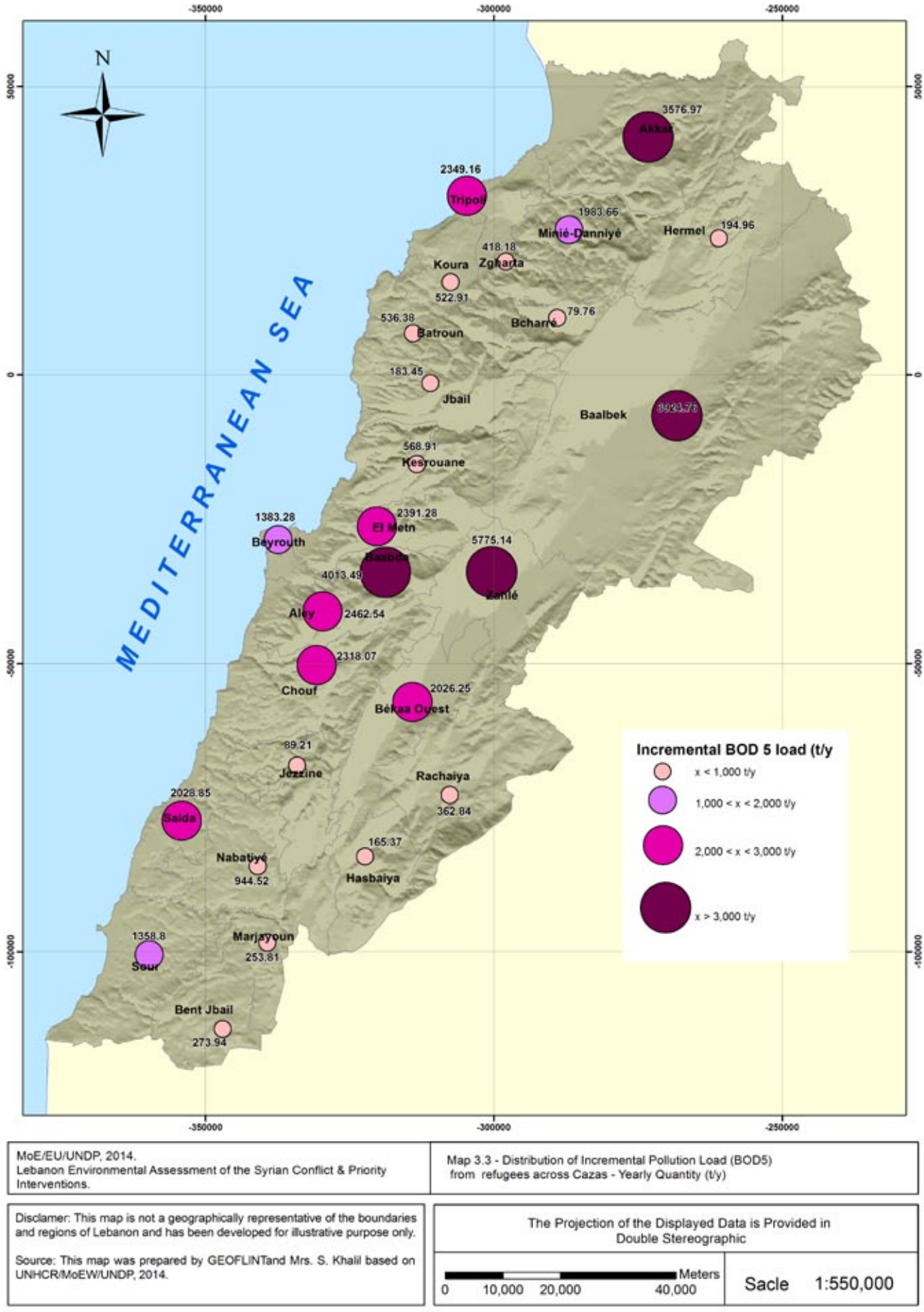
Given the lack of accurate data, it is difficult to determine the fate of the incremental WW generated by the refugees in the various Lebanese regions. As mentioned in section 3.2.1.1, only eight percent of the WW generated at the national level is treated and the remaining is untreated and discharged into open lands or in watercourses. As such, it is expected that similar trends would apply to the WW generated by the Syrian refugees.

A more accurate estimation of the means of disposal of the wastewater generated by the Syrian refugees can be made in the Litani basin based on the business plan for combating pollution of the Qaraoun Lake (MOE/UNDP/ELARD 2011). Taking the number of refugees located in the villages around the Litani basin[15], it has been estimated that the incremental quantity of wastewater generated by the refugees would range between 7 to 11 MCM per year, which is equivalent to around 12 to 19 percent of the total amount of municipal wastewater generated in the Litani basin prior to the Syrian conflict.

Simulations based on the business plan of the Qaraoun Lake also show that 74 percent of the incremental quantity of WW generated by the refugees will be discharged without treatment in the Litani river and 10 percent will be discharged into open lands; thus threatening the current environmental situation.

Releases of WW in water bodies have several environmental and health impacts. These impacts can include negative effects on fish and wildlife populations, oxygen depletion, beach closures and other restrictions on recreational water use, restrictions on fish and shellfish harvesting and consumption, as well as restrictions on drinking water consumption. In addition, disposal of wastewater on soil causes soil contamination and negatively affects agricultural crops.The ecological impacts of wastewater discharges on ecosystems are assessed in **Chapter 5 - Impact on Land Use and Ecosystems.**

[15] The calculations are based on the results of the business plan for combating pollution of the Qaraoun Lake in each village where refugees are located and the projected numbers of refugees in each village in December 2014.



Map 3.3 Distribution of incremental pollution load (BOD_5) from Syrian refugees across cazas

3.3 ENVIRONMENTAL MANAGEMENT PLAN FOR THE WATER AND WASTEWATER SECTORS

The incremental increase in domestic water demand for refugees is expected to reach 43 to 70 MCM by the end of the year 2014, corresponding to an increase in water demand of 8 to 12 percent at the national level. As for the wastewater generation rates, refugees are expected to contribute to an increase of 34 to 56 MCM by the end of the year 2014, resulting in an increase of 8 to 14 percent in wastewater generation at the national level.

The incremental pollution load from wastewater generated by the refugees is estimated at 40,817 tons of BOD_5 per year with 27,930 tons per year disposed on land and within water resources.

The Syrian conflict and the influx of refugees to Lebanon coincided with a period of severe water shortage, further stressing the scarce water resources and the under-developed water and wastewater infrastructure in the country.

3.3.1 Potential mitigations measures

The present EMP includes mitigation, environmental monitoring and capacity building measures intended to alleviate the environmental impacts on the water and wastewater sectors caused by the influx of the Syrian refugees. Various short- to long-term timeframes are proposed for the implementation of these mitigation measures (**Table 3.4**). The priority intervention areas, particularly in terms of water demand management and conservation, are those that are experiencing increased demand within stressed groundwater areas (Refer to **Map 3.4** - Incremental water demand of refugees overlapped with stressed groundwater basins).

3.3.1.1 Water

3.3.1.1.1 Short-term mitigation measures

- Regulating groundwater extraction by controlling unlicensed wells.
- Minimizing well licensing and supervising extraction from licensed wells, especially in stressed aquifers with highly increasing demand (Refer to **Map 3.4**).
- Purchasing water only from licensed suppliers.
- Developing an emergency action plan for scarcity and drought management and linking it to an early warning system. Efforts of the different national committees working on this issue should be consolidated and integrated into one emergency plan.
- Raising awareness on water management and conservation through conducting awareness campaigns for water conservation (encouraging reuse, installation of water efficient fixtures and irrigation systems, etc.).
- Providing support to WEs to improve collection of O&M fees.
- Improving water quality through distribution of hygiene kits, water filters, and water storage tanks.

3.3.1.1.2 Medium to long-term mitigation measures

- Supporting the Ministry of Energy and Water/Water Establishments for continuous monitoring and assessment of groundwater quantity and quality.
- Improving water efficiency in the productive sectors in the short to medium terms. In the agriculture sector, this can be achieved by educating farmers to use efficient irrigation systems, alternative crops and cropping patterns as well as adopting and operationalizing wastewater reuse systems. Within SMEs and larger industries, water conservation measures should be implemented and highly encouraged.
- Improving water infrastructure in impacted areas (Akkar, Baalbeck, Zahle, Baabda, Minieh-Danniyeh, Tripoli, Aley, Chouf, West Bekaa, Saida and Tyre) (**Map 3.4**) in line with the NWSS in terms of storage, transmission and distribution:

  - Implementing water infrastructure projects that are under preparation/planned in impacted areas.

  - Designing and mobilizing resources for water infrastructure projects in regional water establishments to cover all the remaining needs in impacted areas.

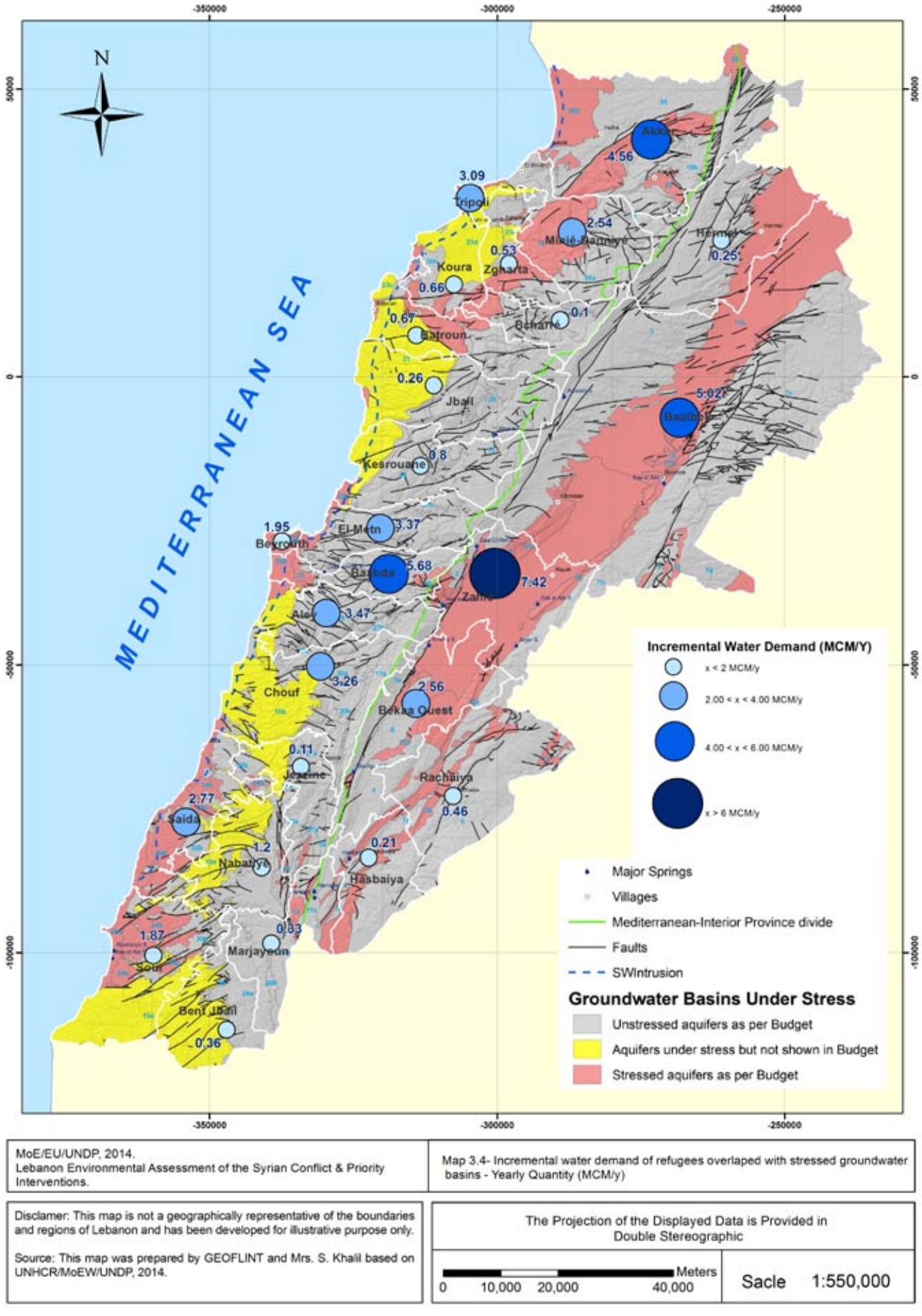
  - Implementing projects for groundwater recharge in impacted aquifers.

- Supporting the Ministry of Energy and Water/Water Establishments to improve water quality.

3.3.1.2 Wastewater

3.3.1.2.1 Short-term mitigation measures

- Managing sludge and wastewater disposal. Wastewater and sludge should be transferred to the closest functioning wastewater treatment plant (Refer to **Map 3.5** - Location of existing and planned wastewater treatment plants). Municipalities with high number of refugees should be provided with tankers for de-sludging and trucks for cleaning and maintaining sewer lines operational.
- Monitoring and enforcing compliance with environmental standards.



MoE/EU/UNDP, 2014.
Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.

Map 3.4- Incremental water demand of refugees overlaped with stressed groundwater basins - Yearly Quantity (MCM/y)

Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only.

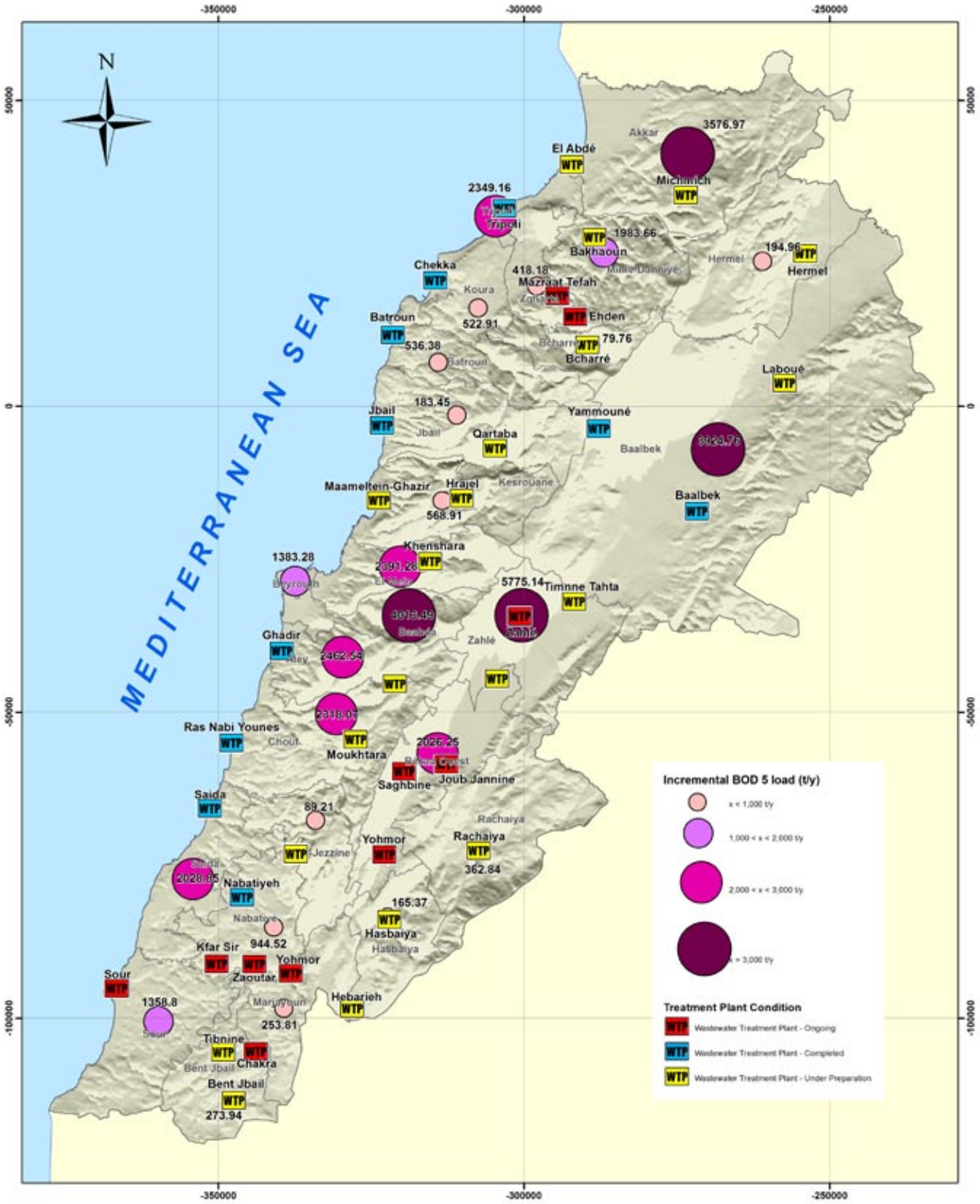
Source: This map was prepared by GEOFLINT and Mrs. S. Khalil based on UNHCR/MoEW/UNDP, 2014.

The Projection of the Displayed Data is Provided in Double Stereographic

0 10,000 20,000 40,000 Meters

Sacle 1:550,000

Map 3.4 Incremental water demand of refugees overlapped with stressed groundwater basins



MoE/EU/UNDP, 2014. Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.	Map 6.3 - Location of existing and planned wastewater treatment plants
Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only. Source: This map was prepared by GEOFLINTand Mrs. S. Khalil based on UNHCR/MoEW/UNDP/ CDR, 2014.	The Projection of the Displayed Data is Provided in Double Stereographic 0 10,000 20,000 40,000 Meters Sacle 1:550,000

Map 3.5 Location of existing and planned wastewater treatment plants

3.3.1.2.2 Medium to long-term mitigation measures

- Speeding up the implementation of projects related to the wastewater sector in the pipeline; and securing the financing for the O&M of these plants from the national budget once construction is completed.
- Mobilizing resources for wastewater projects not yet pipelined in priority areas.

3.3.2 Environmental monitoring and capacity development

The different environmental monitoring responsibilities in the water sector are divided among several players:

- MOEW has the responsibility of monitoring, controlling and measuring water resources. This includes determining the specific needs and uses of water resources in addition to continuous monitoring of their quality.
- MOE is in charge of monitoring environmental pollution through review and approval of EIAs for WWTPs and through monitoring compliance with the set standards for treated wastewater discharged into sewers and surface waters (MOE Decision 8/1 dated 30/1/2001). MOE monitoring and enforcement capacities can be enhanced in the presence of fully operational regional environmental departments, and with the establishment of an environmental police.
- MOPH has the responsibility of monitoring drinking water to ensure compliance with local and international standards.
- Water establishments are responsible for monitoring the quality of water supplied to their communities.
- The LRA is responsible for monitoring all surface flows throughout the country, as well as water quality in the Litani basin.
- International agencies and NGOs should work on monitoring water quality, and ensuring that WW and sludge are disposed of in an environmentally acceptable manner. Agencies should encourage water conservation and should use environmentally friendly technologies to address refugees' needs and ensuring the disposal of WW in WWTPs.
- The capacities of the municipal police should be increased to include the control of WW disposal in surface water bodies and on land. The MOE should coordinate with humanitarian agencies and NGOs for an improved integration of the environmental aspect in their humanitarian response.

3.3.3 Environmental management plan costs

The costs for the implementation of the proposed environmental management plan over the short and medium terms (i.e until 2020) - including environmental monitoring and capacity development- reached a total of 1,287.3 MUSD.

According to the NWSS, the estimated O&M cost between 2015 and 2020 will increase from USD 0.14/m^3 to USD 0.41/m^3 for wastewater collection and treatment and from USD 0.45/m^3 to USD 0.55/m^3 for water supply (MOEW 2010).

Table 3.4 Environmental management plan to mitigate the potential impacts of the Syrian conflict on the water and wastewate

Impact	Mitigation Measures	Nature	Planned/proposed measures
1. Depletion of water resources	**1.1 Controlling groundwater usage especially in water stressed areas**	Technical	Regulating groundwater extraction by controlling unlicensed wells.
			Minimizing the licensing of wells and supervising extraction from licensed wells, especially in stressed aquifers where demand highly increased.
		Capacity Development	Limiting water purchase to licensed suppliers to prevent unregulated development of new sources.
		Capacity Development	Supporting the MOEW/WEs for continuously monitoring and assessing groundwater quantity and quality.
	1.2 Developing an emergency action plan for scarcity and drought management	Technical	Developing an emergency plan linked to an early warning system.
	1.3 Raising awareness on water management and conservation	Capacity Development	Conducting awareness campaigns for water conservation (e.g. water reuse, installation of water efficient fixtures and irrigation systems).
	1.4 Improving water efficiency in the productive sectors	Technical	Supporting farmers to use water efficient irrigation systems in agriculture and to use alternative crops and cropping patterns.
		Technical	Adopting and operationalizing wastewater reuse systems.
		Capacity Development	Supporting SMEs and larger industries to implement water conservation measures.
	1.5 Improving water infrastructure storage, transmission and distribution systems especially in impacted areas (Akkar, Baalbeck, Zahle, Baabda, Minieh-Dennieh, Tipoli, Aley, Chouf, West Bekaa, Saida and Tyr)	Technical	Supporting WEs to increase collection rates.
		Technical	Implementing emergency water infrastructure projects that are under preparation/planned in impacted areas.
		Technical	Implementing artificial water recharge systems in vulnerable aquifers.

er sectors in Lebanon

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/yr)	Timeframe	Remarks
MOIM	TBD		Short-term	
MOEW, WEs	TBD		Short-term	Refer to **Map 3.4** about stressed aquifers.
Humanitarian Aid agencies, NGOs			Short-term	
MOEW, WEs	TBD		Medium to long term	Some monitoring already exists but the network needs to be increased under the ministry's supervision.
MOEW, WEs, MOE, MOA, MOI, MOT, Humanitarian Aid agencies	TBD		Short-term	As recommended by the MOEW (Tayar, 2014).
MOEW, MOE, MOA, WEs, Humanitarian Aid agencies, NGOs, Media	TBD		Short-term	A national campaign for water conservation has been initiated by MOEW. The campaign should be expanded to target the different water uses.
MOEW, MOA, Humanitarian Aid agencies	TBD		Medium term	
MOEW, MOA, WEs, Humanitarian Aid agencies	TBD		Medium- term	Guidelines for wastewater reuse have been developed and are being reviewed.
MOEW, MOE, MOI, Humanitarian Aid agencies	TBD		Medium -term	Law 444/2002 related to the protection of the environment promotesthe sustainable use of natural resources.
MOEW, WEs, Humanitarian Aid agencies		TBD	Short- to medium-term	
MOEW, WEs, CDR	600		Medium- to long- term	
MOEW, RWE	64.00		Medium- to long- term	Refer to **Map 3.4** about stressed aquifers. The cost estimate is in accordance with the NWSS.

Impact	Mitigation Measures	Nature	Planned/proposed measures
2. Deterioration of water quality	**2.1 Improving water quality for host-communities and refugees**	Technical	Supporting the MOEW and WEs to improve water quality.
		Technical	Distributing hygiene kits, water filters, and water storage tanks for refugees in need.
3. Increased wastewater discharges	**3.1 Managing sludge disposal**	Technical	Transferring and disposing sludge from septic tanks to the closest functioning WWTP.
		Technical	Providing Unions of Municipalities (UOMs) with high number of refugees with tankers for de-sludging.
		Technical	Providing UOMs with high number of refugees with trucks for cleaning and opening sewer lines.
	3.2 Implementing wastewater collection and treatment infrastructure projects in impacted areas (Akkar, Baalbeck, Zahle, Baabda, Minieh-Danniyeh, Tipoli, Aley, Chouf, West Bekaa, Saida and Tyr)	Technical	Implementing wastewater infrastructure projects that are under preparation/planned in impacted areas.
		Technical	Designing and mobilizing resources for wastewater infra-structure projects to cover the unmet needs in impacted areas.
		Environmental Monitoring	Monitoring and enforcing compliance with standards.
TOTAL			

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/yr)	Timeframe	Remarks
MOEW, WEs, Humanitarian Aid agencies	4		Medium to long term	
Humanitarian Aid agencies; NGOs	115		Short-term	Humanitarian Aid agencies have provided these items to 70% of refugees and continue to do so. Around 30% of refugees are vulnerable (550,500 refugees by end of 2014). The estimated cost is USD 122/individual/7 months as per WB/ESIA (i.e. 209 USD/individual/year).
WEs, Municipalities	TBD		Short-term	Refer to **Map 3.5** about locations and statuses of WWTPs.
WEs, UOMs, Municipalities, Humanitarian Aid Agencies	1.65	TBD	Short-term	
WEs, UOMs, Municipalities, Humanitarian Aid agencies, NGOs	2.64	TBD	Short-term	
MOEW, WEs, CDR, Donors	500		Medium to long term	
MOEW, WEs, Donors	TBD		Medium to long term	
MOE, MOEW, LRA, Municipalities (Police)	TBD		Short to medium term	
	1,287.3	**TBD**		

4

IMPACT ON AIR QUALITY

4.1 BASELINE CONDITIONS

4.1.1 Air quality in Lebanon

The Mediterranean region is an enclosed area where air masses coming from Eastern and Central Europe combined with high local insulation and high emissions lead to the degradation of air quality (Afif et al. 2008; Waked et al. 2013). Continuous air quality monitoring is conducted in only a few countries in the Eastern part of the Mediterranean region such as in Egypt and Turkey. Since 2001, Lebanon's capabilities in air quality monitoring have vastly improved. Although the country still lacks a national, government-driven program for air quality monitoring, several universities and institutions have started to coordinate their air pollution related activities (MOE/UNDP/ECODIT 2011). The research studies indicate that the problematic air pollutants in Beirut at present are NO_2, and Particular Matter (PM) with around 93 percent of the population in Beirut being exposed to NO_2 concentrations greater than the WHO standards (Afif et al. 2009; Massoud et al. 2011; Badaro-Saliba et al. 2014; SOER 2010). However most of these studies are outdated (field measurement campaigns were mostly conducted between 2004 and 2006) and might not represent the current situation.

In 2013, the MOE with the support of the United Nations Environment Programme (UNEP) and UNDP launched real time air quality monitoring in five sites using online analyzers connected to a supervisory control and data acquisition system located at MOE. The current network includes five urban background stations; however, air quality trends cannot be extracted from these measurements at present, as data need to be collected for several years in order to identify real trends in air quality. Implementation of additional air quality monitoring stations are currently planned with the support of the EU/StREG programme. Installation sites will be determined in regions where air quality is most affected. The results of these monitoring stations will allow close monitoring of air quality trends and retrospective assessment of the air quality.

Since air quality data is not available for 2011 (baseline year of this assessment), the spatially distributed emission data of 2010 will be used for this assessment. Emissions are the quantities of pollutants that are released into the atmosphere by different sources, i.e. vehicles, industries, etc. For more details on the methodology and assumptions adopted in this assessment refer to **Annex D**.

Main greenhouse gases (GHGs) including CO_2, methane (CH_4) and nitrous oxide (N_2O) are also emitted from the sectors under consideration. However they were not retained in this report because they do not have adverse short-term effects on human health. An in-depth impact of the Syrian conflict on GHG emissions is recommended along with an assessment of vulnerability to climate change of host communities and refugees.

4.1.2 Pollutants Emissions in Lebanon in 2010

Different anthropogenic and biogenic[16] activities result in the emission of pollutants into the air. The significant sources of air pollution are the transport sector (road, sea, and air), the industrial sector, energy production (power plants and generators), the commercial, residential, and construction sectors, agriculture, solid waste, and biomass burning. In 2010, before the Syrian conflict, the total estimated anthropogenic and biogenic emissions by source category of CO, NOx, SO_2, PM10, and PM2.5 from Lebanon were 563,000, 75,000, 62,000, 12,000, and 9,000 tons, respectively (Waked et al. 2012a). Once released into the air, the dispersion and chemical reactions change the concentrations of the different pollutants. Human health is affected by air pollution depending on the concentrations of pollutants and time of exposure; that is the reason for the establishment of average periods of exposure and concentration limits in air quality standards (e.g. National Ambient Air Quality standards in MOE Decision 52/1, dated 1996).

4.1.3 Health impact of air pollution in Lebanon

Ambient air pollution is a major environmental health problem affecting both developed and developing countries alike. In 2012, for example, 3.7 million premature deaths worldwide were associated to ambient air pollution (WHO, 2014). Several studies indicate that ischaemic heart disease[17] and strokes have caused 80 percent of outdoor air pollution-related premature deaths, while 14 percent of deaths were due to chronic obstructive pulmonary disease or acute lower respiratory infections; and lung cancer was responsible for six percent of deaths (WHO 2014).

