



SECTION 5

ENVIRONMENTAL IMPACT ASSESSMENT



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ANNEXES TO SECTION 5

V.1 Simulations of air pollutant dispersion

V.2 Simulation of noise diffusion



5.1 Introduction

In the present section potential effects with the following environment and anthropic components are examined:

- Air
- Water
- Land
- Noise
- Landscape
- Flora, fauna, ecosystems
- Health and safety.

As already mentioned in Section III-Project description, potential interferences with environmental and anthropic components are the following:

- Air emissions
- Water use and discharge
- Land use
- Waste production
- Noise emissions
- Visual impact.



5.2 *Impacts description and assessment*

5.2.1 *Air*

INTRODUCTION

As described in Sec.3 – Project Description, air emissions are mainly due to:

- Fuel oil combustion in Hot oil unit, Pacol charge heaters, Steam boiler burners, power generators (diesel oil).

Minor contributions are due to:

- Evaporation losses from tankfarm
- LPG and waste gases combustion in flare.
- Traffic from and towards the site (about 15-20 trucks/day).

On the base of emissions values from stacks and tankfarm, assessment of main effects on air quality has been performed by applying a mathematical model in order to calculate the expected pollutant concentrations at soil level.

Comparison with present situation, in which highway traffic is presumably the principal air emission source, has been performed.

In the following, adopted methods and obtained results are described.

5.2.1.1 *Effects on air quality due to emissions from stacks and tankfarm*

The effects on air quality due to emissions from LAB site have been estimated by applying BREEZE AIR ISC3 (Industrial Source Complex) air dispersion modelling software.

There are two versions of ISC3, a short-term model (ISCST3) and a long-term model (ISCLT3), which differ in the averaging times available for calculation, available terrain and deposition options, and the format of input meteorological data.

The Industrial Source Complex (ISC3-Short and Long Term) models are used to predict pollutant concentrations from continuous point, area, volume and open pit sources. These versatile models are preferred by the Environmental Protection Agency because of the many features that enable the user to estimate concentrations from nearly any type of source emitting non-reactive pollutants.



In this case, the available meteorological data allowed to model only short term effects on air quality: BREEZE AIR ISC3 (Industrial Source Complex-Short Term) has been used.

The output file coming out from ISC3 can be used as an input file for Surfer (version 7.0) software: Surfer interpolates all grid points pollutant concentration values to work out the dispersion pollutant map. In the following picture a scheme showing software working is reported:

A) MATHEMATICAL MODEL INPUT DATA

Investigated pollutants are:

- SO₂
- NO_x
- TSP (Total Suspended Powders)
- CO

coming from LAB site three different stacks (number 1, number 3 and number 4 ^a); and