Published information and data do not clearly link adverse health effects to air pollution in Lebanon. This is due to limited air pollution measurements and appropri-

[16] Biogenic : Nature made

[17] Ischaemic heart disease: Disease characterized by reduced blood supply to the heart

ate medical reporting which results in the incapacity of establishing long term epidemiological studies that reflect the health impacts from air pollution on the Lebanese population.

However, it can be estimated that health risks on the Lebanese population resulting from exposure to some pollutants exist in the country. This has been confirmed by the World Bank which indicated that the cost of degradation of air quality in Lebanon has been estimated to be around US$170 million in 2001 (World Bank, 2004) and is attributed to losses of health and quality of life.

4.2 FOCUS ON THE BASELINE EMISSIONS OF THE AFFECTED SECTORS

Since the beginning of the Syrian conflict in 2011, the increase of population in Lebanon due to the Syrian influx is affecting the existing air quality. This section will focus on the main sectors including the on-road transport sector, the residential sector through heating, the solid waste sector, and the electricity production. It is worth noting that although annual cement production did not change, a small growth in the local market was observed (from 5.2 MT in 2010 to an estimated 6 MT in 2014). This can be attributed to the fact that cement production is relatively constant and independent of the local market sales[18]. It is, however, expected to increase post-conflict in anticipation of a massive reconstruction effort in Syria; this is not factored into the current assessment. The methodology adopted and assumptions are made available in the Annex D of this report.

4.2.1 On-road Transport

The road network condition in Lebanon is considered to be fair to poor with around 21,705 km (World Bank, 2013). In 2010, the vehicle fleet in the country comprised around 1.43 million vehicles with 86.1 percent of passenger cars, 7.4 percent of light duty vehicles, 2.3 percent of heavy duty vehicles, and 4.2 percent of 2- and 3-wheelers. The fleet is characterized by an advanced vehicle age with 63 percent above 10 years old (Waked and Afif, 2012).

Greater Beirut Area (GBA) is the densest region in Lebanon in terms of traffic. Traffic intensities can reach 90,000 vehicles per day for some segments in Beirut with around 81 percent of the vehicle fleet dominated by passenger cars with an average speed of 23 km/h (Waked and Afif, 2012).

The transport sector is the main source of CO (93 percent) and NOx (52 percent) emissions at the national level. Emissions are principally concentrated on main axes and cities, as shown in **Map 4.1**. Although CO concentrations have not exceeded WHO guidelines to date, NO_2 concentrations exceed WHO guidelines in some cities where high traffic prevails (Waked et al., 2013b). Although this sector is not the main contributor to PM emissions at a national level, however, PM levels exceed WHO guidelines on the coast and where traffic is dense (Waked et al., 2013b). Trends in the transport sector in Lebanon are alarming and it is expected that the contribution of this sector to air quality would negatively affect the health of the Lebanese people.

The following considerations regarding the increase of on-road transport due to the Syrian conflict have been used based on the World Bank's studies (World Bank 2013):

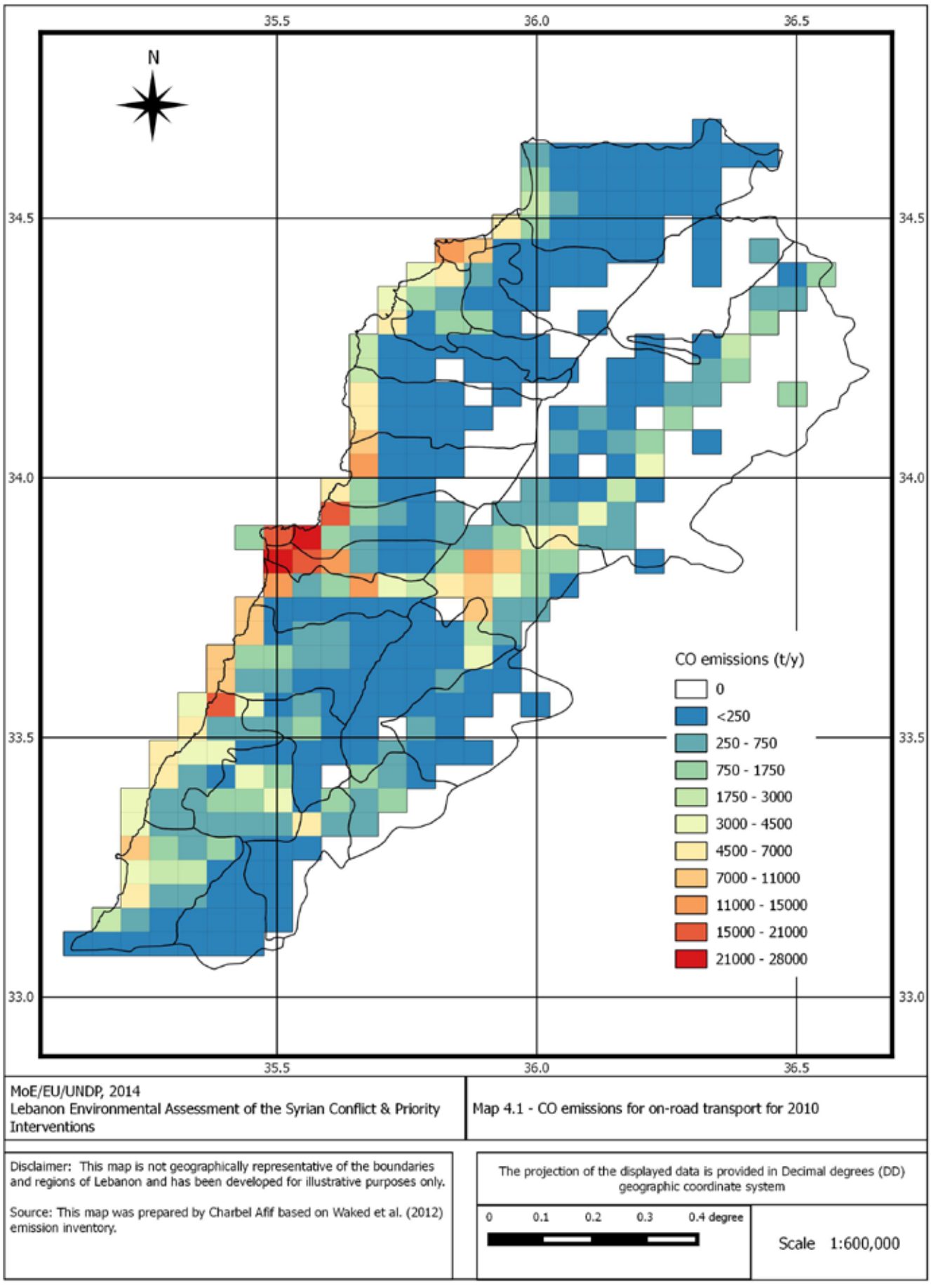
- 15 percent increase in traffic with lower speeds in GBA,
- up to 50 percent increase in traffic in the major cities where the refugees are located, and,
- 65 percent decrease in transit trucks due to the prevailing security situation.

Hence, a five percent increase in traffic was estimated on the main national axes.

The assessment has revealed the following results:

- 17 percent CO increase from road transport emissions at the national level; this figure will not drive the background CO concentrations above WHO and/or Lebanese standards as the concentrations of this pollutant are low in Lebanon,
- 10 percent increase in NOx and three percent increase of PM at the national level, which will worsen the situation in some areas where the concentrations of these pollutants are already above standards, and,
- 6 percent increase in NOx and PM in Beirut where chronic air pollution already exists; this figure will worsen the existing situation and can lead to higher rates of emergency entrances in hospitals for asthmatic and elderly people.

[18] Private communication with Mr. Elias Chahine, Cimenterie Nationale



Map 4.1 CO emissions for on-road transport in 2010 (tons/year)

4.2.2 Residential heating

The residential sector in Waked et al. (2012) covered heating and hot/warm water processes. Fuel types used in these processes comprised diesel oil, liquefied petroleum gas, and wood (Waked et al., 2012). SO2 emissions contribute to five percent to the national SO2 quantity released into the air (Waked et al., 2012). Other pollutants present an increase of up to two percent at the national level which makes this sector of minor importance when compared to others. Generally, residential heating has a more pronounced impact at the local scale where the use of heating is concentrated in one geographical areas such as cities.

The Syrian refugees, who live in villages at altitudes above 500 meters, received diesel stoves with cash-for-fuel or fuel vouchers. The amount distributed during the winter 2013-2014 is equivalent to around 40 million liters of fuel oil[19]. If the average fuel quantity per refugee is assumed to remain the same as in the winter of 2013-2014, then approximately 67 million liters of diesel for heating would be needed in the 2014-2015 winter for Syrian refugees living at altitudes above 500 meters. If the winter is as mild as in 2013-2014, the national increase in air pollution will account for less than 0.2 percent for the various pollutants. The stress will not be significant on a national level but might be of importance in a few localized areas like ITSs, thus affecting the health of refugees and the nearby host communities.

4.2.3 Solid waste

Lebanon generated 1.57 million tons of Municipal Solid Waste (MSW) in 2010 where different management practices exist: eight percent recycling, nine percent composting, 51 percent landfilling, and 32 percent open dumping (Refer to **Chapter 2 - Impact on the Solid Waste Sector**). Emissions generated by the solid waste sector can vary depending on management practices. Open burning contributes more to air pollution than open dumping; the latter contributes mainly to climate change. In 2010, the contribution of the different solid waste management practices to air pollution was insignificant at the national scale with less than one percent for the different pollutants (Waked et al., 2012).

Among the major concerns rising from open burning of waste is the release of very toxic and carcinogenic compounds including dioxins (PCDD) and furans (PCDF). These chemical compounds are regulated by the Stockholm Convention on Persistent Organic Pollutants which Lebanon ratified in 2002. PCDD/PCDF affect the health of the population living nearby open dumps. With more than 300 open dumps in Lebanon, which are characterized by open burning practices, the assessment estimated an increase of 12.05 grams of Toxic Equivalents (TEQ)[20] in PCDD/PCDF emissions. This represents a significant increase from the last emissions inventory established for PCDD/F in Lebanon by MOE-UNEP in 2004 and which estimated the release into the atmosphere of 80.2 g TEQ/yr from all sources (MOE/UNEP 2005). **Figure 4.1** presents an example of open burning at the Jeb Jennine open dump.

Additional quantity of PCDD/F released into the atmosphere will jeopardize specifically the health of local com-

Figure 4.1 Open burning in Jib Jennine open dump (Photo from K. El Jisr)

[19] Values calculated based on UNHCR (2014). For details, refer to Annex D

[20] TEQs, are used to report the toxicity-weighted masses of mixtures of dioxins. The TEQ method of dioxin reporting is more meaningful than simply reporting the total number of grams of a mixture of variously toxic compounds because the TEQ method offers toxicity information about the mixture. Within the TEQ method, each dioxin compound is assigned a Toxic Equivalency Factor, or TEF. This factor denotes a given dioxin compound's toxicity relative to 2,3,7,8-TCDD, which is assigned the maximum toxicity designation of one

munities (and refugees) around the open dumps where the burning is taking place, adding to the effects of already existing open burning practices.

The increase in air pollution from waste management practices due to Syrian refugees is insignificant for CO, NOx, and SO_2. However, an increase of more than six percent compared to total emissions of 2010 is estimated for PM at the national level i.e. double of the PM emission from road transport. This will induce a negative impact on human health.

Moreover, it is estimated that odors resulting from waste dumping affect Syrian refugees and host communities within an area of 2-km radius. These odors can cause adverse impacts on human health following a short term exposure and serious health problems following a long-term exposure.

4.2.4 Electricity production

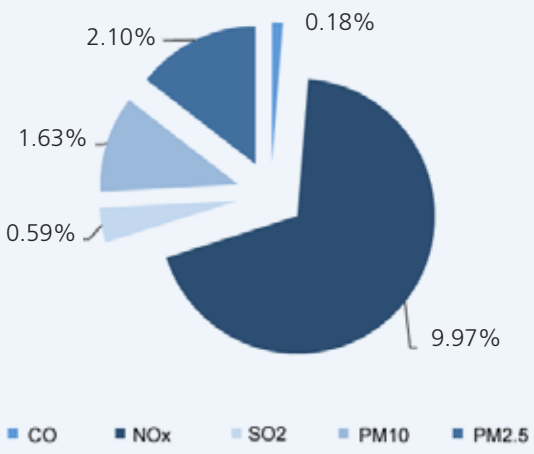
As Lebanon is unable to cover all the electricity demand at national level, private generators are mainly used to respond to electricity shortage. Daily average power supply provided by Electricité du Liban (EDL) in 2010 was 18.4 hours. In 2010, the electricity production sector emitted high quantities of NOx, SO_2, and PM with half of the NOx emitted by private generators; the highest share of SO_2 originating from power plants, and more than half of the PM released by private generators which make them an important source of air pollution in Lebanon (**Table 4.1**).

Table 4.1 Contribution of power plants and private generators to national emissions in 2010 (Waked et al., 2012)

	CO	NOx	SO_2	PM10	PM2.5
Private Generators (%)	0.44	10.07	2.21	4.42	5.86
Power Plants (%)	0.07	9.54	51.37	2.92	2.69

Given that private generators emit high concentrations of NO_2 and finer PM which are the most hazardous to human health, they can pose a serious health risk on nearby communities.

Figure 4.2 Incremental levels of pollutants originating from private generators



The 251 MW increasing demand due to Syrian refugees (World Bank, 2013) will result in more investment for the acquisition of private generators which are mostly installed in neighborhoods near residential buildings. These generators, if not appropriately installed in open areas far from buildings and equipped with high stacks and control equipment, will result in air pollution hot spots inside the cities.

The incremental quantities of air pollutants originating from private generators have been estimated to be 10 percent for NOx and around two percent for the remaining pollutants as shown in **Figure 4.2**.

4.3 ASSESSMENT OF TOTAL EMISSIONS

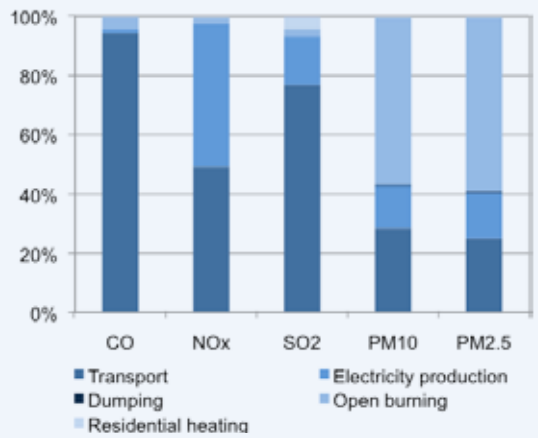
The Syrian conflict will result in an increase of up to 20 percent in emissions in Lebanon and therefore an increase in air pollution and degradation of air quality. **Table 4.2** presents the absolute quantities that are estimated to be released into the atmosphere and the relative increment compared to the baseline of 2010.

This implies that, at the national level, highest potential pollutants of concern are PM and NO_2 since they showed high concentrations in different areas in the country. However, in some specific geographical areas, SO_2 and CO might reach concentrations that exceed WHO guidelines and Lebanese standards.

Table 4.2. Incremental quantities of air pollutants emissions in 2014 compared to 2010

	CO	NOx	SO_2	PM10	PM2.5
Absolute increase in tons end of 2014 compared to 2010	100,346	15,317	2,222	1,221	1,077
Relative increase end of 2014 compared to 2010 (%)	18	20	4	11	13

Fig. 4.3 Sources of contribution to the increase of emissions caused by the Syrian refugees influx to Lebanon



As shown in **Figure 4.3**, the main sectors contributing to the increase of pollutants are the following:

- Transport is the major contributor for CO, NOx, and SO_2
- Electricity production (private generators) do affect NOx and PM
- Open burning is the largest contributor to PM emissions

Therefore, a detailed analysis of the spatial distribution of the different pollutants emissions is essential to locate areas of potential concern.

An example of a spatial distribution conducted as part of the assessment (**Map 4.2** and **Map 4.3**) shows that GBA, which already has moderate to poor air quality, will suffer from an increase in air pollutants concentrations up to 20 percent (based on the conservative approach followed in this assessment). It is also expected that other main cities such as Zahle, Baalbeck, Tripoli, and Saida will witness a significant degradation of their air quality and the health of their population, while rural areas will be affected but to a lesser extent.

4.4 ENVIRONMENTAL MANAGEMENT PLAN FOR THE AIR POLLUTION SECTOR

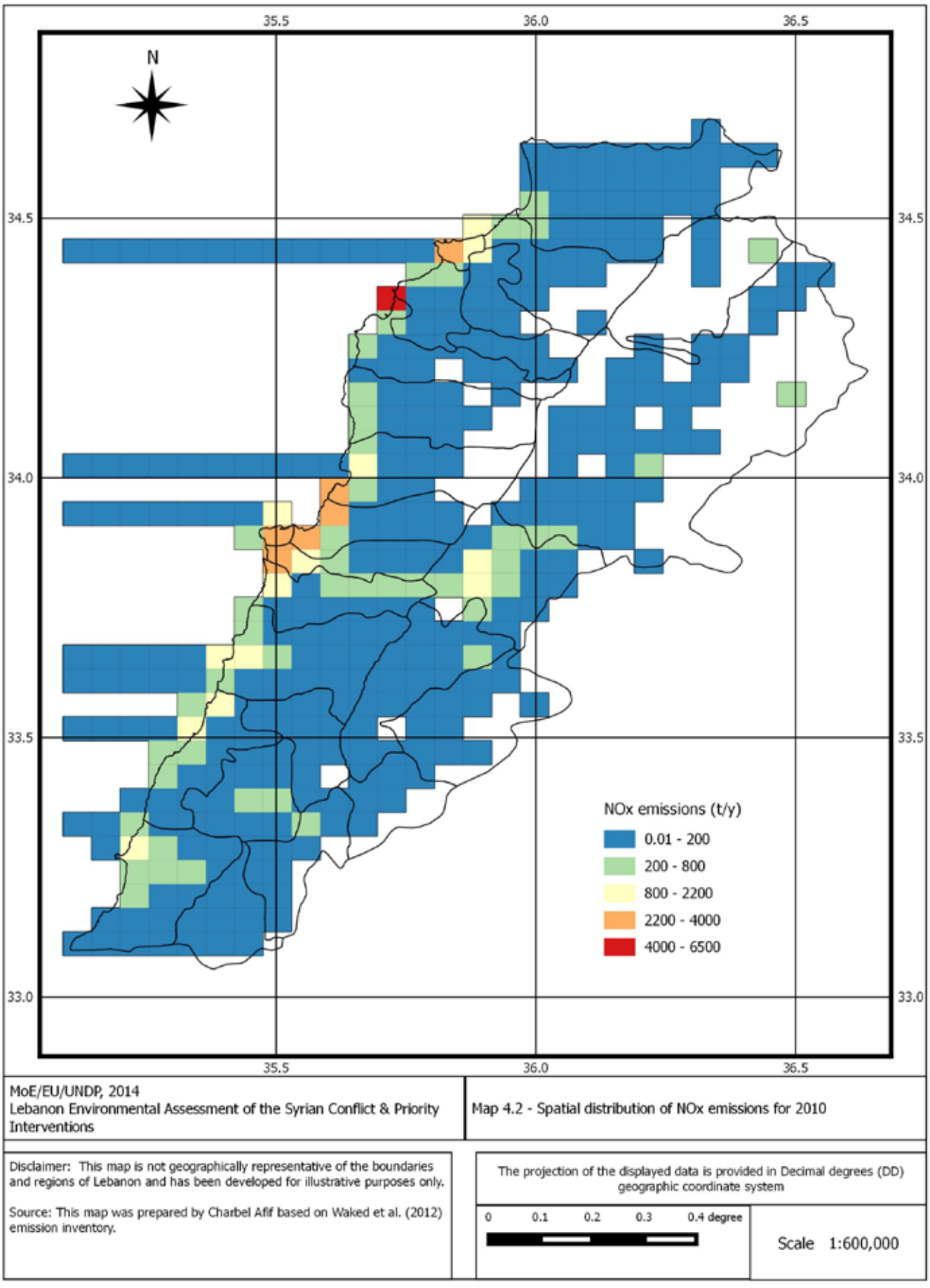
As presented in the previous sections, it is estimated that the extent of air pollution has increased up to 20 percent compared to 2010 baseline data, knowing that some of the major Lebanese cities have already high concentrations of pollutants. The major affected sectors contribute differently to air pollution. The most important issues that should be addressed in order to reduce the harmful effects of air pollution are the transportation sector, waste treatment and electricity production sectors, and residential heating.

The EMP for the air pollution proposes potential mitigation actions for each sector with an estimate of the cost and the responsible parties. It is to be noted that mitigation measures related to the transportation and electricity sectors are foreseen in the Lebanon Roadmap of priority interventions for stabilization; most of these measures are adopted in the EMP to further emphasize their importance and their positive environmental impact. The additional proposed measures are complementary and help making the whole mitigation process greener.

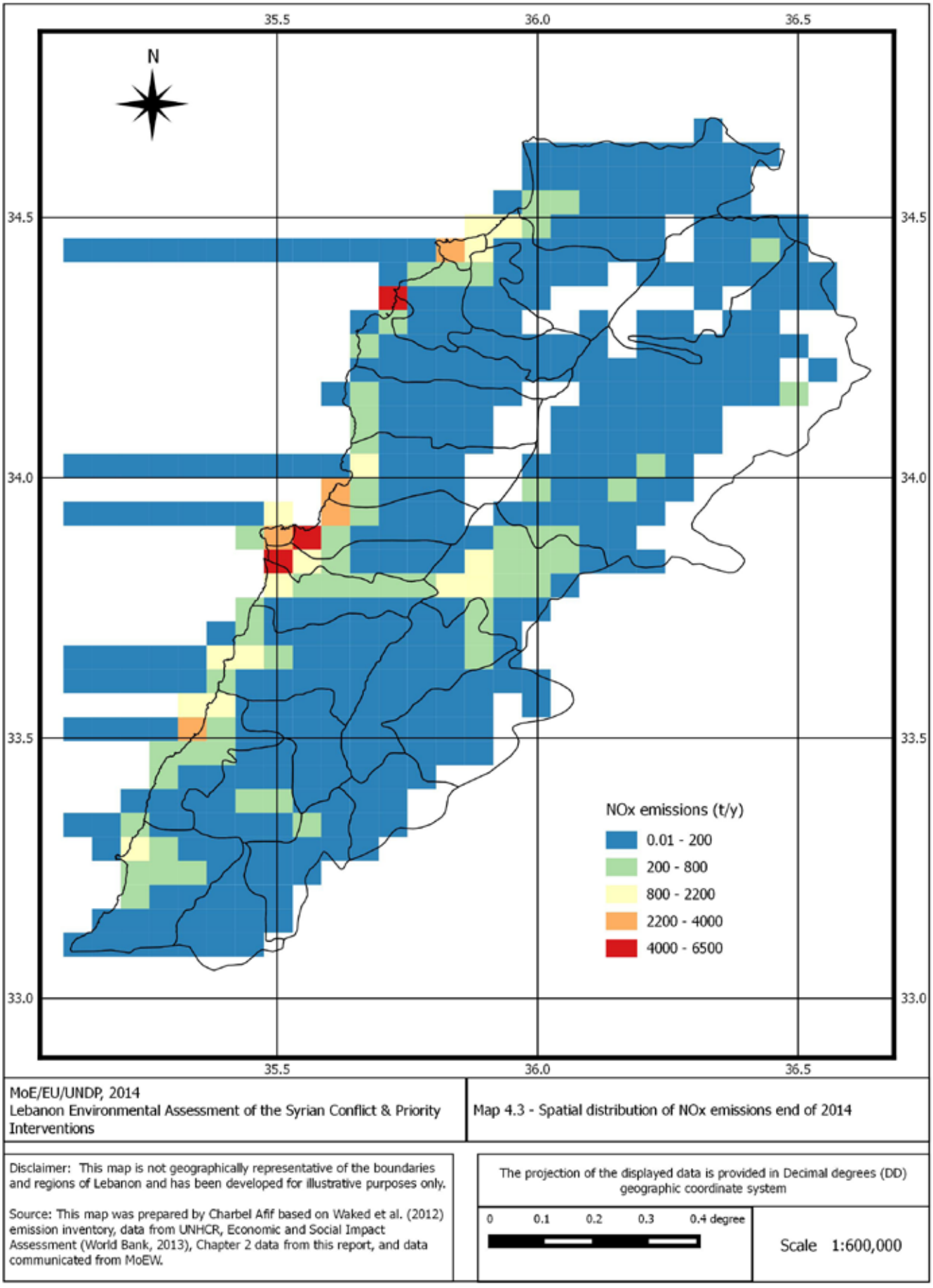
Moreover, an in-depth assessment of the impact of the Syrian conflict on the emissions of Greenhouse Gases is highly recommended along with a thorough assessment of adaptation and vulnerability to climate change.

4.4.1 Potential mitigation measures

The detailed mitigation measures are presented in the EMP-**Table 4.3.** They are divided in short and medium term actions.



Map 4.2 Spatial distribution of NOx emissions for 2010 in tons/year



Map 4.3 Spatial distribution of NOx emissions end of 2010 in tons / year

4.4.1.1 Short term mitigation measures:

- Implementation of a Bus Rapid Transit (BRT) system by the MOPWT, in coordination with CDR as needed, with a first phase consisting in managing the existing private and public bus fleet and dedicating lanes between the Jounieh area and the Northern entrance of Beirut as well as between Beirut and Khaldeh area to decongest the entrances of the capital.
- Relocation of the private generators installed inside neighborhoods to the more open areas located far from buildings with stack height, in compliance with MOE Decision 8/1 (2001), with the aim of minimizing the smoke impact on nearby residential buildings. Generators' owners will be responsible for taking such actions in compliance with existing regulatory texts. Moreover, the installation of emissions control equipment is crucial in order to reduce the impact on air quality and on human health, especially with the dependence of the host communities on the existence of these generators, since EDL is still not capable of meeting the increase in electricity demand.
- Immediate banning of waste open burning techniques in dumps should take place and be enforced by the MOE and the municipalities to reduce the highly carcinogenic PCDD and PCDF, and the harmful effects of these particulates on the host communities.

4.4.1.2 Medium term mitigation measures:

- Providing buses with low emission technology to back up the existing fleet for connections within and between major cities (e.g. Bekaa area) as a second phase of the BRT system. This mass transport system that should be implemented by the CDR and the MOPWT will attenuate the traffic congestion problem in a sustainable and cost-efficient way and will reduce the quantities of air pollutants emitted per passenger.
- Increasing access to sustainable energy such as solar water heating, public lighting and others to allow for a decrease in energy consumption from the EDL power grid, thus alleviating the pressure on the electricity network.
- Rehabilitating the Zouk and Jiyeh power plants running on Heavy Fuel Oil (HFO) is crucial. Contract bidding and awarding should be prioritized as the rehabilitation will reduce air pollutants' emissions and will increase the production by 209 MW, by restoring the generating capacity. Lebanese communities and Syrian refugees will benefit from a higher daily supply of electricity and, in the long run, from improved air quality.
- Providing additional control equipment to the old engines running on HFO in the power plants of Zouk and Jiyeh. The space needed for the installation of such equipment is of about 50,000 m^2 per site, and the lands on which the power plants are currently located do not have this space capacity. The acquisition of the needed space will therefore be mandatory for it to be feasible in the near future.
- Switching existing and/or under construction power plants operating on HFO to natural gas will decrease air pollution in the nearby areas, noting that the new plants in Zouk and Jiyeh that are under construction are estimated to increase the supply by 272 MW while the second power plant planned to be built in Deir Ammar will add another 538 MW. This action led by MOEW requires the installation of a gasification unit in North Lebanon with pipelines reaching Zouk and Jiyeh power plants, as well as interventions in the new plants in Zouk and Jiyeh to make them operate on natural gas. In preparation for these measures, the Lebanese Government should enact legal texts demanding and allowing for the installation of the needed natural gas pipelines.
- Closing dumps to reduce air pollution from solid waste and improve the welfare of host communities. MOE and the municipalities should ensure proper closure of dumps located in areas with the highest concentrations of Syrian refugees.
- Using energy efficient stoves for residential heating to reduce fuel consumption while maintaining the same heating capacity.

4.4.2 Environmental monitoring and capacity development

MOE and municipalities should play a crucial role in ensuring the relocation of private generators to open areas and the installation of the appropriate control equipment on the short term. On the medium term, MOPWT and CDR should conduct field observations and surveys assessing the effectiveness of the implemented BRT system and its consequences on traffic volumes. The benefits of such a system should be assessed 6 months following its implementation. Finally, with regards to the solid waste sector, medium term environmental monitoring consists of ensuring proper closure of open dumps by the MOE and the concerned municipalities.

Capacity development encompasses mainly national awareness campaigns to encourage the use of mass transport systems (led by MOPWT, MOE, and the municipalities), the use of renewable energy (led by MOEW and MOE), and that of bio-energy for residential heating (led by MOE, MOEW, and NGOs). On the medium term, technical assistance and support to MOEW for managing on-going projects and developing new ones will be essential in order to speed up the implementation of the policy paper for the electricity sector. Capacity development actions should include conducting awareness campaigns touching on the harmful environmental impacts of open-air dumps and the need for their rehabilitation and eventual closure by MOE and municipalities.

4.4.3 Environmental management plan costs

The total capital cost of the EMP addressing the four sectors (transport, energy production, solid waste and, residential heating) is estimated at 1,986.75 MUSD. This includes 620.25 MUSD intended for stabilization and improvement of the transportation sector, which is the major contributor to air pollution, while energy production optimization is estimated to require the most capital funds of about 1,346.4 MUSD. It is worth noting that most of the total estimated cost has not been secured yet.

Table 4.3 Environmental management plan to mitigate the potential impacts of the Syrian conflict on the air pollution sector in

Targeted sector	Potential Mitigation Measures	Nature of Measures	Planned/proposed measures
Transport	1.1 Implementation of a BRT system	Technical	Managing the existing private and public bus fleet and dedicating lanes from Jounieh area to the Northern entrance of Beirut, and from Beirut to Khaldeh area.
		Technical	Providing 250 buses (type: new diesel technology buses, buses running on Liquified Natural Gas(LNG) or Compressed Natural Gas (CNG)NG, hybrid buses) to complement existing fleet and ensure reliable connections between major cities.
		Environmental monitoring	Field observations and survey for the use of mass transport system and assessment of traffic volumes.
		Capacity development	National awareness campaign to encourage mass transport system use.
	1.2 Implementation of organized mass transport systems in cities	Technical	Providing buses (type: new diesel technology buses, buses running on LNG or PNG, hybrid buses) to ensure proper travelling within cities and connection to major national axes.
	1.3 Maintenance and expansion of the road network including border crossings	Technical	Maintenance of existing network and expansion of roads to link to international roads and border crossings.
Energy production	2.1 Decrease effect of private generators	Technical	Relocating private generators from in neighborhoods to open areas far from buildings.
		Technical	Installing air pollution control equipment to reduce emissions.
		Environmental monitoring	Ensuring relocation of private generators and installation of control equipment.
	2.2 Increase access to sustainable energy	Technical	Using renewable energy for solar water heating, public lighting, etc. to alleviate the pressure on the network and decrease the electricity demand.
		Capacity development	National awareness campaign to promote the use of renewable energy.

Lebanon				
Responsible parties	**Capital cost (MUSD)**	**O&M costs (MUSD/yr)**	**Timeframe**	**Remarks**
MOPWT, CDR	100.00	5.00	Short-term	
MOPWT	100.00	5.00	Medium- term	
MOPWT, CDR	0.1		Short-term	
MOPWT, MOE, Municipalities	0.15		Medium-term	
MOPWT, Municipalities	70.00	5.00	Medium-term	
MOPWT, CDR	350.00	40.00	Short- to Medium-term	
Private generators' owners	3.00		Short-term	
Private generators' owners	20.00	2.00	Short-term	
Municipalities	1.3		Short-term	
MOEW, NGOs	25.00	2.00	Medium- term	
MOE, MOEW	0.1		Short-term	

Targeted sector	Potential Mitigation Measures	Nature of Measures	Planned/proposed measures
Energy production	**2.3 Installation of control equipment**	Technical	Providing additional control equipment to stacks for engines operating on HFO. Estimated cost includes the acquisition of the control equipment without the land price (acquisition of 50000 m² terrain in Zouk and 50000 m² terrain in Jiyeh for the installation of the control equipment).
	2.4 Changing fuel type in power plants	Technical	Switching to natural gas in Deir Ammar, Zouk and Jiyeh Power plants (Gasification Unit; pipelines; intervention on units in Zouk and Jiyeh).
	2.5 Rehabilitation of the power plants	Technical	Rehabilitating the Zouk and Jiyeh power plants.
	2.6 Strengthening of the electricity network	Technical	Strengthening the transmission and distribution of electricity.
	2.7 Support to the energy sector management	Capacity development	Supporting MOEW in terms of management of ongoing and new projects.
Solid Waste	**3.1 Closure of dumps**	Technical	Banning of open burning in dumps.
		Technical/ Environmental monitoring/ Capacity development	Closure of dumps.
Residential heating	**4.1 Use of bio-energy for residential heating**	Technical	Using residues of olive trees, fruits trees, etc. to alleviate the pressure on diesel combustion in residential heating.
		Capacity development	Awareness campaign to promote the use of bio-energy for residential heating.
TOTAL			

Responsible parties	Capital cost (MUSD)	O&M costs (MUSD/yr)	Timeframe	Remarks
MOEW	85.00	18.00	Short-term	
MOEW	400.00	20.00	Medium-term	
MOEW	600.00	30.00	Short-term	
MOEW	200.00	10.00	Short-term	
MOEW	12.00		Medium- term	
Municipalities, MOE				Ref. to SW mitigation measures for further details
MOE, municipalities				
MOA, MOE, NGOs	20.00	2.00	Medium-term	
MOE, MOEW, NGOs	0.1		Short-term	
	1,986.75	**139.00**		

5

IMPACT ON LAND USE AND ECOSYSTEMS

5.1 BASELINE CONDITIONS

5.1.1 Land use in Lebanon

5.1.1.1 An overview

Lebanon has a complex land tenure system which was articulated during the Ottoman empire and consolidated during the French Mandate (see **Box 5.1**). Lebanon's land use and land cover map has significantly changed in the last few decades.

Box 5.1 Land tenure in Lebanon

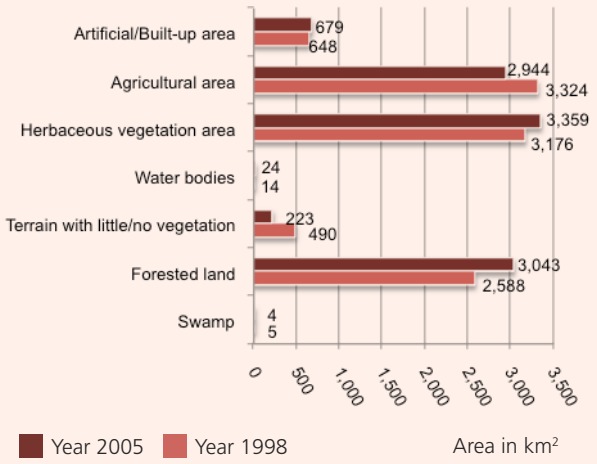
There are five types of land ownership in Lebanon[21]:

- mulk: private ownership
- amiria: State owned and managed by Ministry of Finance
- matrouka/machaa: State owned and managed by municipalities
- matroukamahmiya: can be owned by the State or by municipalities
- Khāliyamoubaha: also stated owned but not delineated

Land tenure systems in Lebanon were introduced by the Ottomans more than two centuries ago (known as Tabo). The sanctity of the private property is rooted in the Lebanese Constitution of 1943 (Article 15) which states that "private land is under the protection of the law, no land can be taken away from his owner, except in cases that serve the public interest and as established by law, and only after the owner has been duly and fairly compensated." The General Directorate of Land Registration & Cadastre at Lebanon's Ministry of Finance maintains all title registers and survey maps and records the ownership and encumbrances resulting from all property transactions.

Current maps are based on satellite images which date back to 1998 (published by MOE and the National Center for Remote Sensing (NCRS) in 2002) and 2005 (published by NCRS in 2011). These maps present land use and land cover in seven main categories (refer to **Figure 5.1**). Between 1998 and 2005, agricultural areas receded by about 11 percent while urban areas increased by about five percent (from 648 km^2 to 679 km^2). By contrast, urban areas in 1960s covered only 260 km^2.

Figure 5.1 Type and extent of main land cover categories in Lebanon



5.1.1.2 Status of land surveys and zoning regulations

Survey and registration of lands in Lebanon started under the French Mandate, in 1926. By 1975, the start of the Civil War, 80 percent of Lebanon was delineated but only 50 percent was surveyed[22]. Delineated lands have a plot number but no map; surveyed lands are mapped. Today, the following situation occurs (see **Map 5.1**):

- 50 percent of Lebanon is delineated and surveyed and has both title registers with area and survey maps
- 30 percent of Lebanon is only delineated and has title registers with no area (referred to as certificates of title)
- 20 percent of Lebanon is neither surveyed nor delineated, and property transactions still use the old Ottoman transaction recording system

In short, the delineation and survey of lands in the coastal zone and Beqaa Valley is largely complete, whereas lands in Lebanon's western mountain range and the south have not been surveyed (or surveys are on-going).

The extent of zoning regulations in Lebanon is difficult to quantify. However, according to a study conducted by CERMOC[23] in 2007, urban master plans approved by the

[21] Based on MOF Decision 3339 and its amendments dated 12/11/1930

[22] In Arabic: delineated is محدد ومحرر ; surveyed is محدد ومحرر وممسوح

[23] Centre d'Etudes et Recherches sur le Moyen-Orient Contemporain

Higher Council of Urban Planning (HCUP) and decreed by the COM covered about 10.3 percent of the Lebanese territory. A separate study conducted in 2004 estimated that urban master plans covered about 16.2 percent of the territory (1,693 km²) if we include all master plans that were approved by the HCUP but not decreed (Verdeil et al., 2007).

5.1.1.3 National Land Use Master Plan (SDATL)

The National Land Use Master Plan for Lebanon was completed in 2005 and endorsed by the COM in 2009 (Decree No. 2366/2009). The Master Plan presents a holistic vision for national urban planning and critical recommendations for enhancing and harmonizing land uses in Lebanon while protecting the natural and cultural resource base.

Despite limited application, the Master Plan is a valuable reference document for several administrations including the Directorate General of Urban Planning (DGUP) and line ministries. They should refer to the Master Plan when making decisions related to urban development, the provision of public services, and environmental heritage conservation. The Master Plan recognizes nine planning zones (denoted U, R, A, N, P, S, F, G and W) with servitudes for land management. Those zones and servitudes are inserted in **Annex E, Table E-1** for reference as they will influence the corresponding Environmental Management Plan (EMP).

5.1.1.4 Migrant workers in Lebanon and related housing needs

Lebanon's migrant population has been historically dominated by Syrian workers, with an estimated 744,530 workers in 1998[24]. Whereas in recent years the number of migrant workers from other countries has risen sharply (Egypt and Sudan), Syrian workers continue to represent a large proportion of the workforce in the agricultural and industrial sectors, many with deep-rooted social ties in Lebanon. Migrant workers in the agricultural sector usually live in make-shift or semi-permanent housing built inside agricultural areas to minimize daily commute and housing expenditures. Those areas today host hundreds of ITSs, as explained below.

5.1.2 Ecosystems

5.1.2.1 Environmentally Sensitive Areas and other areas under protection

Environmentally Sensitive Areas (ESA) are areas that contain important natural features or habitats for rare species. They may include riverine habitats (riparian ecosystems), estuaries, sandy beaches and reefs, canyons, caves, forests, mountain summits, as well as surface and underground Karst formations. From a biodiversity perspective, ESA should be protected and managed accordingly.

As of June 2014, Lebanon had 15 legally established nature reserves covering approximately 2.5 percent of the territory (see list in **Annex E**-Land use and ecosystems). The management and operation of nature reserves is a shared responsibility between the MOE, the Appointed Protected Areas Committee and the management team of the protected areas. Several of these reserves have earned other designations such as Biosphere Reserves and Important Bird Areas. In total, Lebanon offers three Biosphere Reserves (Shouf Biosphere Reserve, Jabal Moussa and Jabal El Rihane), 13 protected forests, at least 16 protected sites, four Ramsar Sites, five World Heritage Sites, and about 15 Important Bird Areas (IBAs). Additionally, there are on-going efforts to establish "micro-reserves" to protect smaller areas that offer unique biodiversity but may not require national designation.

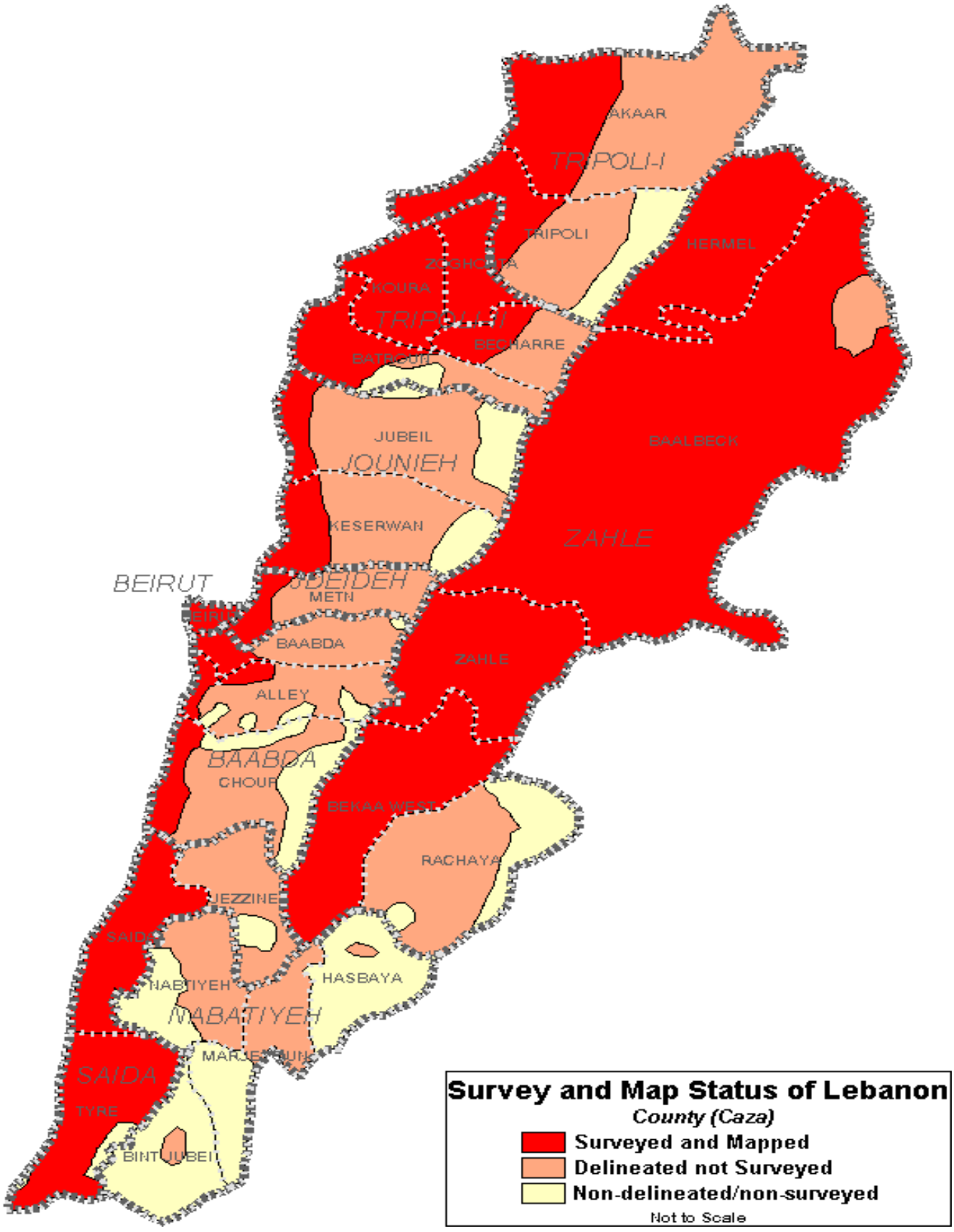
5.1.2.2 State of forests and baseline pressures on dwindling forest resources

Lebanon has extensive forest legislation but enforcement remains weak (see **Box 5.2**). Despite inconsistencies in forest terminology and forest data, there is a general consensus that forests cover about 137,000ha (13 percent of the territory) and Other Wooded Land (OWL) covers 106,000ha (about 10percent), totaling 23 percent of the country (FAO, 2005). The extent of forests and OWL for years 2000, 2005 and 2010 show there has been remarkably little change in forest and OWL cover in the last decade despite recurring and widespread forest fires, extensive logging, and haphazard urbanization.

Box 5.2 Lebanon has two forest laws

The first law is the Forest Code of 1949 that provides the basis for the management of forests by the Ministry of Agriculture, and the second, Law 85 for the Protection of Forests was promulgated in 1991 and amended by law 558 in 1996. MOA has designated more than a dozen forests as national Himas and/or protected, pursuant to the Law 558/1996.Many activities are banned inside protected forests and within a 500m radius (camping, logging, grazing, and hunting). The ban exempts activities related to forest management and research. Although the 1949 Forest Code bans the felling of cedars, junipers, and firs, enforcement remains painfully weak.

[24] http://www.lnf.org.lb/migrationnetwork/mig2.html



Map 5.1 Survey and map status of Lebanon *(Source: UNDP/COMAP, 2005)*

Those pressures may have been offset by extensive reforestation programs, improved protected areas management, and the gradual transformation of abandoned agricultural hillside lands to shrubs and forests. Fires occur mainly between July and October, during heat spells, and are partly due to changing land uses. In broadleaved forests, Quercus species are the most common (Q. calliprinos, Q. cerris and Q. infectoria).In coniferous forests, Pinus species are the most common (P. brutia and P. pinea).

5.2 ENVIRONMENTAL ASSESSMENT

5.2.1 Land use

5.2.1.1 Urban densification

The influx of Syrian refugees (formal housing, shelters, and ITSs) has increased Lebanon's population density by about 37 percent from 400 to 520 persons/km^2. Lebanon is now ranking 16 on the world population density index[25] (at par with Aruba), up from 21 before the Syrian conflict. Such densification results in many environmental and social stresses on host communities including: more waste generation, water and sanitation problems, more vehicles and scooters on the roads, noise pollution, and crowdedness. Urban densification also encourages new construction. The environmental repercussions of densification are highest in vulnerable communities, as defined and determined by the UNHCR[26]. The number and extent of vulnerable communities is expected to increase as the Syrian conflict prolongs and as the influx of Syrian refugee intensifies (see **Box 5.3**). The impact of Syrian refugees in the most vulnerable communities (at the level of the cadastre) on natural areas is assessed below.

5.2.1.2 Impact of Syrian refugees on rental and construction sector

Notwithstanding the Syrian refugee influx, the MOIM authorized in 2014 municipalities and Qaemmaqam to issue construction "permits"[27] to local residents in mostly rural areas[28]. In theory, the permit allows the owner to build a 150 m2 house, either at ground level or on top of an existing 1-storey house not to exceed 7 meters in total. The MOIM decision bypasses urban planning procedures. Although the policy was conceived to address continued socio-economic hardships, it can have grave repercussions on public safety and the urban environment if building standards (Law No. 464/2004) and urban planning requirement are unheeded. In Bebnine for example, a medium-sized town in Akkar with dramatic population growth, the number of permits increased from 50 to 300 in three months[29]. Although a lot of this construction is attributed to increased demand for rental apartments by Syrian Refugees, baseline demand for new housing in response to population growth cannot be dismissed.

According to UNHCR, the total estimated value of rental transactions by Syrian refugees has reached 34 MUSD per month. This rapidly saturating housing market is encouraging local residents to build new homes and/or finish unfinished homes. Haphazard and accelerated construction can be seen in all affected communities. Accelerated construction can also be detected from cement and clinker demand data. Although annual cement production is constant (about 6.5 Metric Tons (MT)), local demand increased from 5.2 MT in 2010 (onset of Syrian crisis) to 5.8 MT in 2013 (9 percent increase) and is expected to increase to 6 MT in 2014. Higher local demand implies lower exports. According to an industry professional, at least 10 percent of that increase is attributed to the Syrian refugee crisis[30].

Box 5.3 Most Vulnerable Communities

UNHCR, in coordination with UNICEF and the Presidency of the Council of Ministers, have developed a tool to assess community vulnerability in relation to Syrian refugees. Using two indices (poverty and refugees), this tool assumes that a high percentage of refugees correlated with a high percentage of poverty increases the vulnerability of the area. Accordingly, UNHCR defined five levels of vulnerability, from most vulnerable (denoted "1") to least vulnerable ("5"). According to the first vulnerability map produced in July 2013, there were about 30 most vulnerable communities in Lebanon, covering about 750 km2 (7% of the territory). By July of 2014, the number had increased to 45 and their area to about 900 km2 (8.6% of the territory). The impact of vulnerability on natural areas including ESAs and agricultural lands is variable and depends on land cover and land use patterns in host communities.

Source: Meeting Vulnerable Municipalities, July 2013 (UNHCR, UNICEF, and PCM), updated July 2014

[25] Consultant calculations based on http://www.studentsoftheworld.info/infopays/rank/densite2.html

[26] UNHCR-UNICEF presentation "Meeting Vulnerable Municipalities" (26 July 2013)

[27] Arabic إعطاء تصريح بناء طابق واحد أرضي...أو طابق أول فوق بناء موجود

[28] MOIM Circular No. 613/C.M. (dated 5 May 2014)

[29] Interview with Bebnine Mayor, Dr. Kifah Al-Kassar

[30] Data provided by Mr. Elie Chahine, Cimenterie National (May 2014)

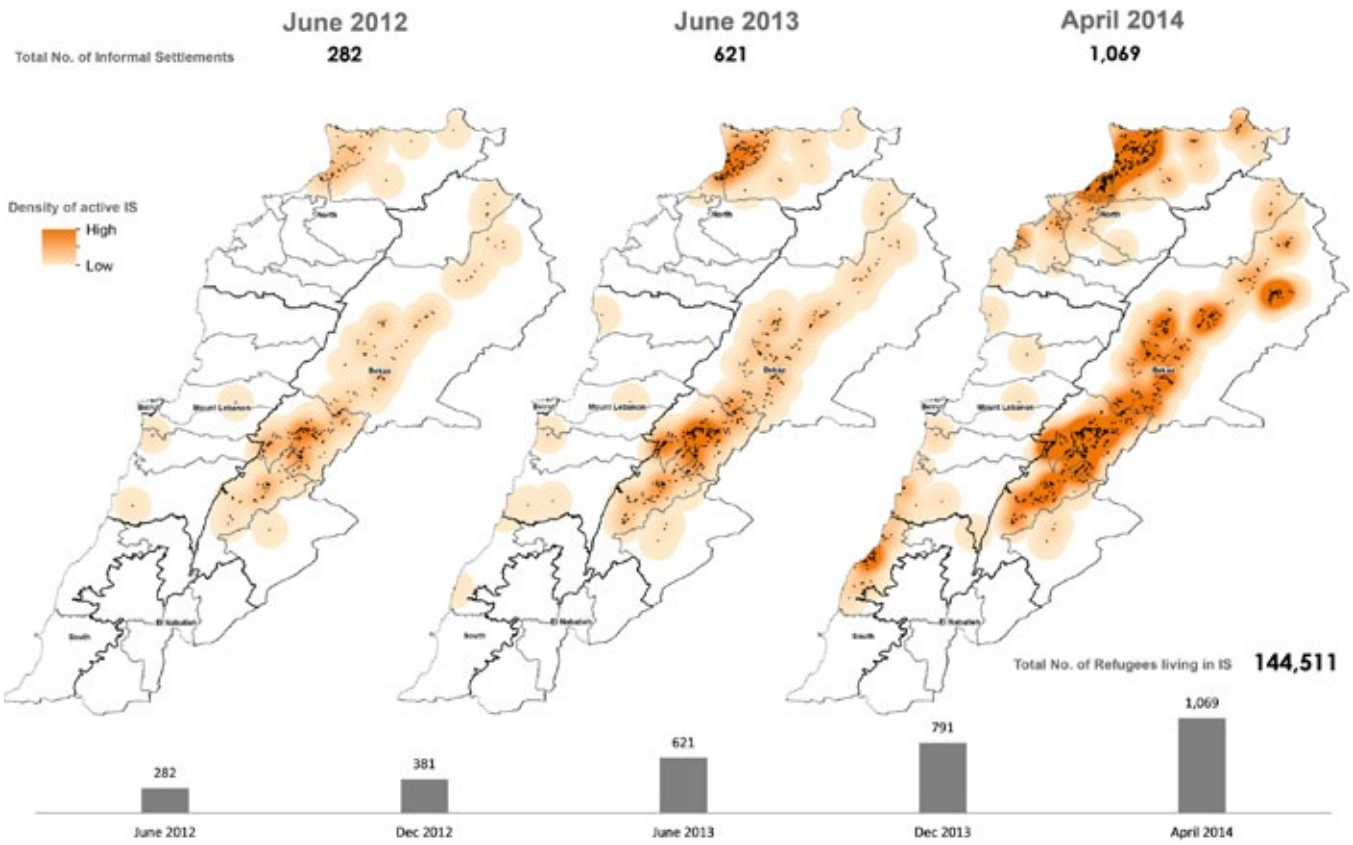
5.2.1.3 Impact of ITS on land use and agriculture

Syrian refugees who live in ITSs occupy more land than those who live outside. Tents cannot grow vertically and must also comply with UNHCR specifications related to inter-tent spacing[31]. According to an on-going assessment of 151 Informal Settlements in the Beqaa (which harbors the highest number of ITS) housing 65,392 refugees, the average area of an ITS is 10,000 m2 (UNHCR 2014). This is equivalent to 23 m2 per refugee, which confirms the observation that ITSs are land greedy in comparison with other shelters.

The number of ITSs is increasing steadily, from 250 in June 2011 to 1,224 by May 2014. Collectively, these ITSs house an estimated 160,894 refugees (15% of the total number of refugees). The largest concentration of ITSs are located in the Beqaa (712 ITS) followed by Akkar (300), which incidentally represent Lebanon's largest agricultural regions (refer to **Map 5.2** below). The number and size of ITSs is expected to increase as the conflict extends, as refugees run out of resources to pay their rent, and as the rental market saturates. Evictions because of unpaid rent are causing a reverse migration of Syrian refugees from the cities to ITSs. This is particularly noticeable in Akkar where 87 percent of refugees rented in 2013 versus only 57 percent in 2014 (UNHCR 2014).

The majority of ITSs are located on private lands (mulk), typically managed by a Syrian land broker called "Shawish". This person rents land from a Lebanese owner on an annual basis, and collects monthly rent from each shelter unit. The average monthly rent per shelter is about LL60.000 ($40) but rent can be much higher. Many ITSs in Akkar and the Beqaa have sprung up on private lands that were previously used by migrant workers. The expansion of ITSs on these lands will eventually impact land use and/or land use planning.

Most ITSs are located on or near agricultural areas. This does not necessarily mean that shelter units are occupying agricultural lands or have impacted agricultural pro-



Map 5.2 Growth of ITSs (as of March 24, 2014) *(Source: GIS & mapping by UNHCR Lebanon)*

[31] According to UNHCR's Information Management Unit (May 2014), the average size of an ITS is 26 shelter units with 131 persons (approximately 6.1 persons / shelter unit). Tents are easily dismantled and entire ITSs have been seen to relocate in search of lower rent and or better jobs.

duction. Many ITSs in the Beqaa and Akkar are established on vacant or bare land, medians separating two adjacent fields, or along roadsides and beneath transmission lines. However as the number of Syrian Refugees continues to rise, further ITS growth will inevitably encroach on agricultural lands and put those lands out of production, unless agricultural lands are designated by the GOL as exclusion zones (refer to **Map 5.3** on next page). There is evidence that some shelter units built by landowners inside agricultural areas are starting to look like semi-permanent housing.

In Lebanon's eastern mountain range, a semi-arid region, the situation is somewhat different. Lying near the Syrian border, the Beqaa Valley border-town of Arsal with a population of 40,000 has witnessed a massive influx of an estimated 85,000 Syrian refugees. Arsal has reached saturation, and overpopulation has put severe strains on basic services such as shelter, water, and sanitation. The refugees are spread in around 40 ITSs, 28 collective shelters, and private accommodation[32]. Arsal is Lebanon's largest cadastral zone and famous for its cherry plantations (an estimated 2 million trees) and relic stands of juniper trees. It has become one of Lebanon's most vulnerable communities (hotspot) and the continued influx of refugees will result in an ecological disaster. The risk of abusive felling is significant whereby the rate of felling would exceed natural regeneration.