- Benzene

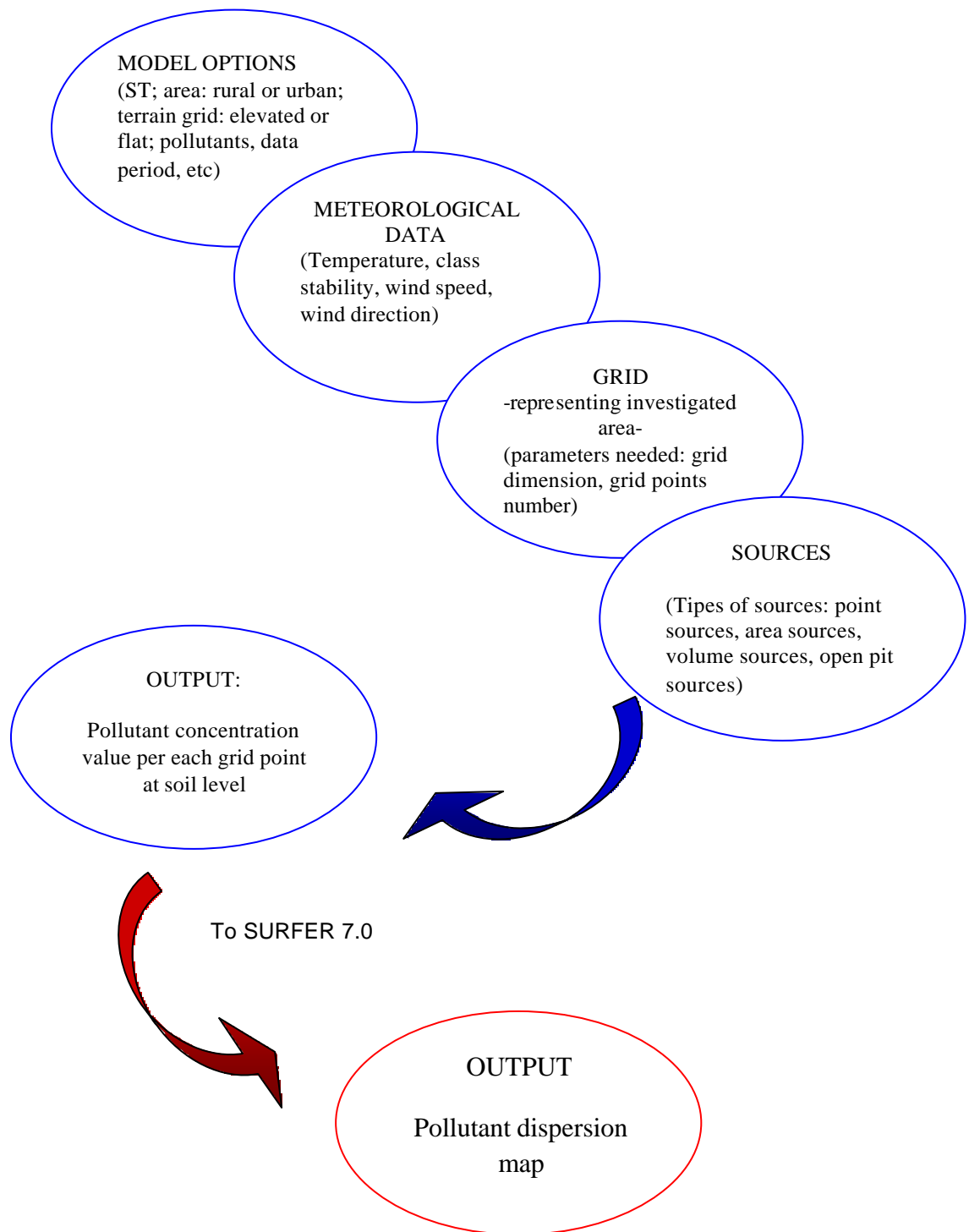
coming from storage tanks 11A/11B (see map in Annex III.4).



The investigated area (grid), centred on LAB site (exactly on stack number 1), extends for 100 km² (10km x 10 km). For calculations, investigated area was considered rural and flat. In the following table grid parameters are shown.

Axes length	X	10 km
	Y	10 km
Number of points	X	51
	Y	51
Distances between points	X	200 m
	Y	200 m
Area characteristics		Rural, flat

Total grid points number is 2601, so 2601 pollutant concentration values are given.

^a Stack number 2 has not been taken into account in the calculations, because its emission is discontinuous: 48 hours every 2 months



-  BREEZE AIR ISC3
-  SURFER 7.0



Stack emission characteristics are shown in the following table:

Stack number	Fuel cons. (kg/h)	Flow rate (Nm³/h)	SO₂ (mg/Nmc)	NO_x (mg/Nmc)	CO (mg/Nmc)	TSP (mg/Nmc)
1	1957	26800	1700.00	500.00	50.00	100.00
3	250	3500	1700.00	500.00	50.00	100.00
4	690	18800 total	28.7	100	25.00	2

SC3 input sources and emissions parameters actually used in calculations are the following ones:

Stack	Height m	Diameter m	Flue gas temp. (°C)	V (m/s) at flue-gas T	SO₂ (g/s)	NO_x (g/s)	CO (g/s)	TSP (g/s)
1	56	2.2	200	3.4	12.7	3.7	0.37	0.7
3	15	1.2	200	1.7	1.7	0.5	0.05	0.1
4	11	0.45	300	28.4	0.15	0.5	0.13	0.010

Storage tanks emission characteristics and parameters used for benzene concentration at soil level calculations are shown in the following table:

Storage tank	Total estimated Benzene annual flow (kg/years)	Benzene flow (g/sec)	Tank diameter (m)	Height (m)
11A	820	0.026	12	11
11B			12	11

On the base of existing local data (see also 4.3.1 and Annex IV.5) and previous experiences, the following meteorological conditions have been chosen:

Class of stability	Wind speed (m/s)	Wind direction
A	2.5	From WNW
D	5	
F	2.5	
	5	

The classification of atmospheric stability requested by ISC is the Pasquill-Gifford one, with A representing the most unstable class and F+G (or simply F) the most stable one.