5.2.2 Ecosystems

With regards to ecosystems, Syrian refugees impact ecosystems either directly through ITS encroachment on ESAs and other fragile ecosystems, or indirectly through environmental impacts of refugees living in formal shelters, such as waste disposal and illegal felling for heating.

Figure 5.2 ITS adjacent to greenhouses in north Lebanon (Bebnine). Photo: K. El-Jisr

5.2.2.1 Potential ITS encroachment on ESAs

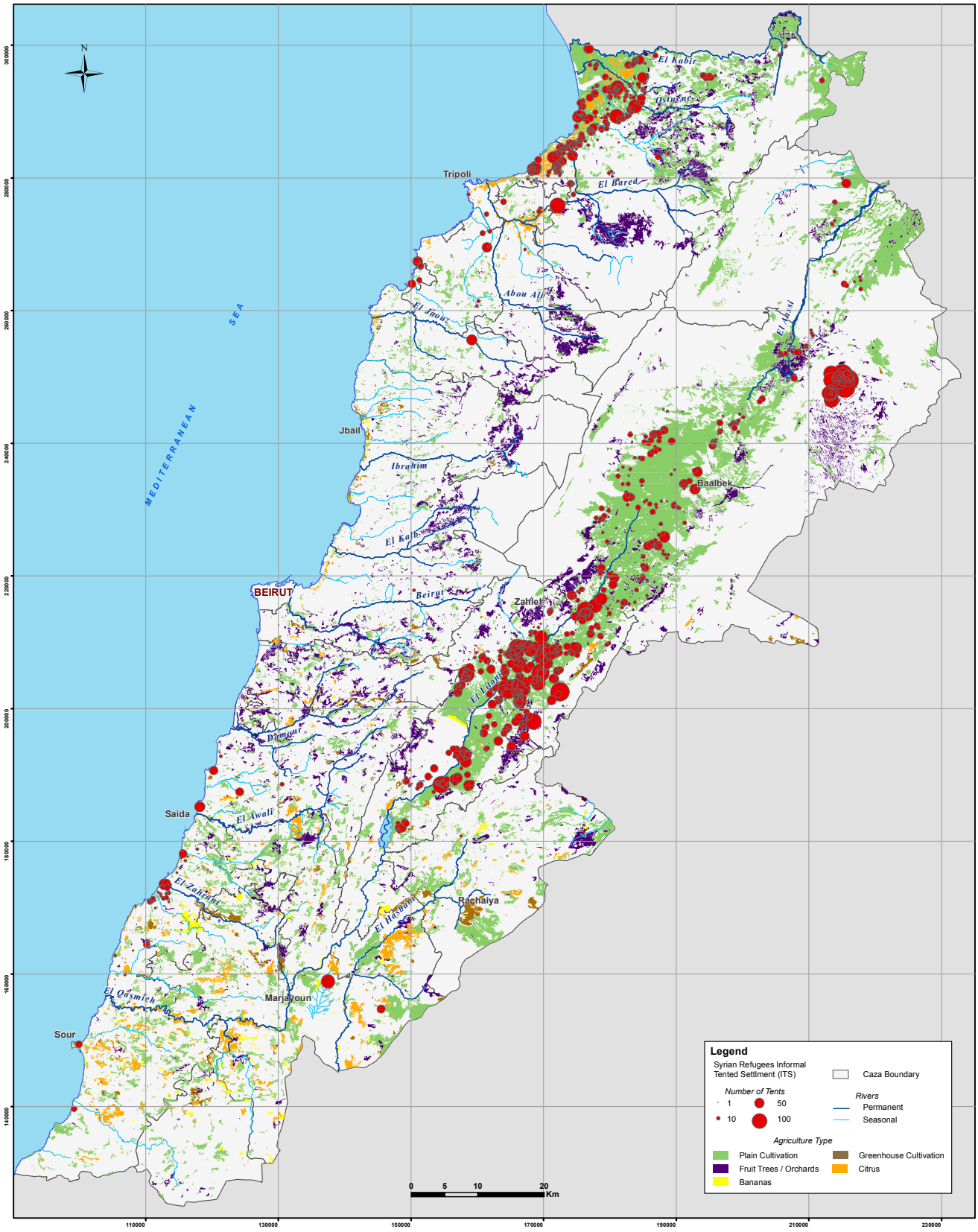
The distribution and growth of ITSs may potentially affect ESAs. Syrian refugees living in other forms of shelter (apartments and garages) will not directly impact ESAs. **Map 5.4** presents an overlay of ITSs and Lebanon's known ESAs and highlights potential environmental stressors (see **Table 5.1**).

Table 5.1 Potential environmental stressors from ITSs on ESAs

ESAs nearby to ITSs concentration	Potential Environmental Impact of ITSs
Perennial rivers (Kabir, Ostouene, Bared, Litani, and Zahrani)	Risk of increased water contamination from incremental wastewater discharges, sludge disposal, and waste disposal
In lowlands or flat lands (Akkar plane, Beqaa, etc.)	Risk of flooding: 81 out of 151 assessed ITS (52%) in the Beqaa are in flood prone areas (UNHCR, 2014); increased risk of wastewater and sludge infiltration into groundwater
Close to Quercus forests north-west of Baalbek (Yammouneh)	Risk of abusive felling during winter to provide firewood
Inside the north-eastern fringes of the Shouf Biosphere Reserve (Qab Elias)	No immediate threat to the Reserve as the area is already impacted by Lebanon's largest quarries

Although Lebanon's protected areas are not immediately impacted by ITSs, they represent however a safe destination for ecological restoration programs, as detailed later in the section Environmental Management Plan (EMP).

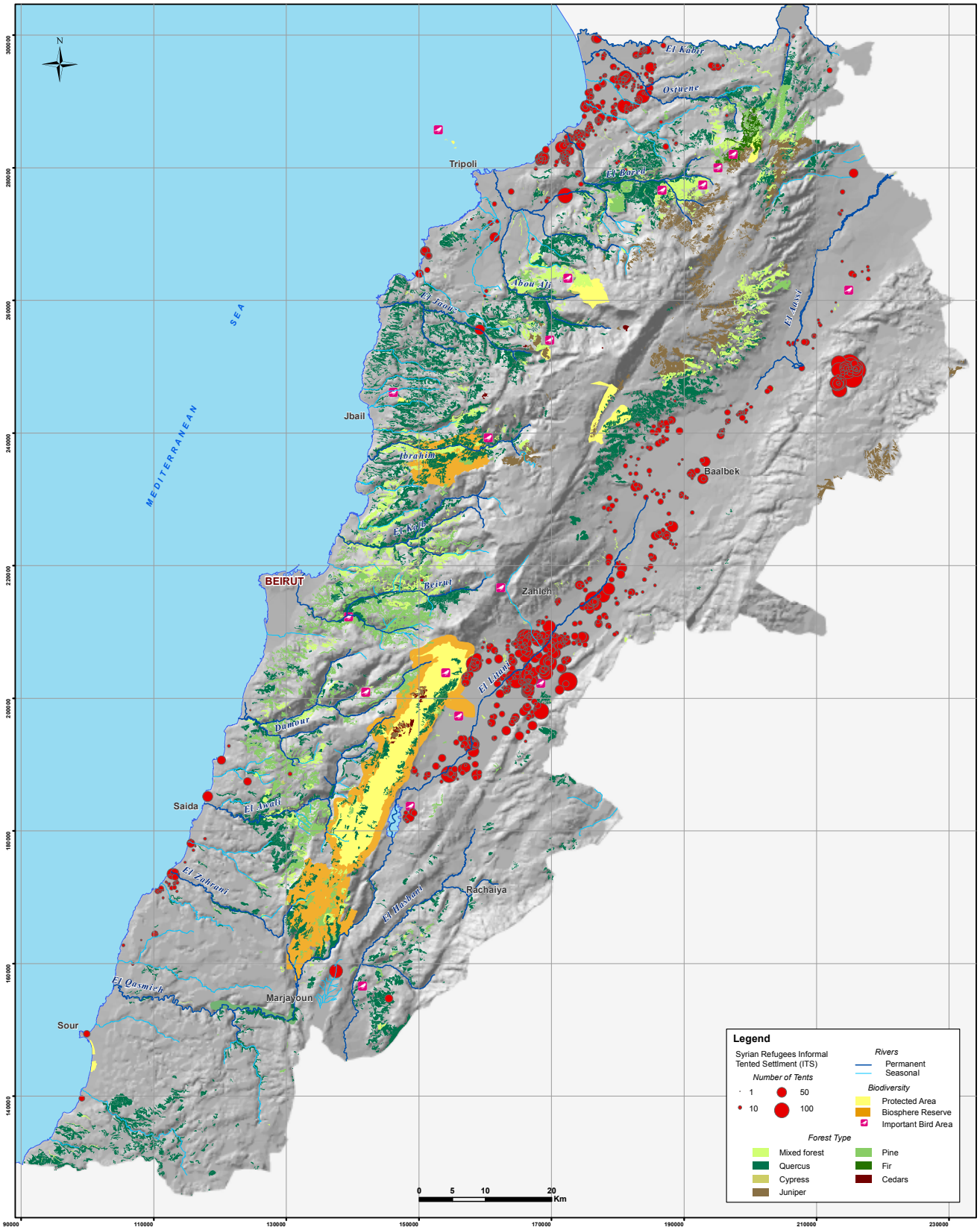
32 www.lb.undp.org/content/lebanon/en/home/presscenter/articles/2014/07/10/needs-and-priorities-of-host-communities-in-arsal/ and www.jadaliyya.com/pages/index/17566/arsal-struggles-to-deal-with-the-syrian-refugee-ov



Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions	Map 5.1 - Distribution of Informal Tented Settlement on Agricultural Areas in Lebanon

Disclaimer: This map was prepared by ECODIT based on the Geo-Database of the National Land Use Master Plan (2004), Data from UNHCR (2014), Landuse Geo-Database of the Ministry of Agriculture (2004). Layer of ITS was provided by GeoFlint. This map is not geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purposes only. The projection of the displayed data is provided in Lambert Conformal Conic.

Map 5.3 Distribution of ITSs in relation to agricultural areas



Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions	Map 5.2 - Proximity of Informal Tented Settlement to Environmentally Sensitive Areas in Lebanon

Disclaimer: This map was prepared by ECODIT based on the Geo-Database of the National Land Use Master Plan (2004) and Data from UNHCR (2014). Layer of ITS was provided by GeoFlint. This map is not geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purposes only.
The projection of the displayed data is provided in Lambert Conformal Conic.

Map 5.4 Distribution of ITSs in relation to ESAs

5.2.2.2 Impact of vulnerable communities on ESAs and other fragile ecosystems

An overlay of the most vulnerable communities on sectoral maps (refer to **Map 5.5** and **Map 5.6**) shows considerable intrusion on agricultural areas, forest areas, and ESAs (including IBAs and rivers) as indicated in **Table 5.2** below. The table shows 33 most vulnerable communities with natural areas (12 communities were removed from the list because they are predominantly urbanized)[33].

Table 5.2 Overlay of the most vulnerable communities on forests, agriculture, and ESAs

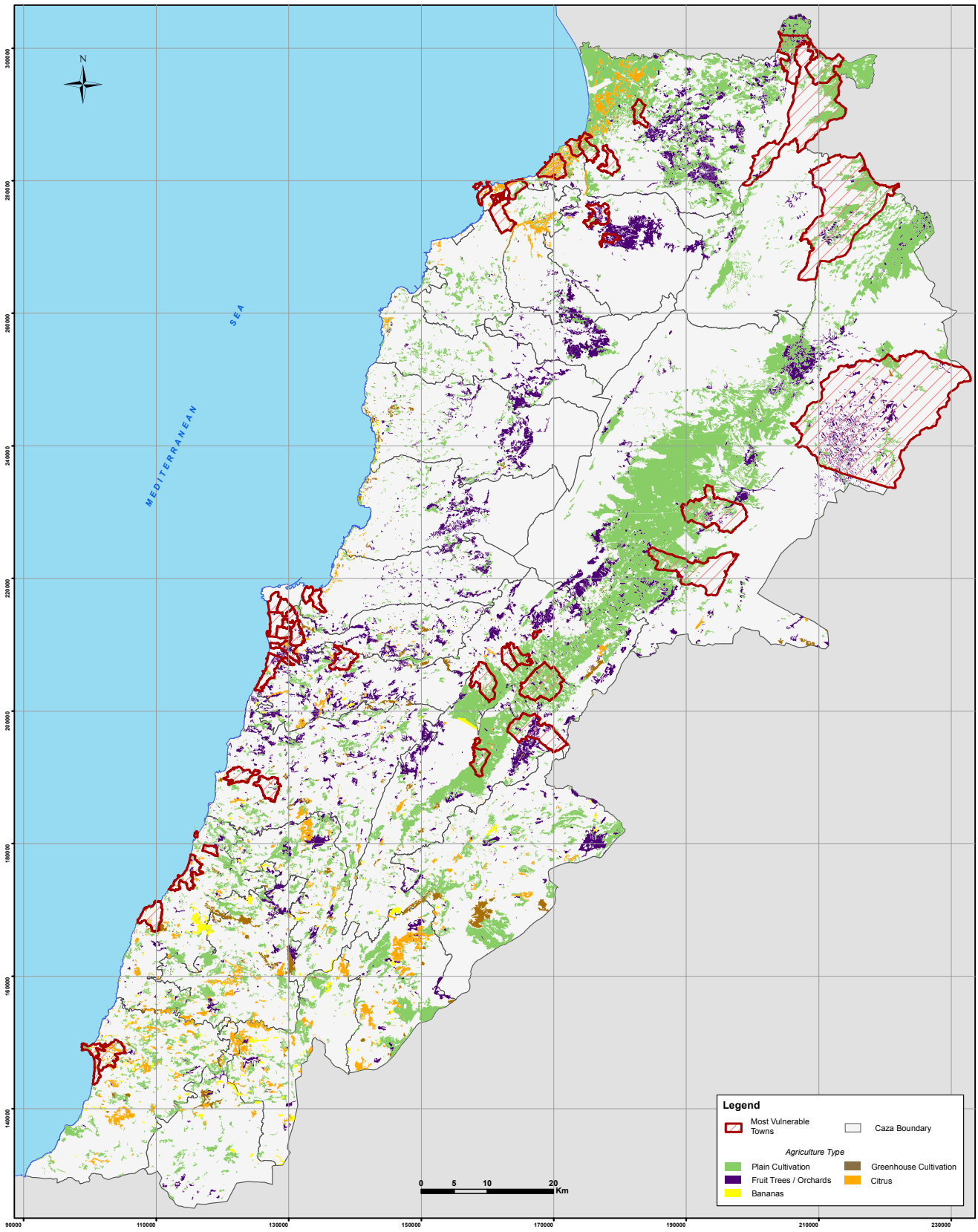
Village Name	Cadastral Area in km²	Forest	Agriculture	PA/ESA
Aaley	8.0		•	
Aarsal	316.6	•	• •	
Akroum	88.0	• •	• •	•
Baalbek	37.4		• •	
Bakhaoun	7.9	•	• • •	
Barja	7.2		•	
Barr Elias	24.1		• • •	•
Bebnine	6.7		• •	
Beddaoui	5.5		• •	
Berqayel	6.2		•	
Borj El Chemali	10.6		• •	
Brital	42.9		• •	
Chhim	8.5	•	•	
Choueifat	9.2		•	
El Mhamra	3.8		• • •	
El Minieh	9.9		• • •	

[33] Tripoli El Tebbanneh, Tripoli El Tall, Tripoli El Haddadine, Zahle El Maalqa, Bourj Hammoud, Bauchrieh, Chiyah, Haret Hreik, Bourj El-Brajneh, Mousaiytbeh, Mazraa, and Saida

Table 5.2 Overlay of the most vulnerable communities on forests, agriculture, and ESAs

Village Name	Cadastral Area in km²	Forest	Agriculture	PA/ESA
Ghaziyeh	9.3		•	•
Ghazzeh	7.6		•••	
Hadath	5.5		•	
Halba	4.9		•••	
Hermel	131	•	••	
Machta Hammoud	19.4	•	•••	
Majdel Aanjar	25.3	•	••	
Mina	2.7		•	•
Miye W Miye	2.2		•	
Ouadi Khaled	15.8	•	•••	
Qabb Elias	13		•••	•
Saadnayel	5.4		•••	
Sarafand	9.7		•	•
Sir El Dannieh	2.6	•	•••	
Sour	6.5		••	••
Taalabaya	5		••	
Tripoli El Zeitoun	11.2		•	

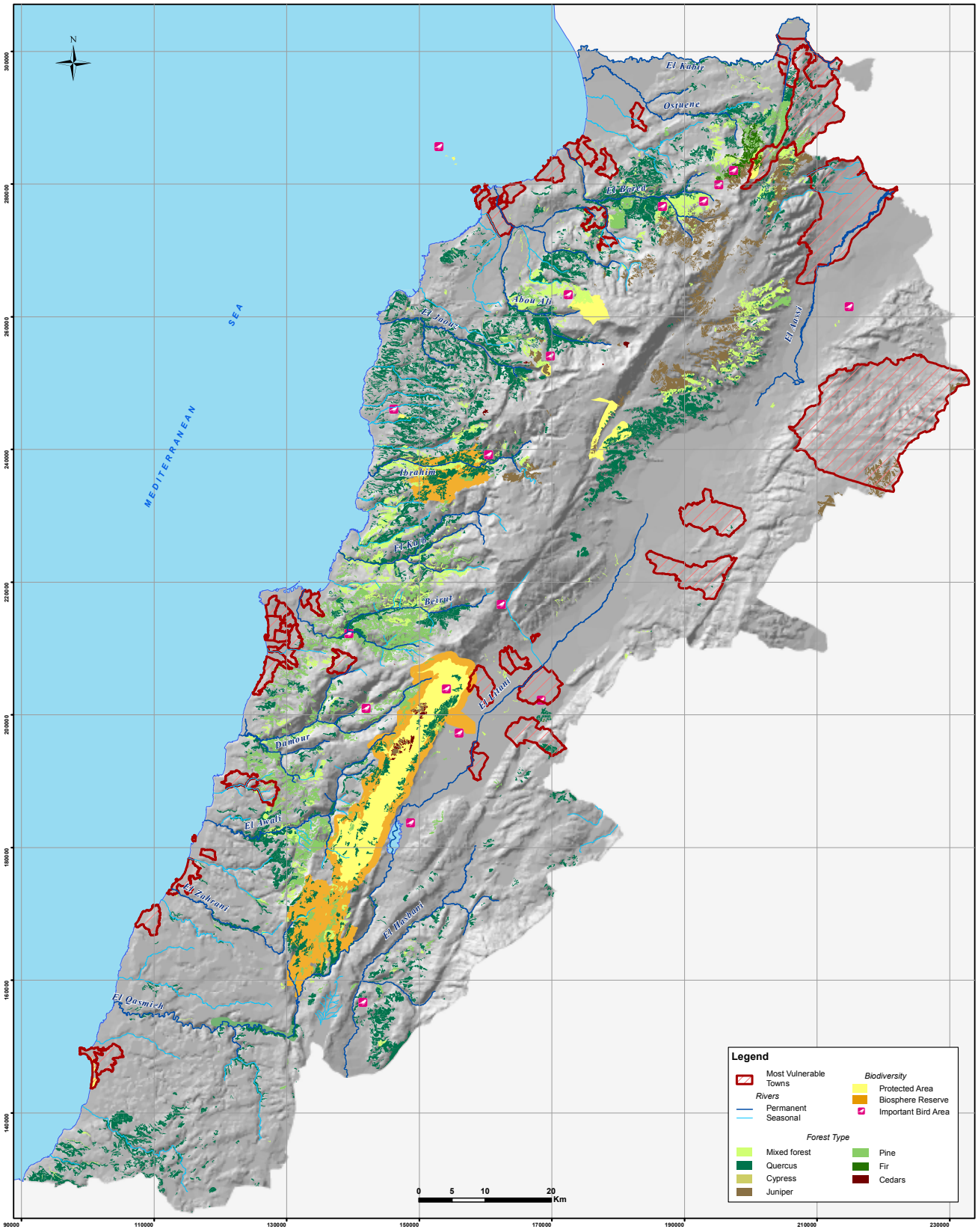
Legend: "•" Low overlap, "••" moderate overlap, "•••" high overlap



Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions	Map 5.5 - Distribution of Vulnerable Towns on Agricultural Areas in Lebanon

Disclaimer: This map was prepared by ECODIT based on the Geo-Database of the National Land Use Master Plan (2004), Data from UNHCR (2014), Landuse Geo-Database of the Ministry of Agriculture (2004). This map is not geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purposes only. The projection of the displayed data is provided in Lambert Conformal Conic.

Map 5.5 Distribution of vulnerable towns on agricultural areas in Lebanon



Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions	Map 5.6 - Proximity of Vulnerable Towns to Environmentally Sensitive Areas in Lebanon

Disclaimer: This map was prepared by ECODIT based on the Geo-Database of the National Land Use Master Plan (2004) and Data from UNHCR (2014). This map is not geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purposes only.
The projection of the displayed data is provided in Lambert Conformal Conic.

Map 5.6 Proximity of vulnerable towns to environmentally sensitive areas in Lebanon

5.2.2.3 Impact of Syrian refugees on forest resources

The impact of Syrian refugees on forest resources is variable, depending on the location. In north Lebanon for example, border villages historically used to thrive on illegal trade routes with Syria, including the smuggling of cheaper Diesel oil (mazout). These trade routes closed when the Syrian Conflict intensified, pushing resident populations to look for alternative energy sources including firewood. According to one resident in Wadi Khaled, the forest landscape has dramatically declined since 2012. In the absence of efficient law enforcement and/or energy substitutes, the illegal felling of forest trees has become a lucrative business in some parts of the country (approximately LL350,000 per truck, or $233)[34]. High wood density (high calorific value) fruit trees including citrus, olive, and cherry are also used as firewood.

Other forest areas in Mount Lebanon and the Beqaa have been less affected but the risk of increased felling in the future and as the conflict extends is very high. In agricultural areas, many ITSs use trimmings and wood from pruning operations as firewood.

According to their winterization program, UNHCR and other relief agencies distributed Cash for Fuel or Fuel Vouchers equivalent to 40 million liters of fuel oil to Syrian refugees across the country between November 2013 and March 2014 (a mild winter). Assuming the average number of refugees during this period was 858,641 (as recorded in December 2013), and assuming efficient distribution systems, then each refugee family would have received the equivalent of 279 liters over the 5-month period[35]. The results of a post-winterization monitoring survey targeting households which have received winterization assistance surprisingly show that between 24percent and 30percent answered that they have not received winterization assistance, and 61percent of respondents indicated that their fuel need was unmet. This signals that more is to be done to meet the fuel needs of all Syrian refugees in Lebanon to avert abusive felling and forest degradation.

If heating needs can be satisfied through (imported) fuel oil, and to a lesser extent from coppicing and agriculture, then the impact on forests should be contained. Interviews with Syrian refugees confirm that many families sold or traded their heat stoves for other commodities, which raises concerns ahead of the next winter. The true impact of winter on forest resources has yet to be felt but will be significant unless sufficient fuel oil is distributed, as well as energy-efficient heat stoves.

5.2.2.4 Impact of increased abstraction on surface water resources and environmental flows

As detailed in **Chapter 3 (Impact on Water and Wastewater sectors)**, the incremental water demand for refugees is estimated between 33 and 53 MCM based on 31 May 2014 data, and is expected to reach 43 to 70 MCM by the end of year 2014. This corresponds to a nationwide increase of water demand between 8 and 12 percent.

Although water sources used by refugees are diverse (public network, wells, public reservoirs/ stand pipes), the main water sources are groundwater resources. Springs are the easiest sources to tap as they require no pumping. The extremely dry winter of 2013-2014 (total rainfall less than 50 percent of the annual mean) has already impacted springs many of which will dry up. Overexploitation of springs and the construction of new wells near springs (Akroum, Anjar, etc.) will reduce environmental flows to a trickle. Environmental flows are important to maintain ecosystem health and natural habitats downstream. In Akroum for example, a new 450m deep well near a tapped spring (Ain el Sabeh)[36] is planned. The spring is running dry and the new well will inevitably dry it up completely until the next rainy season. In Anjar also, in recent months many wells were built near and around the famed Chamsine spring. At the local level, the proliferation of wells (often unlicensed) will increase drawdown which will encourage owners to build new wells or extend existing wells deeper.

5.2.2.5 Impact of septage disposal on lands and ecosystems

As mentioned in **Chapter 3 - Water and Wastewater sectors**, 65.7 percent is channeled into wastewater network, while 32.1 percent of wastewater is collected in septic tanks. The increase in the rates of generation of WW due to the Syrian refugees will further exacerbate the environmental pressure due to the disposal of untreated WW as well as desludging of sceptic tanks.

Although desludging has been done for years, the rate of desludging has dramatically increased since the Syrian conflict. There appears to be no control or restrictions over desludging activities by local authorities or aid agen-

[34] Personal communication with several refugees in an informal tented settlement, Douris, Beqaa

[35] Assuming 6 members per refugee family

[36] Phone interview with local residents

cies alike. The disposal of sludge on open lands, in dolines (funnel-shaped depression of the ground surface), and near streams will increase BOD pollution of these receptors and may alter the composition of aquatic life and riparian ecosystems. Sludge disposal on land and in streams contaminate ecosystems, especially in karstic terrain. For example, collection trucks in Akroum discharge untreated sludge in dolines because high infiltration is regarded as good for disposal.

5.2.2.6 Impact of solid waste disposal on landscapes and water bodies

As detailed in **Chapter 2 (Impact on Solid Waste sector)**, the incremental daily quantity of MSW attributed to refugees reached 683t/d (31 May 2014 data) and is expected to reach 889 t/d by end of year 2014. Solid waste disposal in open dumpsites results in waste dispersion, as well as water and soil contamination. Leachate runoff from open dumpsites exhibit very high BOD and COD load, very high ammonia-Nitrogen, and also contain a variety of heavy metals including lead, zinc and copper[37]. Leachate will percolate into the ground and eventually contaminate nearby surface and groundwater. Site visits revealed widespread waste disposal in open channels and river banks, often obstructing water flows. Solid waste will accumulate in those areas indefinitely or until the local municipality or aid agencies organize a clean-up campaign. Waste disposal in open dumpsites also consumes additional land area (an estimated 109,075 m2 – refer to **Chapter 2**), potentially infringing on agricultural lands. Finally, it should be noted that open dumping impact an area much larger than the dumpsite area because of the diffusion of waste particles. In the absence of containment measures, water and wind carry waste particles long distances and therefore degrade a much wider area (see photos of dumpsites spilling over into stream banks).

Figure 5.3 Jeb Jennin waste dump spreads across riverbed

Figure 5.4 Riverbank near Bebnine recently emptied from accumulated waste

5.3 ENVIRONMENTAL MANAGEMENT PLAN FOR LAND USE AND ECOSYSTEMS

The impacts of the Syrian conflict on land use and ecosystems can be summarized as follow:

(1) Significant increase in Lebanon's population density and related environmental stresses, as well as accelerated construction, mostly haphazard.

(2) ITS growth in flood-prone areas and potential encroachment on agricultural and environmentally sensitive areas, and other fragile ecosystems.

(3) Unsanitary disposal of incremental solid waste, sludge and related soil and water pollution.

(4) Increased demand for fuel and firewood and related incremental pressure on forest resources.

To address these impacts, an EMP for land use and the ecosystem sector is proposed. The plan includes a mix of policy measures and proposed mitigation actions, and assigns implementation responsibilities. Proposed actions may be compensatory or precautionary. The complete EMP is presented in **Table 5.3**.

5.3.1 Potential mitigations measures

Because the impact of Syrian refugees on land use and ecosystems cannot be easily measured (such as emissions, solid waste, and sanitation), this EMP is organized according to the four impact categories listed above and not according to the mitigation's timeframe. This pres-

[37] According to a leachate composition survey of recent waste in UK landfills, COD level reach 23,800 mg/l, BOD_5 mg/l 11,900 and Ammonia-N 790 mg/lleachate.co.uk/main/leachate-chemistry-testing/landfill-leachate-composition/

entation lends better to the policy-action mix proposed in the EMP. Furthermore, the cost of policy oriented measures (including enforcement) is either nil or indicative. It is important to note that many short-term mitigation measures should be implemented and sustained until the end of the Syrian conflict.

5.3.1.1 Mitigating the impacts of population increase, densification and haphazard construction

- The densification of villages and towns in Lebanon is generating a suite of environmental and social stresses on host communities (including 33 vulnerable communities). The most tangible mitigation response is to support efforts and activities that will alleviate the environmental and social burden of host communities. Illustrative activities include the renovation of public spaces such as urban parks and playgrounds, which are historically severely lacking in Lebanon.
- The saturation of Lebanon's rental market is encouraging new and usually haphazard construction, which often escapes law enforcement agencies. The current MOIM directive authorizing mayors to grant construction permits to local residents directly and not through conventional channels should be immediately revisited. Notwithstanding the social and economic rationale (drivers) behind this directive, the MOE has already requested the MOIM to reconsider this policy which could accelerate haphazard urbanization. Separately, in unplanned areas, affected communities should receive additional attention and resources to complete their (regional) urban master plans and associated regulations. Regional master plans require approval by the HCUP and COM decree. More generally, aid agencies and municipalities alike should closely monitor illegal constructions, and incentives should be provided to local residents to complete their unfinished homes. This will increase the rental stock market without accelerating unplanned urbanization.

5.3.1.2 Mitigating the impacts of potential ITS encroachment on agriculture, forests, and ESAs

- Current and future ITS growth may encroach on agricultural and ESAs. The GOL, and based on MOE's mapping work, should immediately delineate exclusion zones that incorporate flood zones, usable agricultural areas, ESAs, and other fragile ecosystems. Exclusion zones should be based on SDATL Decree 2366/2009 (in particular Zone A/Agriculture, N/Natural, and F/flood). Future ITS growth until the end of the Syrian conflict must be avoided in these exclusion zones to prevent ecological impacts and agricultural losses.
- Another priority measure is to protect ITSs located in flood-prone areas against potential winter floods by building flood earth-breaks and/or improving drainage. Flood prevention is necessary to avert loss of life and material damages during winter.
- At the macro level, the MOE launched a government initiative to develop a master plan to organize land use activities in fragile ecosystems (mountains, natural sites and green areas, coastal zone, and agricultural lands).This initiative complements many past and on-going programs including the National Land Use Master Plan[38] (enacted by the COM in 2009), several large-scale reforestation programs lead by MOA and the civil society, and the Lebanon Mountain Trail (established in 2007 as a corridor for recreation, environmental monitoring, and conservation). The current Syrian conflict provides an opportunity to accelerate the political discourse and to consolidate support for the proposed master plan, including from the international community.

5.3.1.3 Mitigating the impacts of unsanitary waste disposal and related pollution

- The disposal of solid waste in open dumpsites must be contained. **Chapter 2** (solid waste sector) has already recommended the closure of 17 high impact and 85 medium impact priority dumpsites. Closure and rehabilitation may require many years. In the short term, priority dumps must be contained to prevent contamination and degradation of a much larger area than the dumpsite footprint. Containment can be achieved by installing fences around the dumpsite perimeter. Cleanup campaigns can also be organized with the Syrian refugees.
- In terms of sludge disposal, it is essential that aid agencies require sludge trucks to transport their load to the nearest WWTP, on the basis of a sludge disposal tipping fee. Such guidelines can be developed and communicated with all aid agencies and affected municipalities immediately.

For other mitigation measures related to solid waste and wastewater, please refer to **Chapters 2 and 3**.

[38] Schéma Directeur pour l'Aménagement du Territoire Libanais (SDATL)

5.3.1.4 Mitigating the impacts on forest resources

- The most significant long-term measure is to enforce existing forest laws and regulations (Forest Law of 1949 amended in 1991 and 2000, and Law 558/1996). In practice, the international community can support conservation efforts as a compensatory measure for ecological damages in affected communities. For example, if the Syrian conflict is impacting forests in Wadi Khaled, but security prevents ecological restoration activities in this area, then aid agencies could instead support conservation activities in other areas not directly impacted by the Syrian conflict. Lebanon's 15 protected areas constitute a priority destination for conservation and ecosystem management.
- Increased demand for fuel and firewood is a direct threat to Lebanon's declining forest resources. The importance of an efficient and flexible winterization program cannot be sufficiently stressed. If alternative sources of fuel are in short supply, then the trade in local timber will increase dramatically. The winterization program should seek to improve the distribution system of fuel oil and heat stoves and encourage the use of renewable energy if possible. The winterization program for 2014-2015 will cost approximately 72 MUSD based on the assumption that at least 120,000 families are vulnerable (poor, and live above 500 meters) and each family will receive 600 USD[39]. Being an energy-poor country, this assessment strongly advocates the use of renewable energy sources such as biomass (heat bricks), PV systems, and small-to-medium sized wind turbines. Humanitarian aid agencies should support on-going efforts to harvest renewable energy, preferably in coordination with the MOEW (Lebanese Center for Energy Conservation and CEDRO).

5.3.2 Environmental monitoring

There is no single organization responsible for environmental monitoring. At minimum, the following parameters and environmental changes should be monitored:

- Haphazard construction (by local municipalities and aid agencies if possible).
- Growth and spread of ITSs in relation to agricultural and ESA maps (by aid agencies).
- Sludge disposal and waste dispersion (by WEs and aid agencies).
- Solid waste accumulation in riverbanks and drainage canals near ITSs (by local municipalities).
- Forests potentially affected by abusive felling (by MOA in north Lebanon and the Bekaa).

5.3.3 Environmental management plan costs

As explained earlier, not all policies carry a tangible cost. For purposes of this EMP, identified mitigation measures can be valued, either as capital (one-time investment), or as O&M (recurring). The estimated capital cost for priority mitigation measures related to land use planning and ecosystem management is around 16 MUSD, plus 78 MUSD in annual O&M costs (incl. 72 MUSD for winterization).

[39] Personal Communication with Mr. Chadi Ghajar, UNHCR Assistant Distribution Coordinator

Table 5.3 Environmental management plan to mitigate the potential impacts of the Syrian conflict on land use and ecosystems

Potential Impacts	Potential Mitigation Measures	Nature of Measures
1. The number of Syrian Refugees has significantly increased Lebanon's population density (from 400 to 520 person/Km2), generating a suite of environmental and social stresses on host communities, and triggering new and often haphazard construction	**1.1 Alleviate the burden on host communities by improving environmental planning at local level**	Technical
		Technical
	1.2 Support municipalities in urban planning to reduce pressure on private lands and the rate of new construction	Policy
		Technical
		Technical
		Monitoring
2. Number of ITSs is increasing rapidly consuming more land; current and future ITSs may be located in flood-prone areas or encroach on agricultural and/or ESAs	**2.1 Prevent ITS encroachment on ESAs, agriculture, and flood prone areas**	Policy
		Monitoring
		Technical

s in Lebanon

Planned/Proposed Actions	Capital Cost (MUSD)	O&M Cost (MUSD/ year)	Responsible parties	Timeframe
Renovate existing parks and/or build new public spaces (parks, playgrounds, and outdoor sports facilities) in all 23 vulnerable communities (at 0.1MUSD/space).	2.3	0	Municipalities; local NGOs	Medium
Provide training to local municipalities and aid agencies on how to integrate environmental management practices during the provision of incremental community needs (water, wastewater, solid waste and electricity demands) (at USD 2,500/training).	0.25	0	Environmental consultants (training); Municipalities (beneficiaries)	Medium
Launch targeted policy dialogue to review/revisit MOIM circular regarding construction permits (No.613/CM).	0.05	0	MOIM (upon MOE request)	Short to Medium
Provide support to affected municipalities who don't have an urban master plan by accelerating pending studies and approvals.	0	0	HCUP for approvals and COM for decree	Medium
Support efforts to complete unfinished housing in vulnerable host communities (while respecting building and urban planning regulations).	0	0	DGUP	Medium
Develop protocol for reporting illegal construction / housing related to Syrian Refugees.	0.05	0	Humanitarian aid agencies and Municipalities	Long-term
Delineate ITS "exclusion zones" based on existing PA legislation, SDATL Decree 2366/2009, and recent calls to develop a master plan for fragile ecosystems (see methodological details in EMP chapter).	0.1	0	MOE	Short/Medium
Monitor ITS growth in relation to exclusion zones (fragile ecosystems including mountains, agricultural areas and coastal zone) to prevent encroachment (at USD10,000/month)	0	0.12	MOA; MOE; DGUP	Long-term
Implement flood control measures in all ITSs which are located in flood-prone areas (flood zones are defined based on SDATL Decree 2366/2009).	5.00	0	UNHCR	Short

Potential Impacts	Potential Mitigation Measures	Nature of Measures
4. Increased demand for fuel and firewood is exacerbating pressure on forest resources (especially in North Lebanon and border areas)	**4.1 Enforce forest laws and regulations (Law 85/1991, Law558/1996) and PAs laws and management plans**	Policy (Cap Dev)
		Monitoring
		Monitoring
	4.2 Ensure alternative sources of fuel before each winter season	Policy
		Technical
TOTAL		

Planned/Proposed Actions	Capital Cost (MUSD)	O&M Cost (MUSD/ year)	Responsible parties	Timeframe
Support forest management programs and activities inmost vulnerable communities (4 comm. @ 0,25MUSD /comm.).	1.00	0	MOA; Municipalities	Medium
Increase the number of PA staff/rangers to monitor 15 protected areas and ecosystems (compensatory measure).	0	0.75	MOE and PA Committees	Medium
Increase the number of forest guards patrolling forests and provide the necessary supplies (preventive measure).	0	1.00	MOA	Short
Prepare an effective winterization program (2014-2015) that will ensure adequate distribution of fuel oil and fuel-efficient stoves in all affected areas.	0	72.00	UNHCR	Annual (fall)
Support activities that will harvest renewable energy including biomass (heat bricks) and small scale wind turbines in the most vulnerable communities.	4.60	0	UNHCR;MOEW (LCEC; CEDRO)	Annual (fall)
	15.95	**78.47**		

REFERENCES

Afif, C.	(2008). L'acide nitreux atmosphérique : implications dans la chimie en milieu urbain. PhD thesis, Université Paris-Est Créteil, 236 pages.
Afif, C., Chélala, C., Borbon, A., Abboud, M., Adjizian-Gérard, J., Farah, W., Jambert, C., Zaarour, R., Saliba, N.B., Perros, P. E., & Rizk, T.	(2008). SO2 in Beirut: air quality implication and effects of local emissions and long-range transport. Air Qual. Atmos. Health, 1, 167–178.
Afif, C., Dutot, A., Jambert, C., Abboud, M., Adjizian-Gérard, J., Farah, W., Perros, P., Rizk, T.	(2009). Statistical approach for the characterization of NO2 evolution in Beirut. Air Quality, Atmosphere and Health, 2, 57-67.
Arcenciel.	(2013). Quantity of infectious waste collected from Hospitals in 2013. Beirut.
Assaf, H., &Saadeh, M.	(2009).Geostatistical Assessment of Groundwater Nitrate Contamination with Reflection on DRASTIC Vulnerability Assessment: The Case of the Upper Litani Basin, Lebanon. Water Resources Management , 775–796.
Awada, H.	(12. May 2014). Mayor of Baalbeck. (S. Mehdi, Interviewer)
Badaro-Saliba, N., Adjizian-Gerard, J., Zaarour, R., Abboud, M., Farah, W., Saliba, N., Shihadeh, A.	(2014). A geostatistical approach for assessing population exposure to NO2 in a complex urban area (Beirut, Lebanon). Stochastic Environmental Research and Risk Assessment 28, 467–474.
Central Administration for Statistics- CAS	(2008). Statistical Yearbook 2007, Central Administration of Statistics, 2008 (based on CAS 1996 National Survey of Living Conditions).
Council for Development and Reconstruction- CDR	(2005). National Land Use Master Plan for Lebanon. Dar Al Handasah and IAURIF. CDR
CDR/LACECO.	(2011).Supervision of Greater Beirut Sanitary Landfills - Annual Report. Beirut.
CDR/LACECO.	(2014).Supervision of Greater Beirut Sanitary Landfills - Progress Report No. 1999. Beirut.
Dbouk, H.	(9. May 2014). Mayor of Tyr. (S. Mehdi, Interviewer)
Doumani, F.	(2007).Economic valuation of the coastal zone of the Mohafaza of North Lebanon. Beirut: University of Balamand.

European Environment Agency -EEA	(2013). European Union emission inventory report 1990–2011 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), Luxembourg.
EMEP/EEA	(2013). Air Pollutant Emission Inventory Guidebook. www.eea.europa.eu.
European Union- EU	(2011). Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection: Republic of Lebanon country report. European Union.
Food and Agriculture Organization- FAO	(2005) .National Forest Assessment and Tree Assessment and Inventory. Final Report. TCP/LEB/2903
Hamandi, M. A.	(2013). Database of Lebanese Hospitals: A new achievement for the syndicate - Part II. Al Sihha wal Insan - 25th Edition, 64-65.
Homsi, D.	(2014). Union of Municipalities of Al Fayhaa - Quantity of waste received at the Tripoli semi controlled landfill between 2011 and 2013. Tripoli.
INTER-AGENCY	(2014). Water, Sanitation and Hygiene (WASH) Working Group-Lebanon. WASH Strategy for 2014. UNHCR.
IPCC	(2006). IPCC Guidelines for National Greenhouse Gas Inventories, prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. http://www.ipcc-nggip.iges.or.jp/public/2006gl/ (accessed 15 May 2014).
Korfali, S., & Jurdi, M.	(2007). Assessment of domestic water quality: case study, Beirut, Lebanon. Environmental Monitoring and Assessment, 241–251.
Korfali, S., & Jurdi, M.	(2009). Provision of safe domestic water for the promotion and protection of public health: a case study of the city of Beirut Lebanon. Environmental Geochemistry and Health, 283–295.
MOEW/UNDP	(May 2014). Groundwater Assessment and Database Project, Final Output. Ministry of Energy and Water/ Lebanese Center for Water Management and Conservation. Beirut, Lebanon.

Massoud, R., Shihadeh, A., Roumié, M., Youness, M., Gerard, J., Saliba, N., Zaarour, R., Abboud, M., Farah, W., Saliba N. A.	(2011). Intra-urban variability of PM10 and PM2.5 in an Eastern Mediterranean city. Atmospheric Research 101, 893-901.
Ministry of Finance	(2013). Public Finance Quarterly Report - Quarter II 2013. Beirut.
Ministry of Tourism	(2013). 2011, 2012 and 2013 Visitor Arrival Statistics. Beirut: Research and Studies Department - Statistics Division.
MOE/UNDP/ECODIT	(2011). State and trends of the Lebanese Environment 2010. Beirut: Ministry of Environment.
MOE/UNDP/ELARD	(2011). Business plan for combatting pollution of the Qaraoun Lake. Beirut: Ministry of Environment.
MOE/UNDP/EU	(2007). Cost of environmental degradation from the olive oil sector. Beirut. Ministry of Environment.
MOE/UNDP/ELARD	(2011). Preparation of a Masterplan for the Closure and Rehabilitation of Uncontrolled Dumps. Beirut.
Ministry of Environment – United Nations Environment Programme, MOE /UNEP	(2005). National inventory on Persistent Organic pollutants: dioxins & furans releases in Lebanon. Ministry of Environment– Lebanon.
Ministry of Energy and Water –MOEW	(2010). National water sector strategy. Beirut: Ministry of Energy and Water.
Ministry of Public Health- MOPH	(2011). Statistical bulletin. Beirut: Ministry of Public Health.
MOPH/UNHCR	(2014). Syrian Refugee Response - Secondary and Tertiary Health Care - January to December 2013. Beirut.
Moussallem, M.	(23. June 2014). Director General of Bekaa Water Establishment. (S. Khalil, Interviewer).
Nassif, R.	(2014). Compilation of data for waste quantities received at the Zahle sanitary Landfill between 2011 and 2013. Beirut.
O'Riordan, M.	(2009). Investigation into methods of pit latrines emptying. Abgerufen am 25. June 2014 von Sustainable Sanitation Allowance: www.susana.org/docs_ccbk/susana_download/2-1424-1745dstudy-of-pit-latrine-desludging-methods1.pdf

RAMBOLL	(2012). SWM in Lebanon - Phase I Report. Beirut.
Roe, S. M., Spivey, M. D., Lindquist, H. C., Thesing, K. B., and Strait, R. P.	(2004). Estimating ammonia emissions from anthropogenic nonagricultural sources, Draft final report, US EPA, Research Triangle Park, NC, USA.
Sabbagh, B.	(2014). Compilation of data for waste received at Karantina and Amrousiyeh sorting facilities between 2011 and 2013. Beirut.
Saliba, N., Moussa, S., Salame, H., El-Fadel, M.	(2006). Variation of selected air quality indicators over the city of Beirut, Lebanon: Assessment of emission sources. Atmospheric Environment 40, 3263-3268.
Sarraf, M., Larsen, B., Owaygen, M.	(2004). "Cost of Environmental Degradation: The Case of Lebanon and Tunisia." Environment Department Paper 97, World Bank. Washington, DC.
SWEEPNET	(2014). Country Report on Solid Waste Management in Lebanon.
Tayar, A.	(April 2014). Aligning for Action to Face Water Scarcity in Lebanon. Beirut, Lebanon: Ministry of Energy and Water.
United Nations Development Programme- CEDRO, UNDP- CEDRO	(2013). Energy from Wastewater Sewage Sludge in Lebanon; 'Transforming a Waste Disposal Problem into an opportunity›. Beirut: UNDP.
UNEP – Stockholm Convention, United Nations Environment Programme - Stockholm Convention on persistent organic pollutants	(2013). Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs, toolkit.pops.int/.
UN-HABITAT	(2014). Assessment of Housing, Land and Property Issues in Lebanon and the Impact of the Syrian Refuges Crisis. UN-HABITAT
UNHCR	(2014). Preliminary Findings of the Informal Settlements Assessment in Bekaa.13 June 2014
UNHCR	(2013). Syria Refugee Response: Secondary and tertiary health care. Geneva: UNHCR Public Health Section.
United Nations	(2014). Sixth Syria Regional Response Plan. UNHCR.
US Environmental Protection Agency – USEPA	(1995). AP42 Fifth Edition, Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources. Available via: www.epa.gov/ttn/chief/ap42/index.html (accessed 5 June 2013).
US Environmental Protection Agency –USEPA	(2005). LandGEM - Landfill Gas Emissions Model, Version 3.02.

Verdeil E., Faour G. et Velut S.	(2007). Atlas du Liban: Territoires et Société, IFPO/CNRS, Beyrouth, Liban.
Waked, A., Afif, C., Seigneur, C.	(2012).An atmospheric emission inventory of anthropogenic and biogenic sources for Lebanon, Atmospheric Environment, 50, 88-96.
Waked, A., Afif, C.	(2012). Emissions of air pollutants from road transport in Lebanon and other countries in the Middle East region, Atmos. Environ., 61, 446-452.
Waked, A., Afif, C., Brioude, J., Formenti, P., Chevaillier, S., El Haddad, I., Doussin, J-F., Borbon, A., Seigneur, C.	(2013a). Composition and Source Apportionment of Organic Aerosol in Beirut, Lebanon, During Winter 2012, Aer. Sc. Tech., 47, 1258-1266.
Waked, A., Seigneur, C., Couvidat, F., Kim, Y., Sartelet, K., Afif, C., Borbon, A., Formenti, P., Sauvage, S.	(2013b). Modeling air pollution in Lebanon: evaluation at a suburban site in Beirut during summer, Atmos. Chem. Phys., 13, 1-14.
World Bank	(2013). Lebanon - Economic and social impact assessment of the Syrian conflict. Washington DC. World Bank.
World Bank	(2013). Lebanon economic monitor: the brunt of the Syrian conflict. Beirut: World Bank.
World Bank	(2012). Lebanon: Country Water Sector Assistance Strategy 2012-2016. Washington: World Bank.
World Bank	(2010). Republic of Lebanon Water Sector: Public Expenditure Review. Washington: World Bank.
World Bank	(2011). Republic of Lebanon: Country Environmental Analysis. Washington: World Bank.
World Bank	(2009b). Water sector: Public expenditure review. Washington: World Bank.
World Health Organization – WHO	(2006). WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005.
World Health Organization – WHO	(2014).www.who.int (visited on July 10, 2014).

ANNEXES

ANNEX A. COMPLEMENTARY INFORMATION TO THE INTRODUCTION

A-1. Lebanon: Economic and social impact assessment of the Syrian conflict (September 2013) and Lebanon roadmap of priority interventions for stabilization (November 2013)

Lebanon: Economic and Social Impact Assessment (ESIA) of the Syrian conflict (September 2013)

"The ESIA provided an empirical knowledge base for the GOL and stakeholder consultations on developing and adopting a comprehensive short-term mitigation plan and a realistic strategy for medium and long term sustainable growth"[40]. The four-week assessment estimated that USD7.5 billion were needed to reinstate the situation to Lebanon pre-Syrian conflict conditions of 2011. This estimate was based on the cumulative impact assessment of the Syrian conflict spill over from mid-2012 until the end of 2014, in the fields of human and social development (including education, health; employment, livelihoods; and safety nets); and infrastructure (electricity, water and sanitation, solid waste management and municipal services, and transportation infrastructure).

The report warned about severe environmental and health impacts arising from deficits in water supply, water access and quality; and in wastewater management practices. Groundwater contamination, pollution of water resources and spread of water-borne diseases were also highlighted as a result of a twofold generation of solid waste in several areas with high concentrations of refugees. In particular, the ESIA report showed that water demand reached 361.1MCM/year; a 7percent increase in demand, when compared to the pre-conflict period. The total net impact in 2012 was estimated at 5.43 MUSD (additional capital and O&M expenditures and/or projections made by regional WEs). An additional economic cost of 143 MUSD was associated with the diversion of 26 million m3/year, reflecting the cost of alternative water sources provided by the informal sector as a result of the influx of refugees[41]. The stabilization assessment was based on an estimated gross water demand from the refugee population of 106 liters/person/day. The short-term costs assessed humanitarian relief intervention costs; O&M costs associated with restoration of access to water supply and sanitation, capital required for restoration of services in schools, as well as urgent sanitation improvement projects and medium-term planning activities. After December 2014, significant infrastructure investments and institutional reforms must be made to reduce the developing deficit in the water and sanitation services sector.

Municipal solid waste costs are estimated between 193-206 MUSD required to close and rehabilitate open and uncontrolled municipal solid waste dumps; establish sorting, composting, and land-fill facilities; and to cover the expected additional operational and capital expenditures. This figure excludes the investment costs associated with the Waste-to-Energy plants planned for the BML area under Solid Waste Management Strategy (MOE 2010) and the draft National Master Plan for Solid Waste Management (MOE 2013).

An immediate impact of the Syrian refugee influx on the electricity sector has been observed due to increased loads resulting from connection of improvised refugee accommodations to the electricity grid, Lebanese households where refugees are being hosted, refugees' rented accommodations, as well as hotels and other rented accommodations

[40] ESIA report, World Bank, page 32.
[41] ESIA report, World Bank, page 111

where occupancy is above normal rates. Additional demand is being met either through privately operated generators where these can be afforded, or reduction in supply to the baseline Lebanese population. The analysis conducted by MOEW and the World Bank concluded that the demand due to the incoming Syrian refugees was expected to increase to 213MW by December 2013[42].

There is no available data that can quantify the costs incurred by the transportation sector. However, the impact of the Syrian refugees resulted in a 50 percent increase in road traffic; with associated vehicles operating costs and additional road accidents. Moreover, in Beirut, speeds have declined by 30 percent; particularly during peak hours. This has resulted in substantial delays, congestion, and associated costs. Along the same vein, transit business for Lebanese trucks has dropped by about 80 percent. Additional costs approximated at around 246-525 MUSD will be incurred during the period from 2012 to 2014.

Lebanon roadmap of priority interventions for stabilization (November 2013)

Based on the outcomes of the ESIA Report, the GOL released the "Lebanon Roadmap of priority interventions for stabilization" in November 2013. Developed with the support of the World Bank and the United Nations, the roadmap presents a preliminary set of priority interventions to contribute towards qualitatively and quantitatively alleviating the impact of the Syrian conflict in Lebanon. Tables 1.1 to 1.4 provide a summary of proposed interventions for stabilization at the short-, medium- and long-term levels for the sectors of environmental relevance: water and sanitation, solid waste management, electricity, and transport.

[42] ESIA Report, World Bank, page 127

Table A-1. Lebanon Roadmap - Summary of priority interventions of water and sanitation

	Track One
Sector	**Intervention**[43]
Water and sanitation services (WSS)	• Repair activities, including repair measures to existing public water supply and wastewater infrastructure to boost supply and improve services in high impacted areas; flood mitigation works in critically affected areas including repair and/or replacement of critical equipment, vehicles and tools including booster pumps, water well rehabilitation, septic tanks rehabilitation, electrical grid reconnection to key distribution plant and additional point of use metering installations. • Extension activities that could include, among others, drilling of wells, installation of bulk water storage tanks (including rainwater harvesting), power generator sets and pipeline extensions; chlorination facilities and associated water supply infrastructure. • Operation and maintenance costs of existing water and wastewater treatment infrastructure, including the cost of fuel/power/manpower inputs associated with increased water and sewerage services. • Technical assistance for project design and implementation and support for mitigation of environmental risks in host communities caused by shortages and degradation of water and wastewater services. Focus: North and Bekaa.

[43] Lebanon Roadmap, Track One interventions, page 12.
[44] Lebanon Roadmap, Track Two interventions, page 13.

	Track Two	
Costs (MUSD)	Intervention	Costs (MUSD)
	• Assist municipal and water institutions to augment capacity to service water and sanitation needs in communities and regions where existing operations are most stressed by incoming refugees through increased private sector engagement. • Put in place rapid deployment matching grant program designed to assist businesses services and undertake training to augment business opportunities and employment generation activities including in WSS[44].	TBD
60	*Increase access to improved water and sanitation services, including*[45] • Rehabilitation/ expansion of water supply sources (e.g. bulk surface water storage, pumping station upgrade and expansion, well rehabilitation). • Rehabilitation/ replacement of water distribution networks and associated infrastructure to reduce leaks and improve distribution efficiency. • Expansion of wastewater collection network infrastructure and wastewater infrastructure including construction, expansion, and commissioning of centralized and decentralized (onsite) wastewater treatment facilities. • Extension of freshwater sources for use in irrigation to reduce the use of untreated wastewater in agriculture. • Technical assistance in the development of regulation for the use of untreated wastewater in agriculture, and piloting of treated wastewater re-use for subsurface irrigation pilots. ** Cross-referenced for Tracks 3 and 4*	175
	Strengthen institutional and technical capacity to sustainably implement the NWSS[46] • Infrastructure investment and studies for improved surface water storage and inter-basin transfer projects. • Infrastructure investment and studies for advanced water and wastewater treatment plants and associated infrastructure. • Assist the Regional WEs (particularly in the Bekaa) in increasing the number of household connections/ subscriptions, which will improve billings and collections rate thereby strengthening its financial sustainability; including recruitment and training of bill collectors, meter reading, awareness raising campaigns. • Purchase/ install/operate water meters and design/ implement metered water distribution zones as possible, to facilitate the implementation and roll out of volumetric metering for water supply. • Finalize regional wastewater master plans and associated organizational management reforms. • Finalize wastewater quality standards for wastewater reuse and discharge including studies into the economic reuse of sludge and wastewater to generate livelihood potential and off-set O&M costs. • Implement pilot pollution control schemes in highly vulnerable areas and in areas more subject to pollution than other, like industrial cities; develop flood mitigation strategies and disaster preparedness response mechanisms. ** Cross-referenced for Track 3*.	155

[45] Lebanon Roadmap, Track Two interventions, page 18.
[46] Lebanon Roadmap, Track Two interventions, pages 18 and 19.