**B) MATHEMATICAL MODEL SIMULATION RESULTS**

Results are graphically shown in **Annex V.1** as pollutant dispersion maps. Some of the most representative maps are shown in the following figures **Fig.5.1**.

Main results are summarized in the following table.

<i>Pollutant</i>	<i>Meteo conditions</i>		<i>Maximum concentration value</i>	<i>Max.concentration point distance from sources</i>
	<i>Stability class</i>	<i>Wind speed (m/s)</i>	<i>($\mu\text{g}/\text{m}^3$)</i>	<i>(meters)</i>
SO ₂	A	2.5	78	500
	D	5	58	600
	F	2.5	31	2100
	F	5	23	2100
NO _x	A	2.5	23	500
	D	5	17	600
	F	2.5	11	4500
	F	5	8	3400
CO	A	2.5	2.4	500
	D	5	1.9	1000
	F	2.5	1.6	4000
	F	5	1.1	3000
TSP	A	2.5	4.4	500
	D	5	3.4	600
	F	2.5	1.9	2100
	F	5	1.3	2100

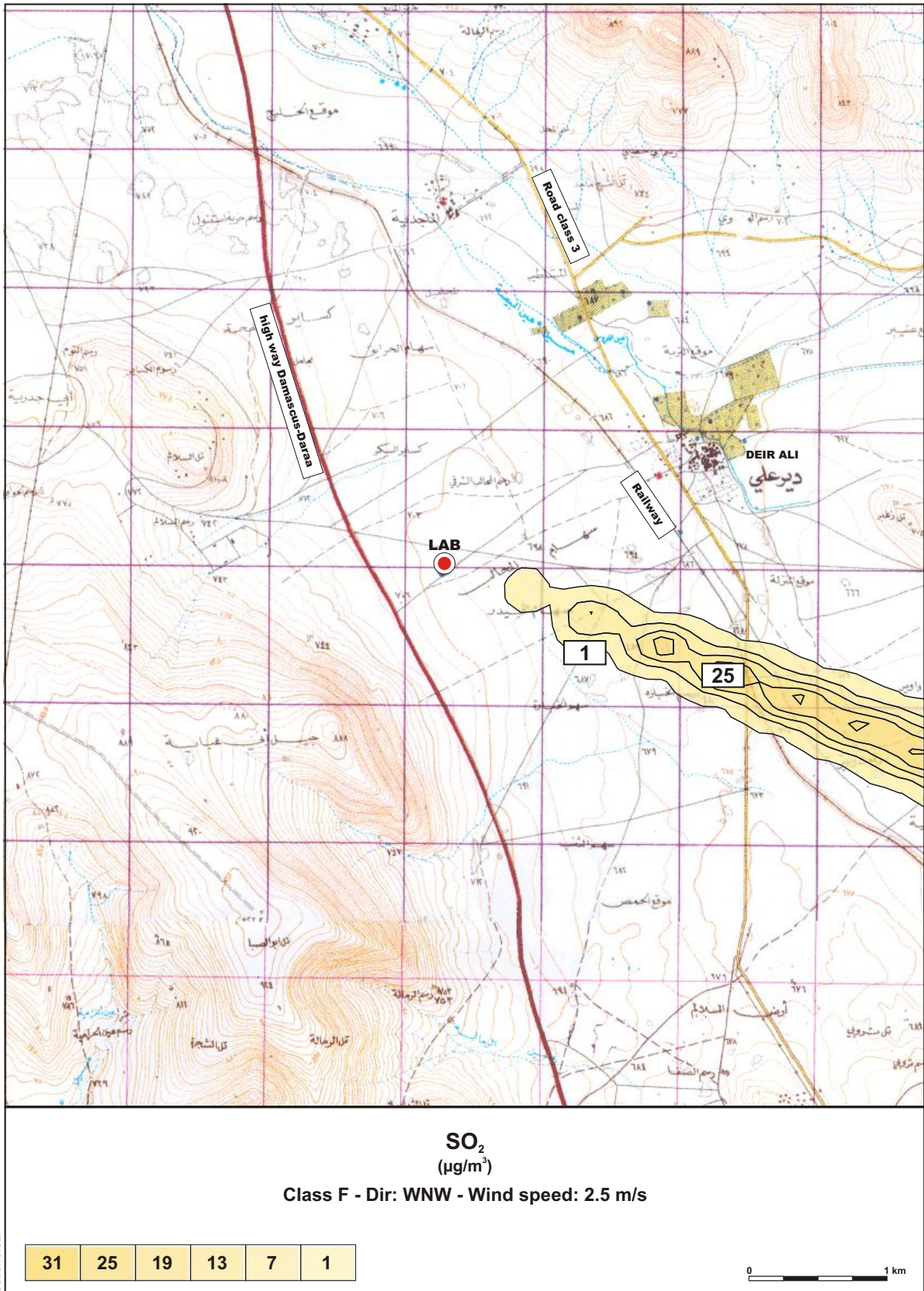


Fig. 5.1a: Pollutant dispersion maps

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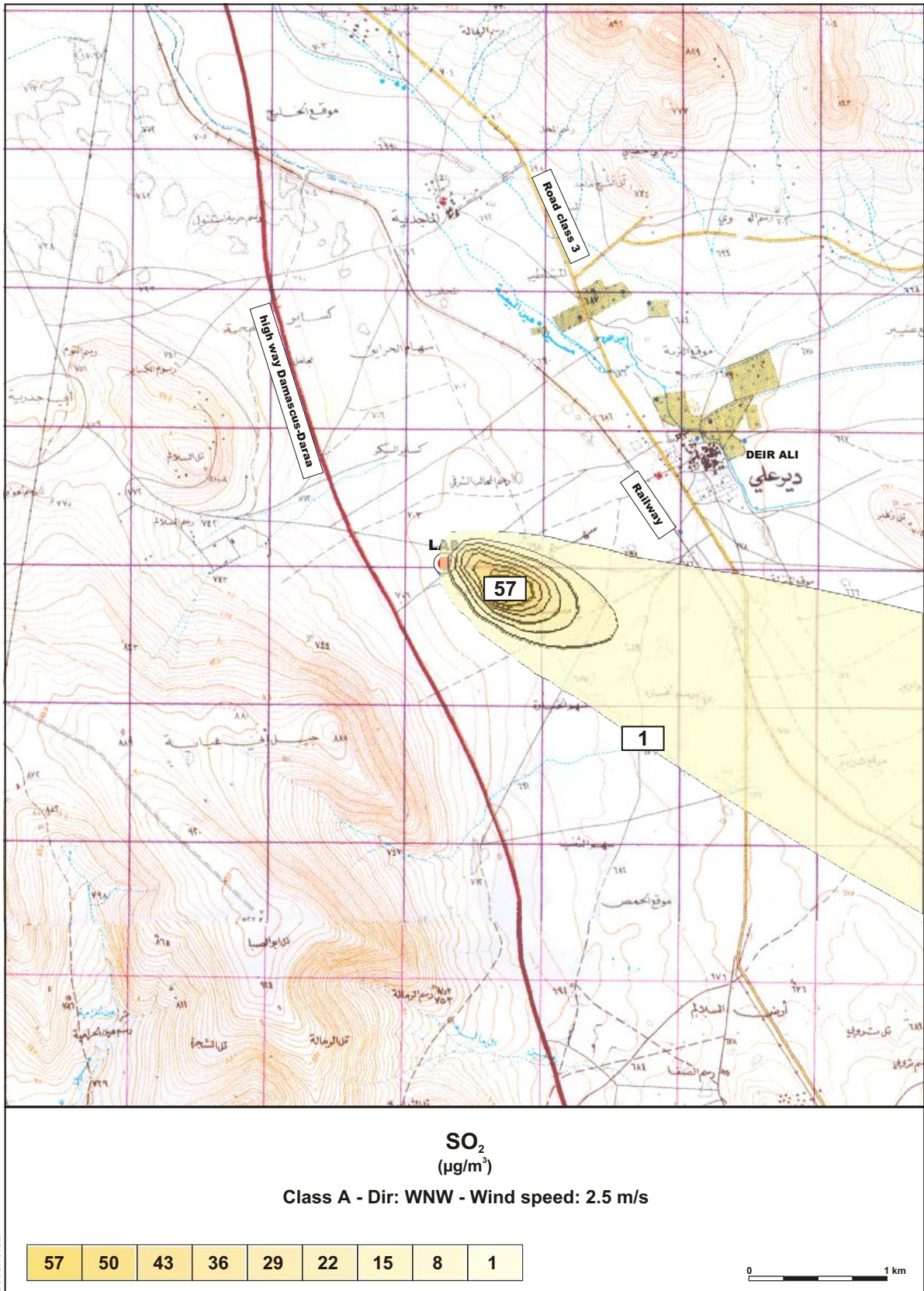