Table A-2. Lebanon Roadmap - Summary of priority interventions of SWM

	Track Two	
Sector	**Intervention**	Costs (MUSD)
Solid waste management and municipalities	• Assist municipal institutions to augment capacity to service solid waste management requirements in communities and regions where existing operations are most stressed by incoming refugees through increased private sector engagement. • Put in place rapid deployment matching grant program to assist businesses to adapt services, and undertake training to augment business opportunities and employment generation activities including in aforementioned solid waste[47].	TBD
	Emergency municipal services and social resilience projects • Help Lebanese municipalities and host communities most affected by the influx of Syrian refugees to address the service delivery and socioeconomic impacts of Syrian refugee inflows by allowing municipalities to finance additional municipal services (services that are directly within the municipal competence as well as services that can be contracted out by municipalities to other service providers)[48].	100 (costs specific to SWM not identified)
	• Rehabilitate and close municipal solid waste dumps. A total of 504 municipal waste dumps were identified over the Lebanese territory. As part of the Lebanese Government's Master Plan for the closure and rehabilitation of open and uncontrolled municipal solid waste dumps, a number of priority dumps were identified for rehabilitation and/or closure[49]. ** Cross-referenced for Track 3*	40
	-Establish composting, separating and landfilling facilities (excluding waste-to-energy plants), based on the NWSS and CDR list of relevant investments in secondary cities and rural areas[50]. ** Cross-referenced for Tracks 3 and 4*	50

[47] Lebanon Roadmap, Track Two interventions, page 13.
[48] Lebanon Roadmap, Track Two interventions, page 19.
[49] Lebanon Roadmap, Track Two interventions, pages 19 and 20.
[50] Lebanon Roadmap, Track Two interventions, page 20.

Table A-3. Lebanon Roadmap - Summary of priority interventions of electricity

	Track Two		Track Three	
Sector	**Intervention**	Costs (MUSD)	Intervention	Costs (MUSD)
Electricity	Support of ongoing program management of energy sector projects[51]	4.5	Increase generation capacity due to the incoming Syrian refugees estimated of 213MW by December 2013. Total demand for electricity by Syrian refugees in the high influx scenario is estimated to rise to 362 MW by end of 2014(MOEW/WB)[52]. ** Cross-referenced for Track 4*	330
	Support the preparation of new priority projects in the energy sector	5.5	Strengthen and expand the transmission and distribution networks in order to accommodate the additional electricity supply required by Syrian refugees, and evacuate the 362 MW of additional generation (mentioned above), further strengthening and expansion of Lebanon's transmission and distribution systems will also be required[53].	100

Table A-4. Lebanon Roadmap- Summary of priority interventions of transportation

	Track Two		Track Three	
Sector	**Intervention**	Costs (MUSD)	Intervention	Costs (MUSD)
Transportation	Maintenance and expansion of the road network in lagging regions that are most affected by the influx of refugees such as Akkar, Bekaa and the North. Investments are needed for better maintenance of the road network and for increasing the capacity of some road sections through rehabilitation, widening and/or expansion[54].	100	Freight sector revitalization and border crossings modernization, including (1) modernization and upgrade of the border crossings with Syria (North and Bekaa), (2) policies aimed at the revitalization of the trucking sector, (3) railway link between Tripoli port to Abboudiyeh border crossing to Syria (in the North).	100M
	Improvement of greater Beirut Public Transport (20% increase in road traffic) First phase will focus on decongesting Beirut-Tabarja[55]. ** Cross-referenced for Track 3*	200		

[51] Lebanon Roadmap, Track Two interventions, page 20.
[52] Lebanon Roadmap, Track Three interventions, pages 23 and 24.
[53] Lebanon Roadmap, Track Three interventions, page 24.
[54] Lebanon Roadmap, Track Two interventions, page 21.
[55] Lebanon Roadmap, Track Two interventions, page 21 and 22.

Table A-5. Summary of interviews with municipalities and unions of municipalities[56]

Union of Municipalities/ Municipalities	Population		SWM
	Resident population	Syrian refugees	
Union of Municipalities of Tyre[57]	200,000	55,000 (registered and unregistered)	Quantities of waste doubled (accordingly costs doubled)
Union of Municipalities of Sahel[58]	35,000	40,000 (most registered)	Quantities of waste doubled (accordingly costs doubled)
Union of Middle and Sahel Al Qaytaa[59]	90,000	Approx. 50,000	250 Million L.L equivalent to USD165,892 (2011, 10 Municipalities) 500 Million L.L. (USD331,785)(10 municipalities, 2012) 650 Million L.L. (USD431,320)(2012, 11 Municipalities)
Union of Municipalities of Ostwan[60]	40,000	17,000 (registered and unregistered)	170 Million L.L. (USD112,806)/year;costs of 10 tons collected daily
Union of Municipalities of Baalbeck[61]	200,000	60,000 (registered and unregistered)	SW used to be collected once daily; now increased to 3 times a day. Costs estimated to 2 Billion L.L. (Increase by 40%)
Municipality of Bar Elias[62]	42,000	60,000	Collected SW increased from 25 tons daily (2012) to 75 tons daily (2014)
Municipality of Majdal Anjar[63]	22,000	23,000	7 tons equal to 175 Million L.L. (USD116,124)/ton (2012) to 14 tons (equal to 200 Million L.L.(USD132,714)/ ton (2014)
Municipality of Bebnine[64]	38,000	17,000	Collection increased from twice daily to 4 times per day; Costs increased from180 Million L.L. (USD119,442)/year (2010) to 350 Million L.L. (USD232,249)/year (2014)

[56] The information provided in the table is presented as communicated by the municipalities and unions of municipalities.

[57] Interview with President of Tyre Municipality, Mr. Hassan Dbouk and Head of Administrative Department of the Union of Municipalities of Tyre, Mr. Mourtada Mhanna, 9 May 2014

[58] Interview with Mr. Ali Taha, member of Municipality of "Qaabrine-Tal Melki-Al Roumoul-Moqaytaa" and the Administrative Coordinator of the Union of Municipalities of Sahel, 15 May 2014

[59] Interview with President of Union of Municipalities, Mr. Ahmad El Mir, 15 May 2014

WW maintenance	Remark
USD150/municipality/ month (2011) USD33,750/ municipality/month (2014)	• Only 15% of households are connected to WW networks. • There are three palestinian camps and informal gatherings hosting PRS(additional pressure on basic infrastructure)
• WW network is unavailable • No capacity to treat WW resulting from ITSs • USD50 (waste disposal in valleys) and USD100 (in Tripoli sanitary disposal)	• 95% of refugees live in ITS. • Pollution from WW flooding is causing skin diseases • All wells are unlicensed (estimated in thousands) • 30% of citrus planted lands are converted to vegetable cultivation
• Maintenance costs equal 6 Million L.L. (USD3,981) (2011) • Maintenance costs equal 8 Million L.L. (USD5,308) (2013) • Emptying septic tanks cost 2 Million L.L.(USD1,327)/ month	• WW disposal is occuring in valleys and open lands • Air is mainly polluted due to WW flooding, and chaotic open burning
• Most municipalities are not connected to WW networks • WW discharged in open lands due to unability of municipalities to cover costs of WW collection and disposal	• Requirements to collect SW increased from once to 4 times per day • Air is mainly polluted due to WW flooding and to open burning • A number of wells has dried due to water scarcity and over-pumping • Ostwan River is polluted
• Costs unavailable for the Union. • Municipal costs doubled; e.g. Baalbeck budget was 400 Million L.L. (USD265,428) (2011-2012)- excluding O&M- now costs doubled	• Baalbeck city alone hosts 40.000 Syrian refugees, and the adjacent Wavel Palestinian camp • Increased demand on construction permits for renting purposes. 95% of constructions are illegal ; and are encroaching on agricultural lands
• Costs of WW maintenance equal 30 Million L.L. (USD19,907)/ year (2012) • Costs of WW maintenance 100 Million L.L. (USD66,357)/ year (2014)	• 60% of households are connected to WW networks
USD3000/month (2012) USD7000/month (2014)	• Disposal and burning of SW is occuring in open dumpsites • There are15 ITS (each including between 25 and 200 tents)
Old sewage network; no treatment Part of an EU funded project that will start in October 2014	• 90% of Syrians live in rented appartments • Construction requests increased from 50 (2010); to 300 requests in 2012/2013

[60] Interview with Mr. Abdallah Mohammad (member of the Union Council) and Mr. Ibrahim Al Rifai (member of the municipality of Baldeh; Head of the Police of the Union), 15 May 2014

[61] Interview with President of Union of Municipalities, Mr. Hussein Awada, 12 May 2014

[62] UNDP, Interview with Mayor of Municipality of Bar Elias, Mr. Saadeddine Ibrahim Mita, 26 June 2014

[63] UNDP, Interview with Mayor of Municipality of MajdalAnjar, Mr. Sami Ibrahim Al Ajami, 24 June 201.

[64] Interview with Mayor of Municipality of Bebnine, Dr. Kifah Al Kassar, 12 June 2014

A-2. Limitations of the methodology

This report faced a number of challenges. While some of these were common across all sectors, some limitations were sector-specific. A key challenge of this assessment was the lack of a reliable and consolidated source of information per sector despite the deployed efforts of all parties. Information is scattered and difficult to trace. Another challenge was the limited time allocated to conduct the assessment, which hindered the field verification of information related to some sectors.

Regarding the solid waste sector, the adopted methodology for calculating waste generation rates by refugees, and consequently the incremental quantity of waste, consisted of assessing available data and making some corrections for the baseline year onwards in BML, Zahle and Tripoli where exact records are available for the quantity of waste received at the SWM facilities. However, it was not possible, within the short period of time, to accurately measure the waste generation rates attributed to refugees in the field mainly in ITSs and substandard buildings. Finally, the MOE/UNDP/ELARD study of 2011 on dumps was used as the basis for assessing the distribution of the incremental quantities of waste in the existing dumps and determining the pattern of their management; however, due to lack of time, it was not possible to verify if new dumps have emerged or a change from depositing of waste in dumps to burning of waste in the dump might have taken place due to increasing pressures or vice versa.

As for the water and wastewater sector, the adopted methodology for calculating water demand and wastewater generation rates by refugees was limited to secondary data available in published reports. Data availability in relation to health, changes in water supply and demand, and operation and maintenance costs in the different WEs[65], and surface water quality data was not accessible within the short period of time required to conduct the assessment; therefore, the quantitative analysis was not possible for all impacts on the sector. Moreover, data obtained through interviews with Union of Municipalities is based on estimations of the members of the Unions.

The adopted methodology for assessing the increase in air pollution due to Syrian conflict was restricted to the calculation of the increase in emissions for the different affected sectors and their regional distribution over Lebanon. Modeling of air quality nationwide requires a modeling of the weather data; validation of the weather model; the calculation of emissions increment; and, the run of a chemical-transport model. Consequently, a full assessment of the degradation of air quality would require more time and was not possible in the duration of the assessment. On the other hand, the data used to calculate the emissions increment was at times based on assumptions made by World Bank or other agencies/authorities, since measurements of some parameters were not possible within the short period of time. As collected data was not always region specific, emissions were sometimes allocated based on the best available and reasonable spatial indicators. Finally, the study could not tackle the health impact as no epidemiological data was/is available vis-à-vis the linkage of air quality and health in Lebanon.

Finally, the development of the chapter of land use and ecosystems was hindered by the limited field access to vulnerable communities due to political and security issues, the reliance on anecdotal evidence during field trips to assess trends and draw preliminary conclusions, and the difficulties in separating the impact of the Syrian refugees from baseline environmental conditions before the Syrian crisis.

[65] An interview with the Director General of Bekaa Water Establishment has provided specific data.

ANNEX B. COMPLEMENTARY INFORMATION TO THE SOLID WASTE SECTOR

Map B-1 Existing solid waste management infrastructure in Lebanon

Box B-1. Methodology for the calculation of solid waste generation rates and incremental waste quantities

In order to determine the incremental quantity of MSW generated by refugees by end of 2014, it was necessary to calculate the waste generation rate attributed to refugees, and apply it to their population by end of year 2014 (as per RRP6 estimates). Available records on solid waste quantities generated during the years 2011 (considered to be the baseline year before the Syrian influx), 2012 and 2013 were collected from:

-MOE, for the solid waste quantities received at the Karantina and Amrousiyeh sorting facilities (serving Beirut and Mount Lebanon – excluding Jbeil), (Sabbagh 2014)

-Union of Municipalities of Al Fayhaa– Tripoli, for wastes received at the semi-controlled dump (Homsi 2014),

-MORES Supervising Consultant for Zahle facility, for the solid waste quantities received from Zahle and 25 surrounding municipalities (Nassif 2014).

Case of BML

The total quantity of waste received at both Karantina and Amrousiyeh sorting facilities amounted to 1,019,639 t/yr in 2011. A forecasting of the waste quantities (at an annual rate of 1.65 percent per year) was applied on 2011 data to calculate the theoretical quantity of waste for the year 2013 (1,053,565 t/yr). The Syrian crisis resulted in a drop in the number of visitors between year 2011 (1,655,051 visitors) and 2013 (1,274,362 visitors) (Ministry of Tourism, 2013). This drop of 380,689 visitors requires correcting the baseline by deducting the portion of waste generated by these tourists from the baseline data (5,482 t/yr).

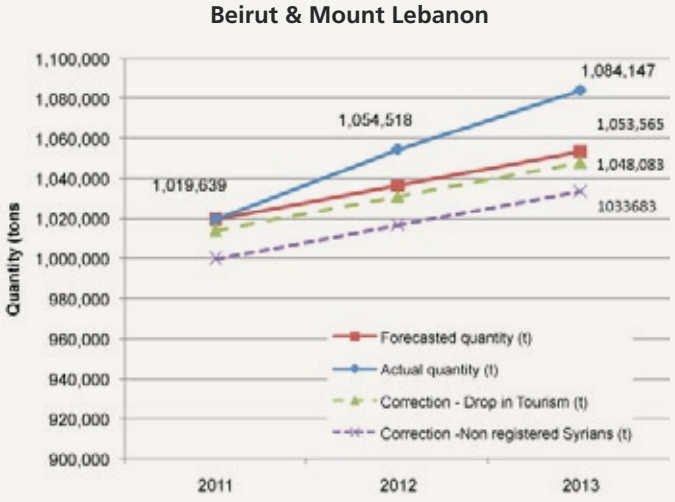


Figure B-1: Calculation of waste generation rate in BML

A similar correction was done to the baseline for the solid waste generated by the non-registered Syrians who fled Syria since the beginning of the crisis in March 2011 and came to a safe refuge in Lebanon (14,400 t/yr). An assumption was made that, out of the 230,000 non registered Syrian present in Lebanon, 100,000 arrived to the country by end of 2011,and 80 per cent of them settled in BML.

The corrected forecasted quantity (after accounting for drop in tourism and non-registered Syrians) for the year 2013 amounted to 1,033,683 t/yr (instead of 1,053.565 t/yr) was deducted from the actual cumulative quantity received at Karantina and Amrousiyeh sorting facilities by the end of 2013. This difference was attributed to the Syrian refugees registered in Lebanon by end of 2013.

By dividing the difference (50,464 t/yr) over the number of refugees by end of 2013, the waste generation rate for BML was computed to be 0.53 kg/refugee/day.

The same exercise of comparing corrected forecasts vs actual quantities received was repeated with the data available for Zahle and Tripoli to compute the waste generation rates in these 2 areas. The results were 0.47 and 0.51 Kg/refugee/day, respectively.

The three computed waste generation rates were used to determine the incremental quantity of waste generated by refugees in these areas by the end of 2014. In other areas, a weighted average (0.50 kg/refugee/day) was used to determine the quantity of waste generated. In cazas where informal settlements are dominant (Akkar, Baalbeck, West Bekaa, El Minieh Dannieh), a specific waste generation rate was calculated based on the fact that ISs produce less waste (UNHCR confirmation and field observations);knowing that 57 percent of refugees live in rented apartments, while the remaining 43 percent live in ISs, unfinished buildings, garages and substandard buildings. This waste generation rate was found to be 0.43 kg/refugee/day.

The calculation of the incremental quantity, cost and destination of MSW generated by refugees based on estimates of 31 December 2014 are presented in table B-1.

Table B-1. Incremental quantity, cost and destination of SW generated by refugees by end of 2014

				31-Dec-14					
Mohafaza	**Caza**	**Gene-ration Rate (kg/p/d)**	**Cost ($/ton)**	**Total refugees**	**Incremental daily quantity (t/d)**	**Incremental yearly quantity (t/yr)**	**Incremental cost/year ($)**	**Destination**	**Number of existing facilities/ dumps**
Beirut	Beirut	0.53	130	63,164	33	12,183	1,583,834	SUKOMI	2 SCL
Mount Lebanon	El Matn	0.53	130	109,191	58	21,061	2,737,978	SUKOMI	11 D
	Baabda	0.53	130	183,265	97	35,349	4,595,379	SUKOMI	9 D
	Kesrewan	0.53	130	25,978	14	5,011	651,395	SUKOMI	20 D
	Chouf	0.53	130	105,848	56	20,417	2,654,153	SUKOMI	11 D
	Aaley	0.53	130	112,445	59	21,689	2,819,564	SUKOMI	5 D
	Jbeil	0.50	35	8,377	4	1,534	53,683	Hbaline/ dumps	1 SC + 3 D
North Lebanon	Akkar	0.43	30	163,332	70	25,406	762,186	Srar - open dumps	30 D
	Tripoli	0.51	52	107,268	54	19,803	1,029,752	UofM-controlled dump	1 S + 1 D
	El Minieh - Dennieh	0.43	35	90,578	39	14,089	493,127	OMSAR facility + open dumps	1 SC +13 D
	El Koura	0.50	30	23,877	12	4,372	131,161	open dumps	20 D
	El Batroun	0.50	30	24,492	12	4,485	134,541	open dumps	7 D
	Zgharta	0.50	30	19,095	10	3,496	104,893	open dumps	11 D
	Bcharre	0.50	30	3,642	2	667	20,005	open dumps	5 D
Bekaa	Zahle	0.47	41	263,705	124	45,311	1,857,738	Zahle SWM + dumps	1 SCL + 18 D
	Baalbeck	0.43	30	179,213	76	27,876	836,294	Kayyal + open dumps	1 SC + 1 Lp + 60 D
	West Bekaa	0.43	30	92,523	39	14,392	431,757	Open dumps	32 D
	Rachaya	0.50	30	16,568	8	3,034	91,011	open dumps	24 D
	El Hermel	0.50	30	8,902	4	1,630	48,901	open dumps	5 D

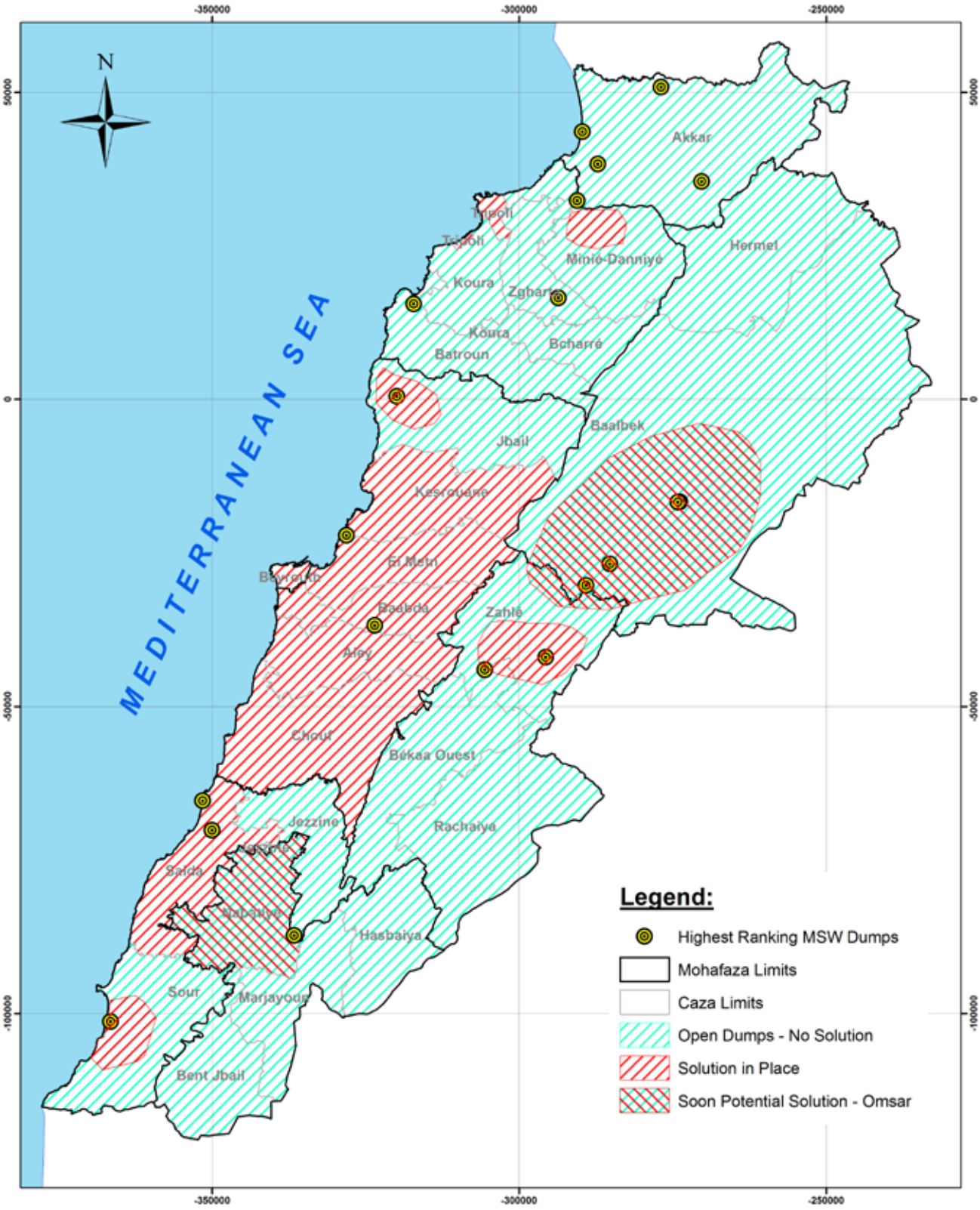
				31-Dec-14					
Mohafaza	**Caza**	**Gene-ration Rate (kg/p/d)**	**Cost ($/ton)**	**Total refugees**	**Incremental daily quantity (t/d)**	**Incremental yearly quantity (t/yr)**	**Incremental cost/year ($)**	**Destination**	**Number of existing facilities/ dumps**
South Lebanon	Sour	0.50	45	62,046	31	11,361	511,245	Ain Baal, ras el aain, open dumps	1 SC + 51 D
	Saida	0.50	110	92,642	46	16,963	1,865,969	Saida SWM facility, open dumps	1 SAD +1L + 38 D
	Marja-youn	0.50	30	11,589	6	2,122	63,663	open dumps	2SC + 25 D
	Jezzine	0.50	30	4,074	2	746	22,377	open dumps	16 D
	El Nabatiyeh	0.50	30	43,129	22	7,897	236,917	open dumps	1 SC+ 30 D
	Hasbaya	0.50	45	7,551	4	1,383	62,222	open dumps	21 D
	Bent Jbeil	0.50	30	12,509	6	2,290	68,713	open dumps	3 SC + 37D
	TOTAL			**1,835,000**	**889**	**324,568**	**23,868,454**		

S = Sorting C = Compositing L = Landfill D = Dumps

Table B-2. Calculation of the incremental waste volume burned and deposited in dumps by end of 2014

			QUANTITY (T/YR)	VOLUME (M^3/YR)		
Mohafaza	**Caza**	**Generation Rate (kg/p/d)**	**Incremental quantity**	**Incremental volume**	**Incremental volume burned**	**Incremental volume in dumps**
Beirut	Beirut	0.53	12,183	34,810	0	0
Mount Lebanon	El Matn	0.53	21,061	60,175	1,171	1,838
	Baabda	0.53	35,349	100,997	399	4,651
	Kesrewan	0.53	5,011	14,316	483	233
	Chouf	0.53	20,417	58,333	426	2,491
	Aaley	0.53	21,689	61,968	1,221	1,877
	Jbeil	0.50	1,534	4,382	13	4,369
North Lebanon	Akkar	0.43	25,406	72,589	24,530	48,059
	Tripoli	0.51	19,803	56,580	0	56,580
	El Minieh - Dennieh	0.43	14,089	40,255	4,561	19,592
	El Koura	0.50	4,372	12,492	8,772	3,720
	El Batroun	0.50	4,485	12,813	23	12,790
	Zgharta	0.50	3,496	9,990	6,445	3,545
	Bcharre	0.50	667	1,905	551	1,354
Bekaa	Zahle	0.47	45,311	129,459	59,940	0
	Baalbeck	0.43	27,876	79,647	79,628	19
	West Bekaa	0.43	14,392	41,120	39,744	1,376
Bekaa	Rachaya	0.50	3,034	8,668	8,668	0
	El Hermel	0.50	1,630	4,657	4,657	0
South Lebanon	Sour	0.50	11,361	32,460	23,592	1,078
	Saida	0.50	16,963	48,467	4,824	7,293
	Marjayoun	0.50	2,122	6,063	2,051	2,496
	Jezzine	0.50	746	2,131	1,715	416
	El Nabatiyeh	0.50	7,897	22,563	22,284	279
	Hasbaya	0.50	1,383	3,951	3,021	930
	Bent Jbeil	0.50	2,290	6,544	3,284	1,624
			324,568	**927,336**	**302,003**	**176,609**

SW Density = 350 kg/m3



MoE/EU/UNDP, 2014.
Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.

Map B-2: Destination of incremental solid waste quantities generated by refugees

Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only.

Source: This map was prepared by GEOFLINT and Mr. F. Merheb 2014.

The Projection of the Displayed Data is Provided in Double Stereographic

0 10,000 20,000 40,000 Meters

Sacle 1:550,000

Map B-2 Destination of incremental solid waste quantities generated by refugees

Box B-2. Methodology for prioritization of impacts of incremental waste quantities on surface and groundwater

The dump survey (MOE/UNDP/ELARD, 2011) was used as a basis for this assessment. Attributes related to incremental waste quantities, geology (lithology and faults density) and hydrology (distance to drainage line and distance to springs) were selected for each of the 503 dumps (excluding Saida dump) and each was assigned an equal weight reflecting the equal significance of their associated environmental impact. Each attribute was then given a "sensitivity grade" varying from 0 to 10 and was divided into 4 quarters or ranges (the higher the value, the greater the sensitivity).

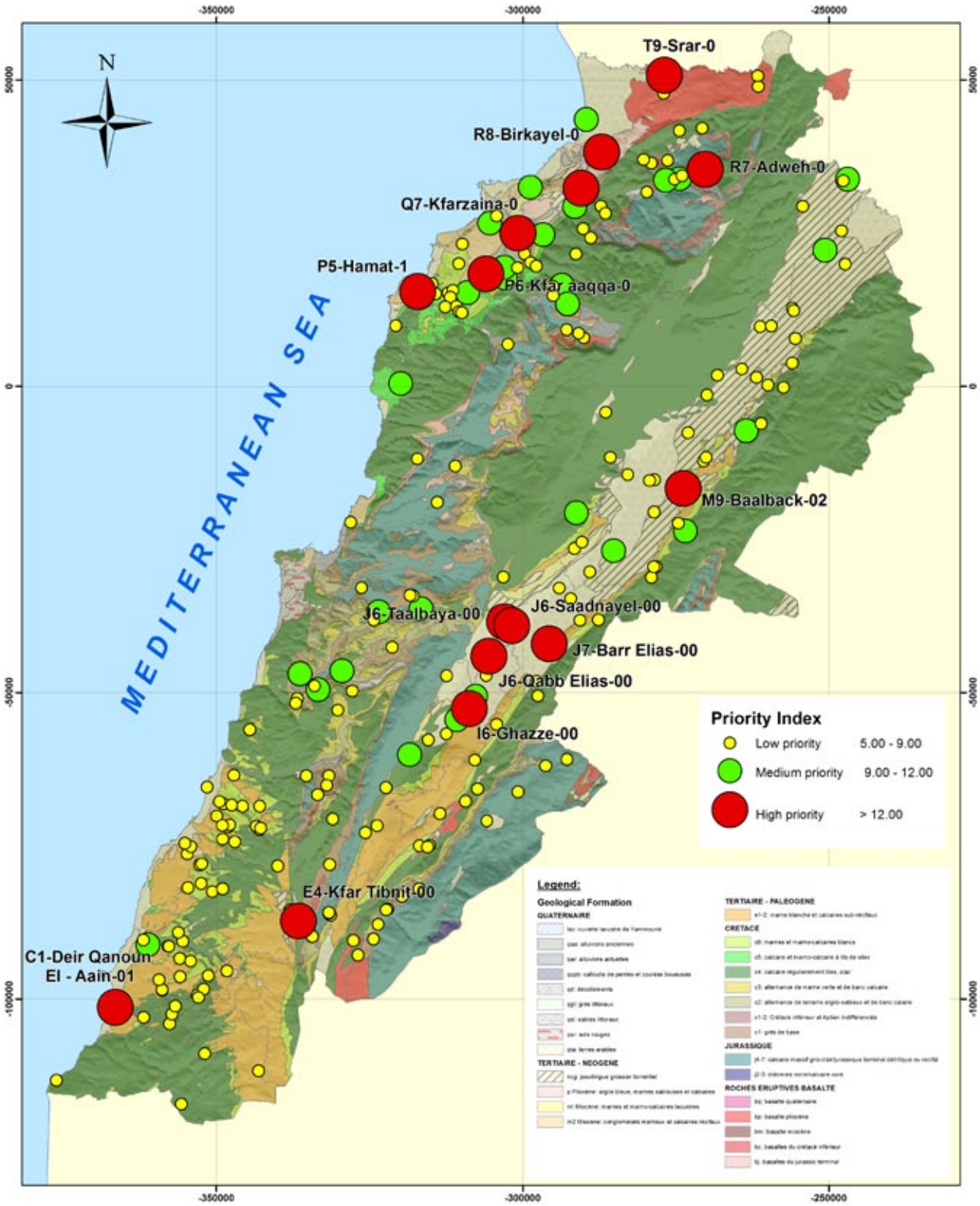
Table B-3. Dumps Attributes

ATTRIBUTE		0.0-2.5	2.5 – 5.0	5.0 – 7.5	7.5 – 10.0
Incremental quantity of waste at site (m^3)		<2,000 m^3		2,000 – 10,000 m^3	>10,000 m^3
Geology	Lithology (70%)	Considerable to high clay content	Clay contents and jointing systems	Secondary porosity, different forms of karstification and presence of some marl intercalations	Secondary porosity (cracks & joints) of carbonate rock, plus high karstification
	Faults & lineaments density (segment /km^2) (30%)	<10	10-15	15-20	> 20
Hydrology	Distance to drainage line (80%)	>200 m	200-100 m	50-75 m	<50 m
	Distance to springs (20%)	>200 m	200-150 m	150-100 m	<100 m

The Risk Sensitivity Index (RSI) was then calculated for each dump by adding all attributes. The maximum score that can be achieved is 30. Sites with high a RSI are the sites where impacts are expected to be important and require immediate intervention. Results of the highest RSI scores for the 20 first sites are presented in **Table B-4**.

Table B-4. RSI Scores for the highest priority areas for impacts on surface and groundwater

Site_ID	Mohafaza	Caza	RSI combined score	Hydrology score	Geology score
T9-Srar-0	North	Akkar	23.67	17.15	16.19
J7-Barr Elias-00	Beqaa	Zahle	20.95	14.71	13.95
C1-Deir Qanoun El - Aain-01	South	Sour	20.62	14.31	14.37
R7-Adweh-0	North	Minieh	19.64	12.36	16.64
J6-Qabb Elias-00	Beqaa	Zahle	19.22	12.91	14.22
E4-Kfar Tibnit-00	Nabatieh	Nabatieh	19.15	11.07	16.65
L8-Haouch el Refqa-00	Beqaa	Baalback	18.46	12.18	10.36
J5-Rouayset El Ballout-0	Mount Leb	Baabda	18.36	11.65	10.88
J6-Taalbaya-00	Beqaa	Zahle	18.18	11.77	15.43
S7-Mqaiteaa-0	North	Minyeh-donniye	18.08	11.77	11.08
R8-Birkayel-0	North	Akkar	17.96	10.71	15.23
R9-Fnaydek-0	North	Akkar	17.77	13.24	12.29
Q7-Deir Nbouh-0	North	Minieh-Diniyeh	17.67	10.34	10.19
P7-Beslouqit-2	North	Zgharta	17.54	9.49	10.06
P5-Hamat-1	North	Batroun	17.32	10.90	14.04
N5-Hbaline-0	Mount Leb	Jbeil	17.16	13.21	9.68
J6-Saadnayel-00	Beqaa	Zahle	16.64	10.29	12.14
G5-Machgha-ra-00	Beqaa	West Beqaa	16.44	12.71	8.96
C-2-Qana-01	South	Sour	16.23	12.50	8.75
H6-Joubb Jannine-00	Beqaa	West Beqaa	15.99	9.75	8.99



MoE/EU/UNDP, 2014.
Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions.

Map B-3 - Prioritization of impacts of Incremental Solid Waste Quantities on Ground Water

Disclamer: This map is not a geographically representative of the boundaries and regions of Lebanon and has been developed for illustrative purpose only.

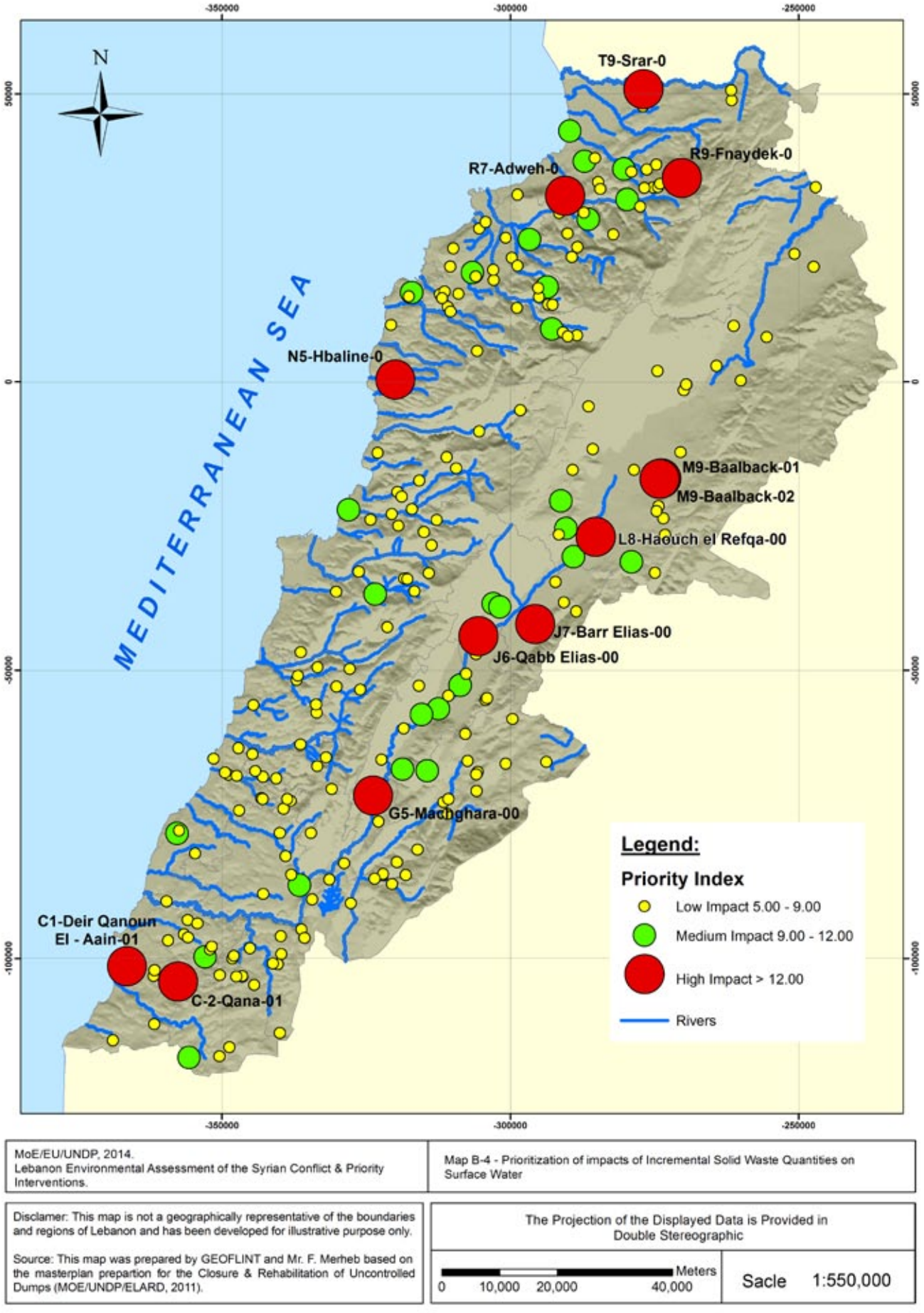
Source: This map was prepared by GEOFLINT and Mr. F. Merheb based on the masterplan prepartion for the Closure & Rehabilitation of Uncontrolled Dumps (MOE/UNDP/ELARD, 2011) & Geological map of Lebanon DUBERTRET, 1955.

The Projection of the Displayed Data is Provided in Double Stereographic

0 10,000 20,000 40,000 Meters

Sacle 1:550,000

Map B-3 Prioritization of impacts of incremental solid waste quantities on ground water



Map B-4 Prioritization of impacts of incremental solid waste quantities on surface water

Table B-5: Calculation of incremental quantity and destination of generated health care waste by refugees (by end 2014)

- Number of referrals to hospitals provided by UNHCR partners by end of 2013 = 41,168 referrals
- Forecasted number of referrals to hospitals provided by UNHCR partners by end of 2014= 84,394 referrals
- Primary health care consultation visits in 2013 = 178,489 persons
- Forecasted primary health care consultation visits by end of 2014 = 365,468 persons
- Infectious waste generation rate for hospitals= 1.5 kg/bed/day
- Infectious waste generation rate for primary health care = 0.08 kg/visitor

Mohafaza	**Infectious waste generation in Hospitals (kg/yr)**	**Infectious waste generation in Primary Health care (Kg/yr)**	**Total infectious waste (Kg/yr)**	**Total non-infectious waste (kg/yr)**
BML	97,178	7,266	104,445	417,779
North Lebanon	99,008	7,403	106,411	425,646
Bekaa	144,921	10,836	155,757	623,028
South Lebanon	49,903	3,731	53,635	214,539
TOTAL	**391,011**	**29,237**	**420,248**	**1,680,992**
Incremental quantity managed by service providers (kg/yr)		72.20%	**303,419**	
Incremental quantity not properly managed (kg/yr)		27.80%	**116,829**	

Table B-6: Additional bins and trucks needed

Mohafaza	Caza	Generation Rate (kg/p/d)	Total refugees	Incremental daily quantity (t/d)	Incremental daily volume (m^3/d)
Beirut	Beirut	0.53	63,164	33	95
Mount Lebanon	El Matn	0.53	109,191	58	165
	Baabda	0.53	183,265	97	277
	Kesrewan	0.53	25,978	14	39
	Chouf	0.53	105,848	56	160
	Aaley	0.53	112,445	59	170
	Jbeil	0.50	8,377	4	12
North Lebanon	Akkar	0.43	163,332	70	199
	Tripoli	0.51	107,268	54	155
	El Minieh - Dennieh	0.43	90,578	39	110
	El Koura	0.50	23,877	12	34
	El Batroun	0.50	24,492	12	35
	Zgharta	0.50	19,095	10	27
	Bcharre	0.50	3,642	2	5
Bekaa	Zahle	0.47	263,705	124	355
	Baalbeck	0.43	179,213	76	218
	West Bekaa	0.43	92,523	39	113
	Rachaya	0.50	16,568	8	24
	El Hermel	0.50	8,902	4	13

Additional bins needed			Additional Trucks needed		
240 liter bins (60%)	**1100 liter bins (40%)**	**Cost ($)**	**Pick up trucks (5 m³)**	**Compactor trucks**	**Cost ($)**
281	41	30,450	0	4	300,000
485	71	52,650	0	6	450,000
814	119	88,300	0	10	750,000
116	17	12,600	0	2	150,000
471	69	51,150	0	6	450,000
500	73	54,200	0	6	450,000
36	6	4,200	0	1	75,000
2,048	298	221,600	33	7	1,680,000
456	67	49,600	0	6	450,000
1,136	166	123,200	19	4	965,000
353	52	38,450	6	2	360,000
362	53	39,300	6	2	360,000
282	41	30,500	5	1	250,000
54	8	5,900	1	1	110,000
2,087	304	225,950	34	8	1,790,000
2,247	327	243,150	36	8	1,860,000
1,160	169	125,600	19	4	965,000
245	36	26,650	4	1	215,000
132	20	14,600	3	1	180,000

Table B-6: Additional bins and trucks needed (continued)

Mohafaza	Caza	Generation Rate (kg/p/d)	Total refugees	Incremental daily quantity (t/d)	Incremental daily volume (m^3/d)
South Lebanon	Sour	0.50	62,046	31	89
	Saida	0.50	92,642	46	133
	Marjayoun	0.50	11,589	6	17
	Jezzine	0.50	4,074	2	6
	El Nabatiyeh	0.50	43,129	22	62
	Hasbaya	0.50	7,551	4	11
	Bent Jbeil	0.50	12,509	6	18
	TOTAL		**1,835,000**	**889**	**2,541**
					Rounding

Collection by caza

Red: collection once per day

Orange: Collection every two days

Green: Collection twice per week

Bins distribution

60 % of the bins are 240 liters

40 % of the bi ns are 1,100 liters

Trucks

70 % of trucks are pick ups

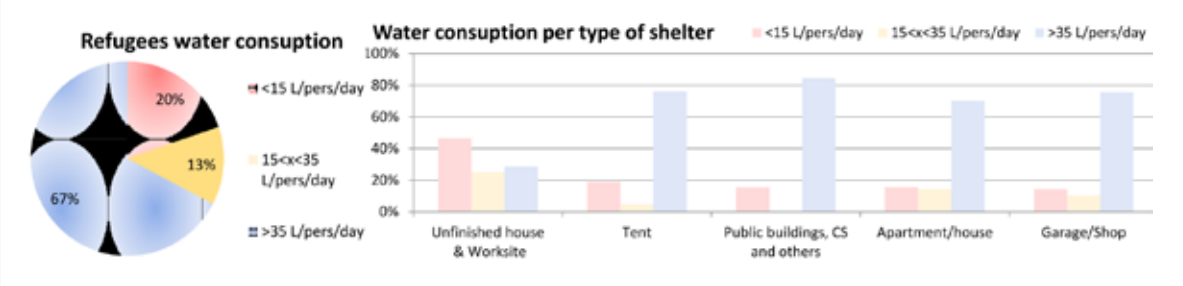
30 % of trucks are compactor trucks (except for BML and Tripoli)

Additional bins needed			Additional Trucks needed		
240 liter bins (60%)	**1100 liter bins (40%)**	**Cost ($)**	**Pick up trucks (5 m³)**	**Compactor trucks**	**Cost ($)**
916	134	99,400	15	4	825,000
1,367	199	147,950	22	5	1,145,000
171	25	18,550	3	1	180,000
61	9	6,650	1	1	110,000
637	93	69,050	11	3	610,000
112	17	12,400	2	1	145,000
185	27	20,050	3	1	180,000
16,714	**2,441**	**1,812,100**	**223**	**96**	**15,005,000**
16,800	**2,500**	**1,840,000**	**225**	**100**	**15,375,000**

ANNEX C. COMPLEMENTARY INFORMATION TO THE WATER AND WASTEWATER SECTORS

Box C-1. Methodology for estimating water demand and wastewater generation rate from Syrian refugees in Lebanon

Data from Solidarités International (January 2014) in the North shows water consumption per type of shelter as per the below graph (figure 7). The same reference mentions that: "with regard to water availability in the North, Syrian refugees are consuming on average 145 litres per person per day" (L/person/day) (UNHCR, 2014).



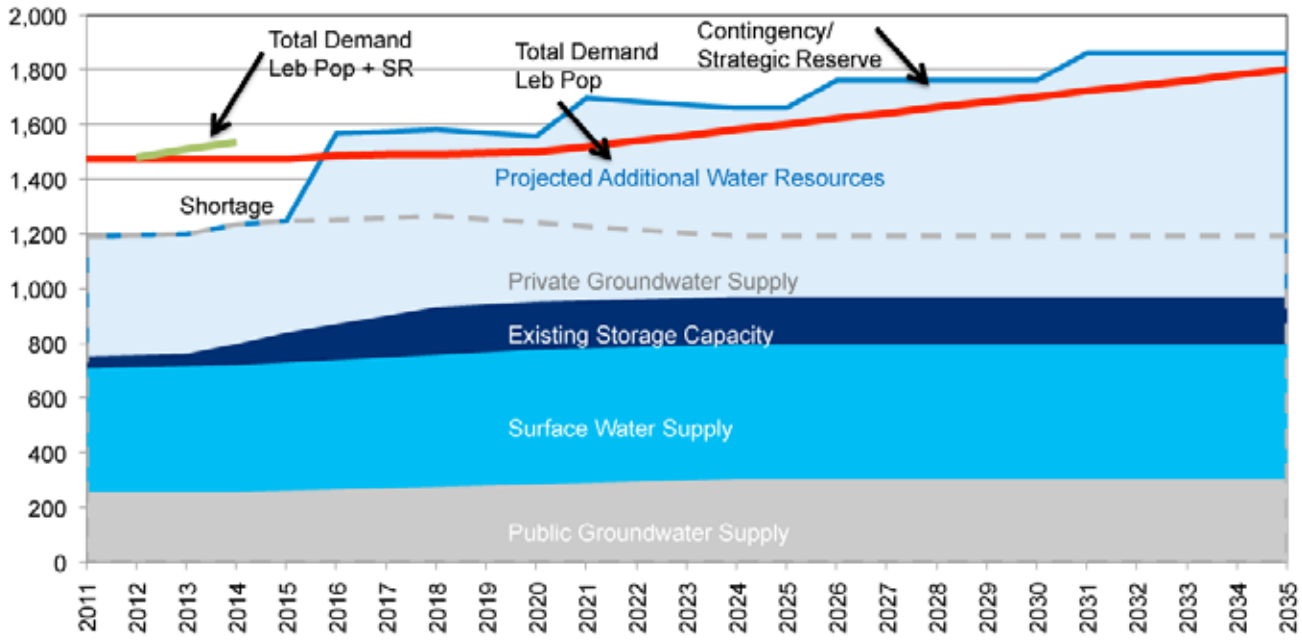
In this context, according to Figure 7 of the WASH chapter, a weighted average for water consumption per type of shelter is calculated (based on the percentages set) using the following assumptions:

- For the quantity of water below 15 litres, it is assumed to be 15 litres
- For the quantity of water between 15 and 35 litres, it is assumed to be 35 litres
- For the quantity of water above 35 litres, 2 scenarios were used as follows:
    - o As a higher estimate, the average water consumption per person per day was assumed to be 145 litres.
    - o As a lower estimate, the average water consumption per person per day was assumed to be 85 litres (half a Lebanese person's water consumption).
- After calculating weighted average water consumption per type of shelter, a national weighted average was calculated taking into account the percentage distribution of refugees according to shelters (57% in apartments, 15% in informal settlements and 28% in substandard buildings and collective shelters).

Type of shelter	Average quantity of water consumed using the higher estimate (litre/person/day)	Average quantity of water consumed using the lower estimate (litre/person/day)
Unfinished house & worksite	62.3	42.5
Tent	116.8	70
Public buildings, collective shelters and others	121.6	72.4
Apartment/house	102.9	63.9
Garage shop	117.6	70.8
Average taking distribution of refugees per type of shelter	104.313	64.255

Concerning wastewater generation rates, wastewater generated is assumed at 80% of water consumed and for pollution load, "BOD_5 load is based on 60 grams per capita per day BOD_5 emission".

Figure C-1. Supply/demand planning in Lebanon for a moderate dry year in MCM for 2011-2035 (MOEW 2010)



ANNEX D. COMPLEMENTARY INFORMATION TO AIR QUALITY

Detailed methodology of the air quality sector

The incremental emissions due to Syrian conflict were determined using a conservative approach, and compared to the base year of 2010 using the gridded emissions inventory numbers provided by Waked et al. (2012). The relative increment reflects the increase in the concentration of each pollutant in the geographical area of interest, if neither chemistry nor advection between regions is taken into account.

GHGs, namely CO_2, CH_4, N_2O, etc. were also emitted from the different sectors, but were not addressed in this assessment as they do not have short term effects on health, hence were not presented in this report.

An in-depth impact of the Syrian conflict on the emissions of GHGs is recommended, along with the assessment of adaptation and vulnerability to climate change.

Emissions calculation methodology

Emissions will be estimated according to the following equation (USEPA, 1995):

$$E = A \times EF$$

where E represents the emissions, A the activity rate, and EF the emission factor per sector per pollutant.

Emissions calculation protocols recognize that the quality of data used to report emissions varies. Each protocol has developed quality levels or "tiers" that classify the quality of data. Three tiers generally exist: Tier 1, Tier 2, and Tier 3 with Tier 1 being the least accurate.

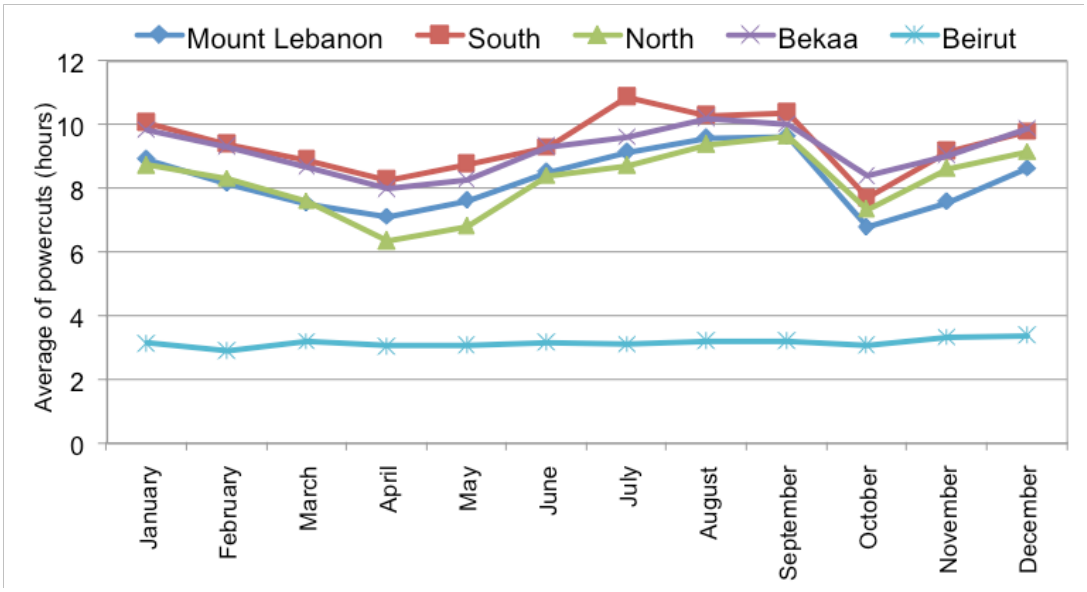
The emissions calculation was based on the European methodology of EMEP/EEA guidebook 2013 where sector methodology is available (EMEP/EEA, 2013). In the case of absence of some sectors calculation methodology, USEPA methodology, namely AP-42 (USEPA, 1995), was used or any other published scientific methodology as a last resort. This also applies on emission factors. On the other hand, activity rate data was collected from different sources, e.g. UNHCR, World Bank, field visits, etc.

Targeted sectors

The targeted sectors were chosen after a thorough study of the proposed emission sectors in the EMEP/EEA (2013) guidebook; site visits of informal settlements, a meeting with UNHCR, and literature review. These sectors included: transport, industrial, energy production, commercial, residential, and construction sectors; as well as the agriculture sector, and waste. Impacted sectors by the refugees' displacement were determined. Consequently, the current assessment has focused on evaluating the impacts of the following sectors on air quality: electricity production, residential heating, solid waste, and road transport.

Electricity production: For many years, the electricity provided by the GOL has been unable to satisfy basic demand for homes, offices and national businesses. The electricity demand due to the Syrian crisis is met through diesel generation since the Lebanese electricity system was unable to meet existing demand. At peak hours, EDL has currently 2,019 MW available against a demand of 3,195 MW. Throughout the years 2010, 2011,2012,and 2013, daily average power cuts were 5.57 hours, 6.83 hours, 10.17 hours, and 8.11 hours per day; respectively. The daily average power cut per Governorate from 2010 to 2013 is presented in **Figure D-1** (from Personal communication with Mr. Karim Osseiran and Mr. Iskandar Kfoury, on June 5, 2014).

Fig. D-1. Daily average of power cuts in Lebanon from 2010 to 2013



Based on the baseline scenario, the ESIA determined a supplemental demand of 251 MW due to the Syrian influx, which is to be met through diesel generators (World Bank, 2013). Based on the temporal profile of daily power cuts per Governorate averaged over 2010-2013, and using available data for daily power cuts per Governorate from January to May 2014 (MOEW, 2014), a scaled temporal profile was determined. The electricity demand of 251 MW was therefore distributed per Governorate proportionally to the power cuts (**Table D-1**). In each Governorate, the generators emissions spatial allocation corresponded to the number of Syrian refugees per village.

Table D-1. Spatial allocation of electricity demand

Governorate	Mt. Lebanon	Beirut	South	North	Bekaa
Power demand (MW)	58.05	20.88	41.74	65.35	64.98

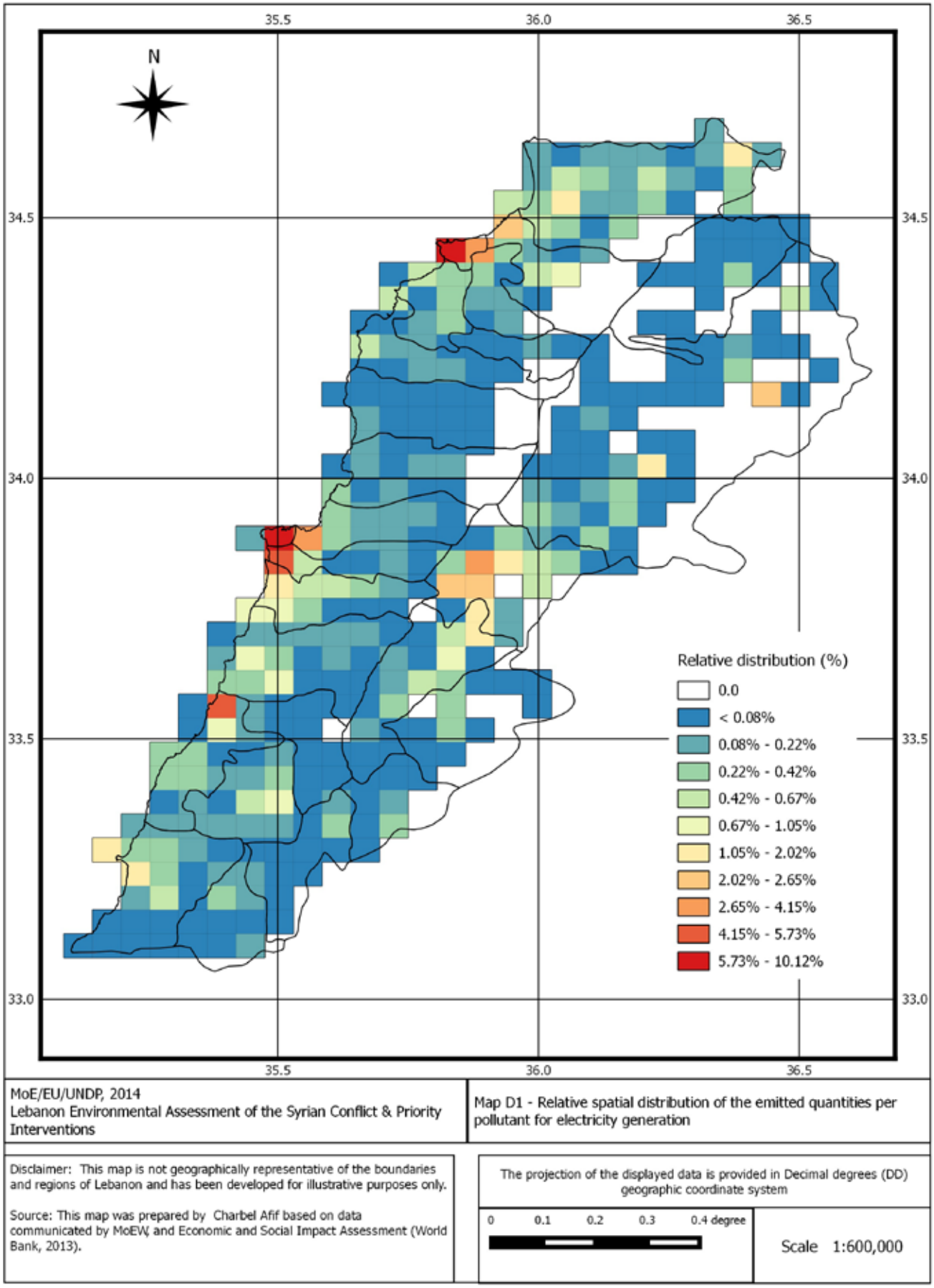
The emissions calculation was based on:

- The activity rate which will be the power demand per village in GJ,
- The Tier 2 emission factors for the different pollutants which are presented in **Table D-2** (EMEP/EEA, 2013).