Fig. 5.1b: Pollutant dispersion maps

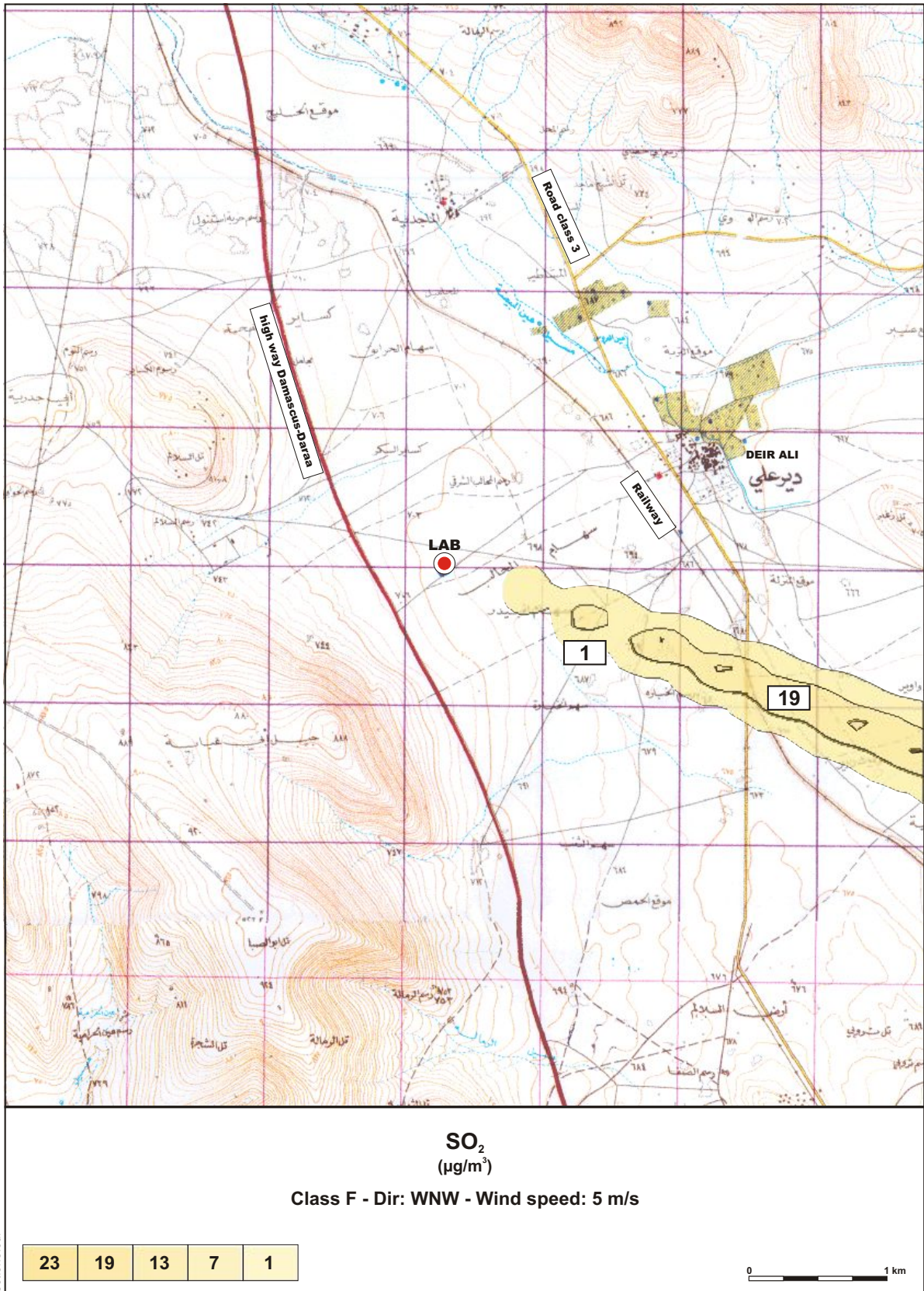


Fig. 5.1c: Pollutant dispersion maps