Table D-2. Emission factors for the private generators

Pollutant	CO	NOx	SO_2	PM10	PM2.5
Emission factor (g/GJ)	130	942	46.5	22.4	21.7

On the national level, the incremental emissions due to the 251 MW demand is determined to be 2,058 tons, 14,912 tons, 736 tons, 355 tons, and 344 tons for CO, NOx, SO_2, PM10, and PM2.5, respectively. The relative increment emissions spatial distribution is presented in **Map D-1**. The figure showed that Beirut, Tripoli, Zahle, Saida and Arsal produced the most emissions.



Map D-1. Relative spatial distribution of the emitted quantities per pollutant for electricity generation

Residential heating: Many of the refugees live in accommodations that are not well insulated. During winter, temperature drops to very low values in mid-altitude villages and above. An Inter-Agency winterization programme was launched providing diesel stoves, vouchers and cash for heating fuel.

The vouchers and cash for heating fuel were distributed during 2013-2014 winter to refugees who live above 500 meters of altitude spatially allocated on the Governorates. The beneficiaries of the vouchers are spatially distributed as in **Table D-3** (UNHCR, 2014).

Table D-3. Spatial distribution of the fuel vouchers

Geographic location	Num. of vouchers	Amount in USD
Arsal	8,000	500
Wadi Khaled	8,000	500
Mount Lebanon	2,200	200
Bekaa	12,670	200
North	5,070	200
South	1,100	200

Moreover, cash for heating fuel was provided to around 89,000 families, along with an amount of 100 USD per month from November 2013 to March 2014 (i.e. one to five months depending on when the family arrived to the country) (UNHCR, 2014). A default amount of 250 USD per family was considered.

In addition to that, other international organizations reported distributing fuel vouchers to around 1,000 families (UNHCR, 2014).

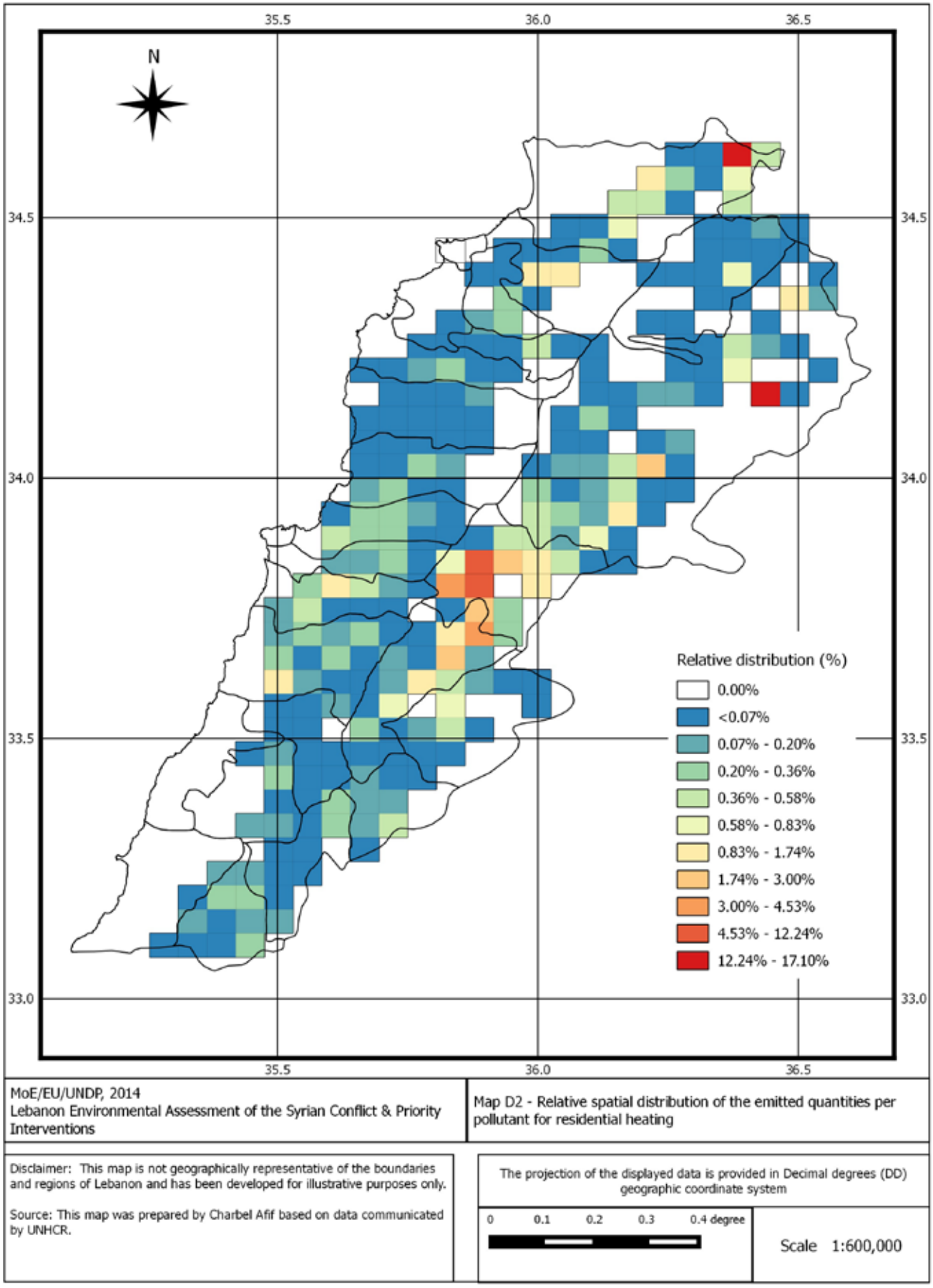
Considering the average price of diesel fuel during the period of November 2013 and March 2014 of 26,586LL/20 litres, the distributed vouchers and cash for heating fuel is equivalent to 39.5 million liters of diesel fuel. Since the 2013-2014 winter was not as cold as usual, the assistance provided as heating fuel was not entirely used; and a factor of 0.75 was applied. In addition, the total number of refugees by end of the year 2013 was 858,641 (UNHCR, 2014). A factor of 1.7 was applied to the activity data in order to meet the number of refugees by end of 2014. The spatial distribution of households and refugees is considered identical to that of May 31, 2014.

The diesel stove emission factors from EMEP (EMEP/EEA, 2013) were used; and are grouped in **Table D-4** with a net calorific value of 43.33 GJ per ton of diesel and a density of 0.745 kg per liter.

Table D-4. Emission factors for diesel stoves (EMEP/EEA, 2013)

Pollutant	CO	NOx	SO_2	PM10	PM2.5
Emission factor (g/GJ)	111	34	60	2.2	2.2

The residential heating will result in 180.60 tons, 55.32 tons, 97.62 tons, 3.58 tons, and 3.58 tons emitted into the atmosphere for CO, NOx, SO_2, PM10, and PM2.5 respectively; for a yearly activity equivalent to that by end of 2014. The relative spatial distribution of the emitted quantities is presented in **Map D-2**.



Map D-2. Relative spatial distribution of the emitted quantities per pollutant for residential heating

SWM practices: Waste generation in Lebanon increased with the Syrian influx. The incremental quantity per day is 889 tons per day, of which 459 t/d going to open dumps, 290 t/d are burned, and 169 t/d are deposited in the open dumps (Ref. to **Chap. 2** of the report). Open burning is occurring in 389 sites while disposal only in open dumps is occurring in 115 sites (Ref. to **Chap. 2** of the report). Open burning and open dumping are sometimes occurring at the same site. According to *arcenciel*, only 38 percent of the MSW in Lebanon is combustible (personal communication with Dr. Dominique Salameh, June 15, 2014). This figure was adopted for the composition of waste generated by Syrian refugees since no specific data was available. The emission factors used for open burning are presented in **Table D-5** (USEPA, 1995, UNEP/Stockholm Convention, 2013).

Table D-5. Emission factors for MSW open burning (USEPA, 1995, UNEP/Stockholm Convention, 2013)

EF (g/ton entire refuse weight)			EF (g/ton actually burned)		
CO	NOx	SO_2	PM10	PM2.5	PCDD/F
38,505	2,718	453	17,214	15,764	0.0003

On a national level, open burning will result in 4,070 t/yr,287.29 t/yr, 47.88 t/yr, 691.42 t/yr, 633.20 t/yr, and 12.05 g/yr TEQ, of CO, NOx, SO_2,PM10, PM2.5, and PCDD/F. The relative spatial distribution of the emitted quantities is presented in **Map D-3**.

The emission factors used for open dumping are presented in **Table D-6** (EMEP/EEA, 2013).

Table D-6. Emission factors for open dumping

Pollutant	PM10	PM2.5
Emission factor (g/t)	0.219	0.033

Open dumping of this incremental quantity of waste will result in 0.014t/yr for PM10, and 0.0024 t/yr for PM2.5.The relative spatial distribution of the emitted quantities is presented in **Map D-4**.

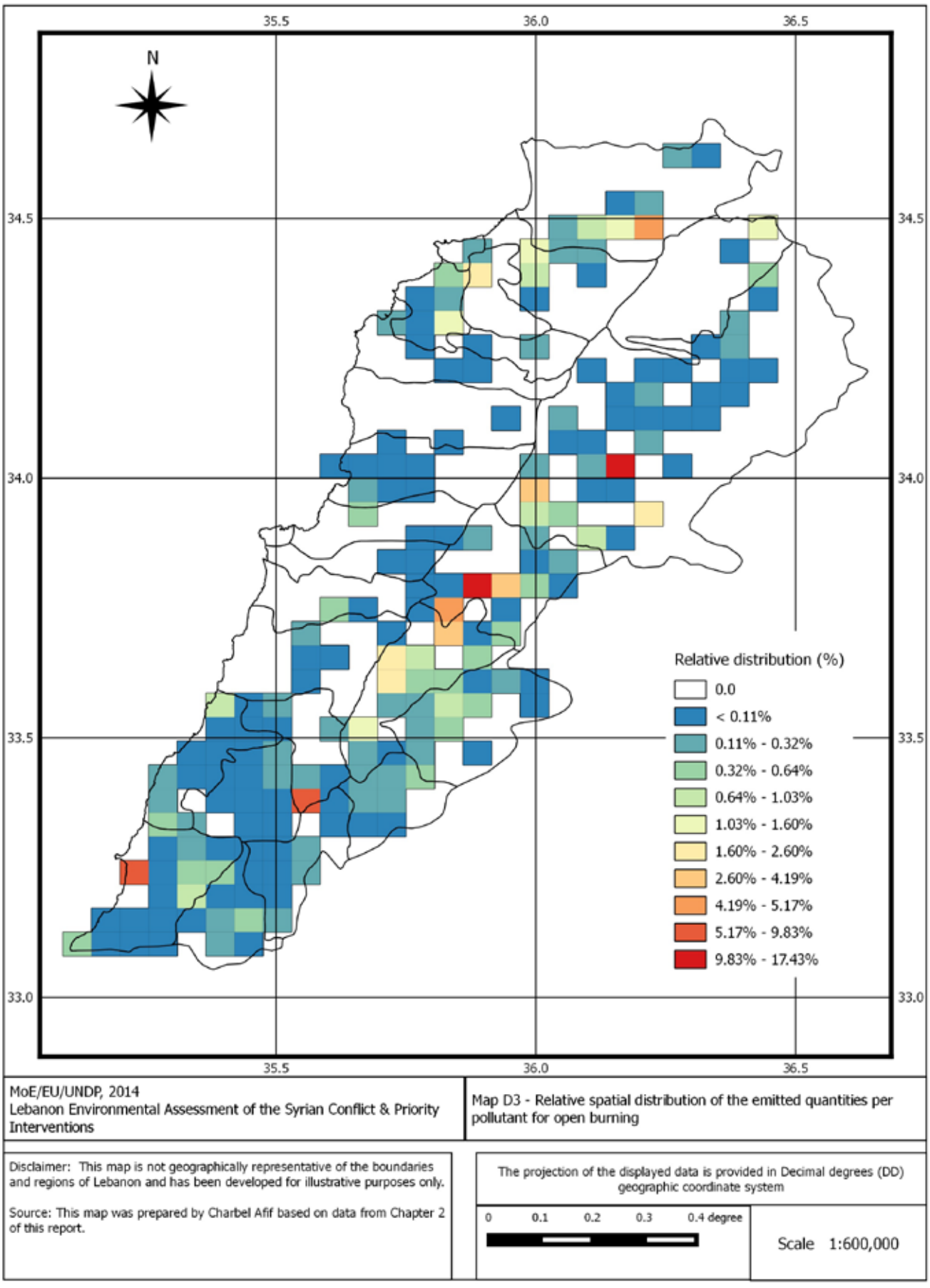
Transport: The road network condition in Lebanon is considered to be fair to poor with very dense traffic in the Greater Beirut Area (GBA). A detailed description of the Tier 3 EMEP methodology, which is adopted for the calculation of emissions for on-road transport, along with the appropriate emission factors can be found in Waked and Afif (2012) and Waked et al. (2012).

For the calculation of the incremental emissions of on-road transport from the Syrian refugees' displacement, several assumptions, based on the World Bank Economic and Social Impact Assessment (2013), were used in this exercise:

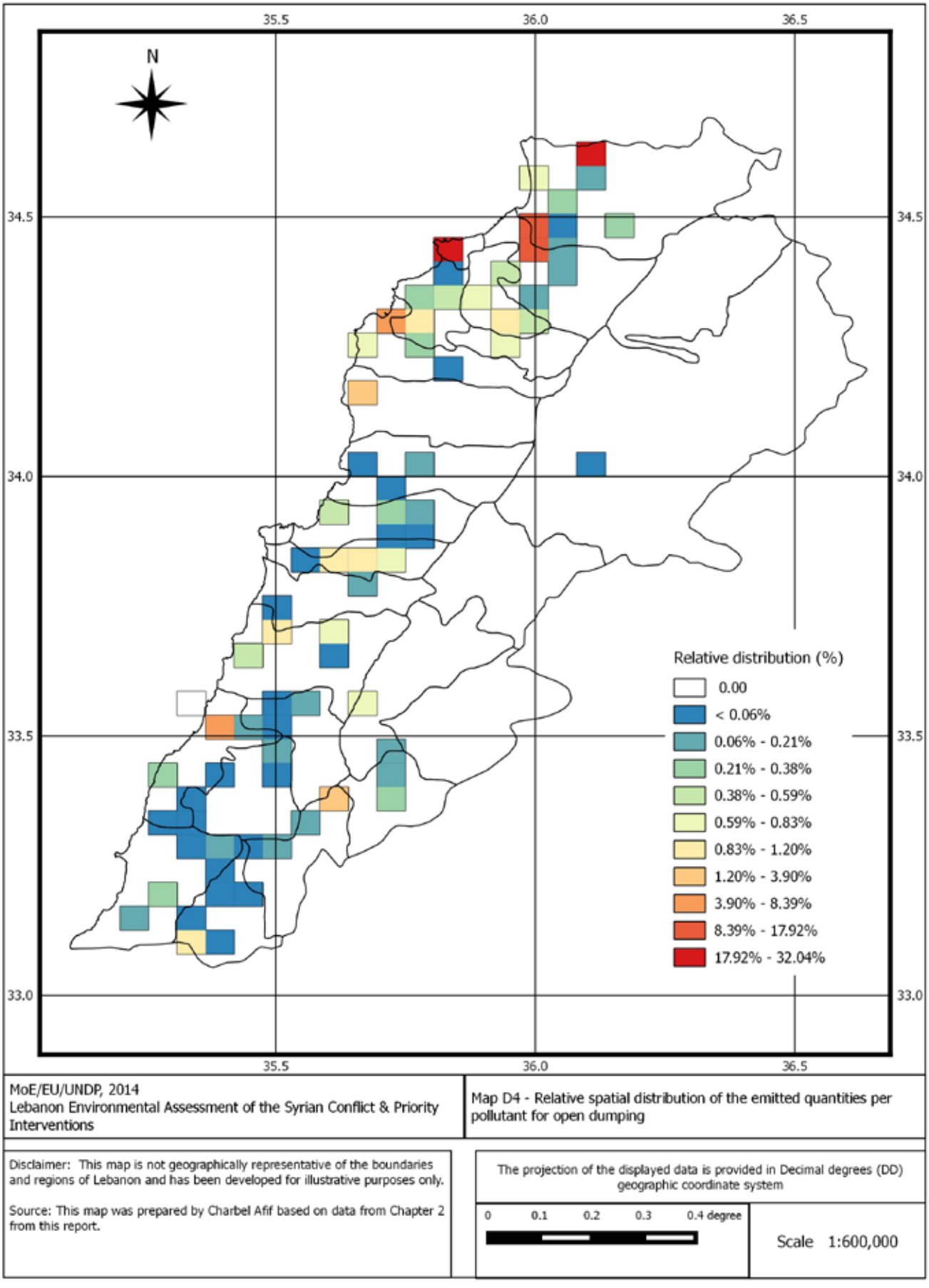
- Traffic volume has increased by 15 percent in Greater Beirut Area.
- Average vehicle speed has decreased by 20 percent.
- Transit trucks volume has decreased by 65 percent.
- Main cities traffic volume has increased by 50, 20, and 10 percent respectively, depending on the number of Syrian refugees in these cities.

In addition to that, a five percent increase in traffic volume was considered for major roads.

The activity data showed an increase in emissions of 95,067 tons/yr, 7,518 tons/yr, 1,709 tons/yr, 349 tons/yr, and 269 tons/yr of CO, NOx, SO_2, PM10, and PM2.5 respectively.



Map D-3. Relative spatial distribution of the emitted quantities per pollutant for open burning



Map D-4. Relative spatial distribution of the emitted quantities per pollutant for open dumping

ANNEX E. COMPLEMENTARY INFORMATION TO LAND USE AND ECOSYSTEMS

Table E-1. National Land Use Master Plan zones and servitudes

Based on Decree No. 2366 dated 20 June 2009

Part A of Decree 2366 dated 20/6/2009

	U Urban	R Rural	A Agricultural	N1 Natural/Peaks	N2 Natural/ Cedars	N3 Natural/ Corridor
General exploitation factor	Medium to high	Medium	Medium inside the residential areas Low outside the residential areas	Very low except for general technical facilities and military facilities	Very low except for ski resorts	Medium inside the residential areas Low outside the residential areas Very low in forests and on slopes of 30%
Buildings Height	Medium to high	Medium inside the residential areas Low outside the residential areas	Low to medium inside the residential areas Very low outside the residential areas	Very low	Low in the residential areas Very low outside the residential areas According to a carrying capacity plan for ski resorts	Medium inside the residential areas Low outside the residential areas
Buildings Setbacks	According to local guidelines	10 meters from rivers border	10 meters from rivers border	No specific additional conditions	20 meters from forests border according to village Master Plan recommendations	10 meters from rivers border during winter
Urban expansion and its location in respect to the current urbanized areas	No specific additional conditions	Preferably near the urbanized village, unsuitable far from it	Preferably near the urbanized village, unsuitable far from it	No specific additional conditions	Preferably near the urbanized village, unsuitable far from it	Preferably near the urbanized village, unsuitable far from it
Land sorting for construction	Possible	Possible near the urbanized village	Preferably near the urbanized village	Not possible except for general technical facilities and military facilities	Preferably near the urbanized village, unsuitable far from it	Preferably near the urbanized village, unsuitable far from it except for touristic resort after the submission of EIA and landscape study

Large Scale Projects	Possible	Possible	Preferably near the urbanized village	Not Possible	Possible for ski resorts after the submission of EIA and landscape study	Possible for touristic resort after the submission of EIA and landscape study
Quarrying	Not possible	Forbidden in the forests Possible on a distance above 500m from rivers border	Possible after the submission of EIA and re-vegetation study for the cover of the quarry site	Not possible	Not possible	Forbidden in forests. Possible at a distance above 500m from urbanized areas and from shore border
Industries and industrial facilities	Possible for industries of 1st, 2nd, 3rd class after the submission of EIA and landscape study	Possible	Possible for industries of 3rd, 4th, 5th class, must abide by environmental guidelines	Not possible	Possible for mineral waters facilities, for vital cooperative facilities such as petrol stations after the submission of EIA and landscape study	Possible for industries of 3rd, 4th, 5th class, must abide by environmental guidelines

Part B of Decree 2366 dated 20/6/2009

	P **View area of natural sites**	**S1** **500 Radius around classified sites**	**S2** **500 Radius around special natural sites**
General exploitation factor	Very low, except inside the residential areas	• Nil outside the residential areas • Very low for zones classified A, N, R • Designated as per terms of zone U	• Nil outside the residential areas • Very low for zones classified A, N, R • Designated as per terms of zone U
Buildings Height	• Low to medium in the residential areas • Very low outside the residential areas	Low for zones classified A, N, R and in a distance selected as per terms of zone U	Very low for zones classified A, N, R and in a distance selected as per terms of zone U
Buildings Setbacks	According to local guidelines	50 meters from site's border except for zone U	50 meters from site's border except for zone U

	P View area of natural sites	S1 500 Radius around classified sites	S2 500 Radius around special natural sites
Urban expansion and its location in respect to the current urbanized areas	Preferably near the urbanized village.	No specific additional conditions.	No specific additional conditions.
Land sorting for construction	Possible following the submission of Project's landscape study and its impact on the general view.	Possible following the submission of Project's EIA study and its impact on the site.	Possible following the submission of Project's EIA study and its impact on the site.
Large Scale Projects	Possible following the submission of Project's landscape study and its impact on the general view.	Possible following the submission of Project's EIA study and its impact on the site.	Possible following the submission of Project's EIA study and its impact on the site.
Quarrying	Not possible.	Not possible.	Not possible.
Industries and industrial facilities	Possible following the submission of Project's landscape study and its impact on the general view.	Not possible on 50 m radius from the site.	Not possible on 50 m radius from the site.

Part C of Decree 2366 dated 20/6/2009

	F* Prone to flooding	G** Prone to landslides and rock fall-down	W Prone to underground water pollution
General exploitation factor	Very low to take into account existing conditions.	• Very low • nil or close to nil on slopes above 10% (natural land before settlement) taking into account existing conditions.	In case of no existing wastewater network, medium in zones U and R, low in zones A and N3, very low in N2 zone, non-existent in N1 zone.
Buildings Height	Low taking into account existing conditions.	• Construction forbidden in zone N1. • Low taking into account existing conditions.	No specific additional conditions.
Buildings Setbacks	80% of the plot area remain natural (gardens without tiling) taking into account existing conditions.	80% of the plot area remain natural taking into account existing conditions.	No specific additional conditions.

	F* Prone to flooding	G** Prone to landslides and rock fall-down	W Prone to underground water pollution
Urban expansion and its location in respect to the current urbanized areas	Imposed along residential areas taking into account existing conditions.	No specific additional conditions.	No specific additional conditions.
Land sorting for construction	Possible with a study that proves there are no threats and no double threats in the neighborhood.	Possible along residential areas with a study that proves there are no risks, no threats and non-double threat in the neighborhood.	Possible if existing wastewater network. If not, a wastewater network and a wastewater treatment plant must be totally implemented before any execution of road networks and construction activities.
Large Scale Projects	Possible if a study proves the safety of the Building occupants.	Possible with a study that proves there are no threats and no double threats in the neighborhood during and after investment.	Possible if existing wastewater network. If not, a wastewater network and a wastewater treatment plant must be totally implemented before any execution of road networks and construction activities.
Quarrying	Possible with a study that proves there are no threats and no double threats in the neighborhood during and after investment.	Possible with a study that proves there are no threats and no double threats in the neighborhood during and after investment.	Possible with a study that proves the absence of any possibility of destabilizing the rock formation in the ground that would change groundwater streams or impact springs.
Industries and industrial facilities	Possible for industries that do not generate solid or liquid waste that contain poisonous or toxic components that will possibly leak into the underground in case of floods.	Possible with a study that proves there are no threats and no double threats in the neighborhood during and after investment.	If no wastewater network prevention of industries that could contaminate groundwater.
Public facilities	Possible if a study proves the safety of the Building occupants.	Possible if a study proves the safety of the Building occupants.	Possible if total implementation of procedures to treat wastewater.

CONTRIBUTORS TO ASSESSMENT REPORT

LIST OF CONTRIBUTORS TO THE REPORT (IN ALPHABETICAL ORDER)

GOVERNMENTAL INSTITUTIONS

Bekaa Water Establishment: Maroun Moussallem
Council for Development and Reconstruction: Assem Fidawi, Elie Helou, Maher Baker, Nabil Itani, Wafa Charafeddine
Economic and Social Fund for Development - Lebanon: Racha Merhebi
Litani River Authority: Nabil Amacha
Ministry of Agriculture: Nabil Bou Ghanem
Ministry of Energy and Water: Iskandar Kfoury, Karim Osseiran
Ministry of Environment: Ghassan Sayah, Youssef Doughan
Ministry of Interior and Municipalities: Pierre Salem
Ministry of Social Affairs: Hala El Helou, Khaled Othman
Office of the Minister of State for Administrative Reform: Mohamad Baraki
Presidency of the Council of Ministers: Lamia Chamas

LOCAL ADMINISTRATIONS

Municipality of Akroum: Mohamad El Adra
Municipality of Bar Elias: Saadeddine Ibrahim Mita
Municipality of Bebnine: Kifah Al-Kassar
Municipality of Majdal Anjar: Sami Ibrahim Al Ajami
Municipality of Tyre: Hassan Dbouk
Municipality of Wadi Khaled: Faeq Shehadeh
Union of Municipalities of Baalbeck: Hussein Awada
Union of Municipalities of Middle and Sahel Al Qaytaa: Ahmad El Mir
Union of Municipalities of Ostwan: Abdallah Mohammad, Ibrahim Al Rifai
Union of Municipalities of Sahel: Ali Taha
Union of Municipalities of Tyre: Mourtada Mhanna
Urban Community of Al Fayhaa: Dima Homsi

INTERNATIONAL AGENCIES

European Union Delegation to Lebanon (EU): Nicolas Ritzenthaler
Food and Agriculture Organization (FAO): Bruno Minjauw, Elie Choueiri, Jean Stephan, Marie Louise Hayek, Solange Matta
United Nations Children's Fund (UNICEF): Joumana Nasser, Talal Tabikh
United Nations Development Programme (UNDP), North & Bekaa Hubs: Abdallah Muhieddine, George Akl, Mouna Ramadan, Nada Sweidan, Raghed Assi
United Nations High Commissioner for Refugees (UNHCR): Chadi Ghajar, Frederic Cussigh, Jad Ghosn, Lynne Miller, Malcolm Johnstone, Peter Okullo, Stephen Njoroge
United Nations Human Settlements Programme (UN-HABITAT): Tarek Osseiran
United Nations Inter Agency team: Anne-Marie Kerrigan-Deriche, Mohammad Mukalled, Ross Tomlinson, Vincent Dupin
World Bank (WB): Hussam Beides, Sateh Arnaout
World Food Programme (WFP): Ekram El Huni, Julia Hug, Naison Chakatsva

NON-GOVERNMENTAL ORGANIZATIONS

Arcenciel: Dominique Salameh, Myriam Mourad
Mercy Corps: Sarah Kouzi, George Antoun
Social Humanitarian Economical Intervention for Local Development (SHIELD): Samer Haydar

PRIVATE SECTOR

ECODIT: Rita Stephan
LACECO International: Nisrine Hojeiri
Lebanese American University (LAU): Charbel Mansour
MORES: Rami Nassif
Independent Land Use and Policy Expert: Raghda Jaber
Syndicate of Hospitals in Lebanon: Rita Rahbani Saad

Ministry of Environment
Lazarieh Center, Downtown Beirut
Block 02A-02B-3, Floor 7 and 8
P.O.Box: 11-2727. Beirut, Lebanon
Tel: + 961 1 976 555
Fax: + 961 1 976 535
Website: www.moe.gov.lb

For comments on this report: EASC@moe.gov.lb