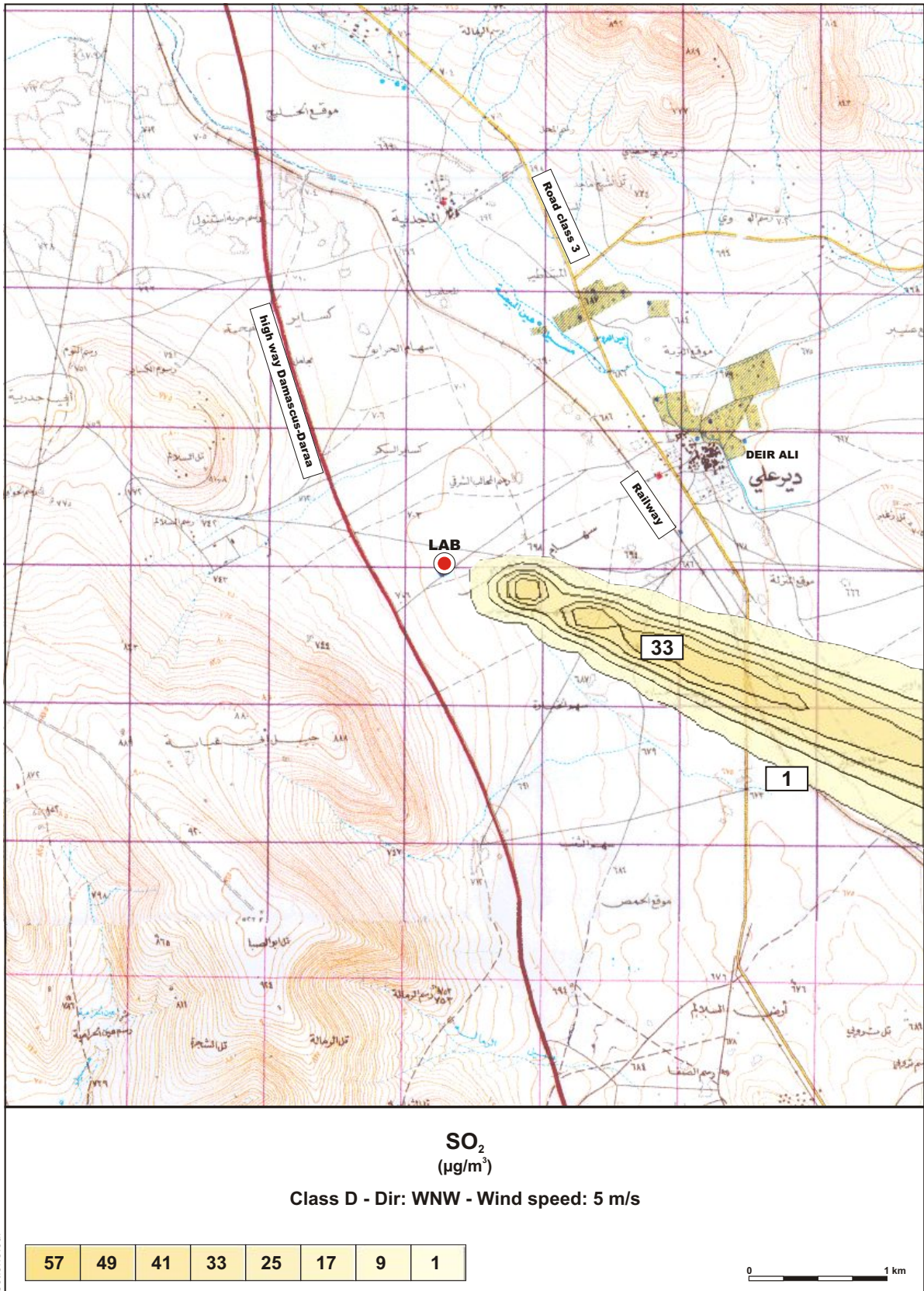
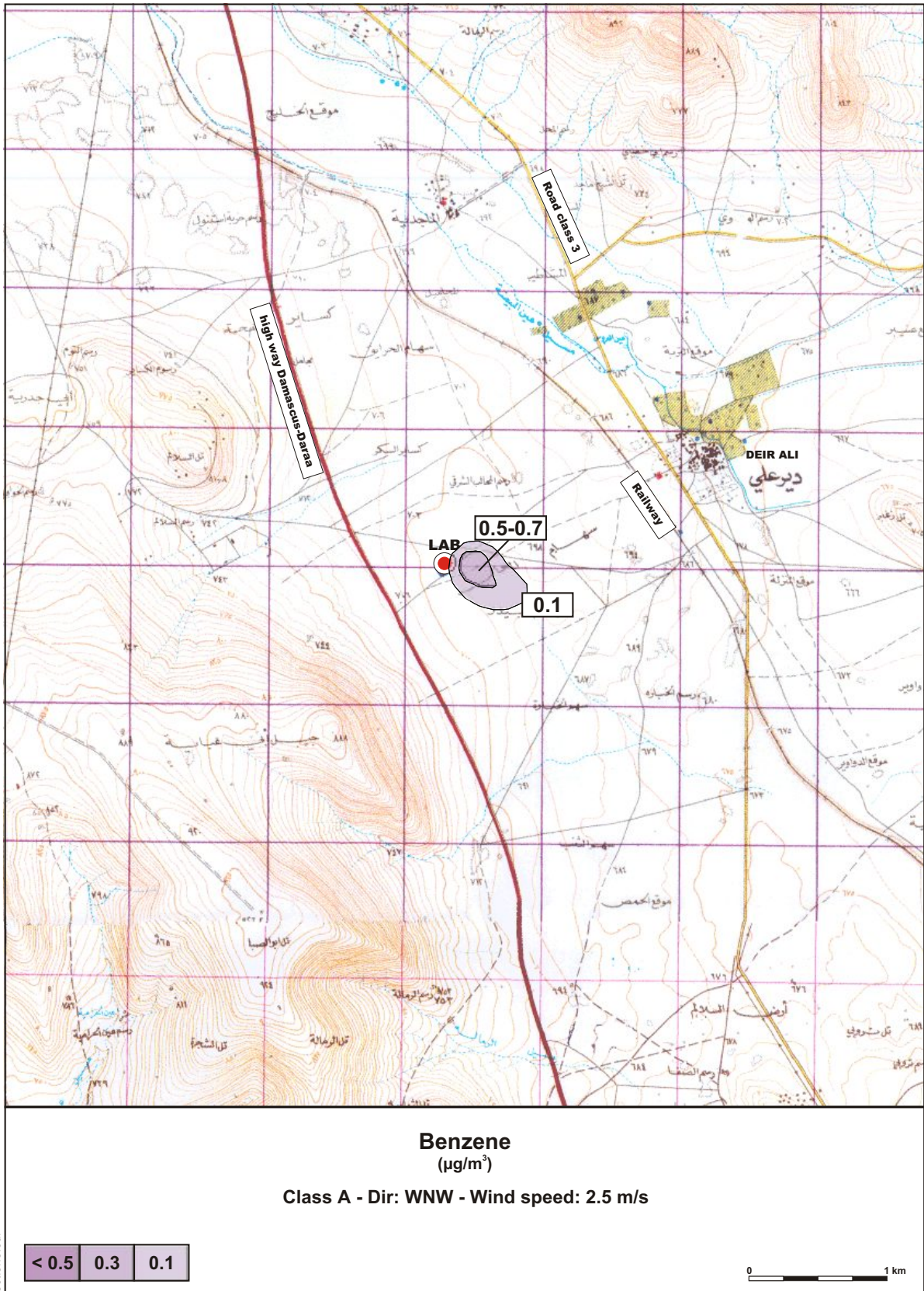


Fig. 5.1d: Pollutant dispersion maps



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Fig. 5.1e: Pollutant dispersion maps

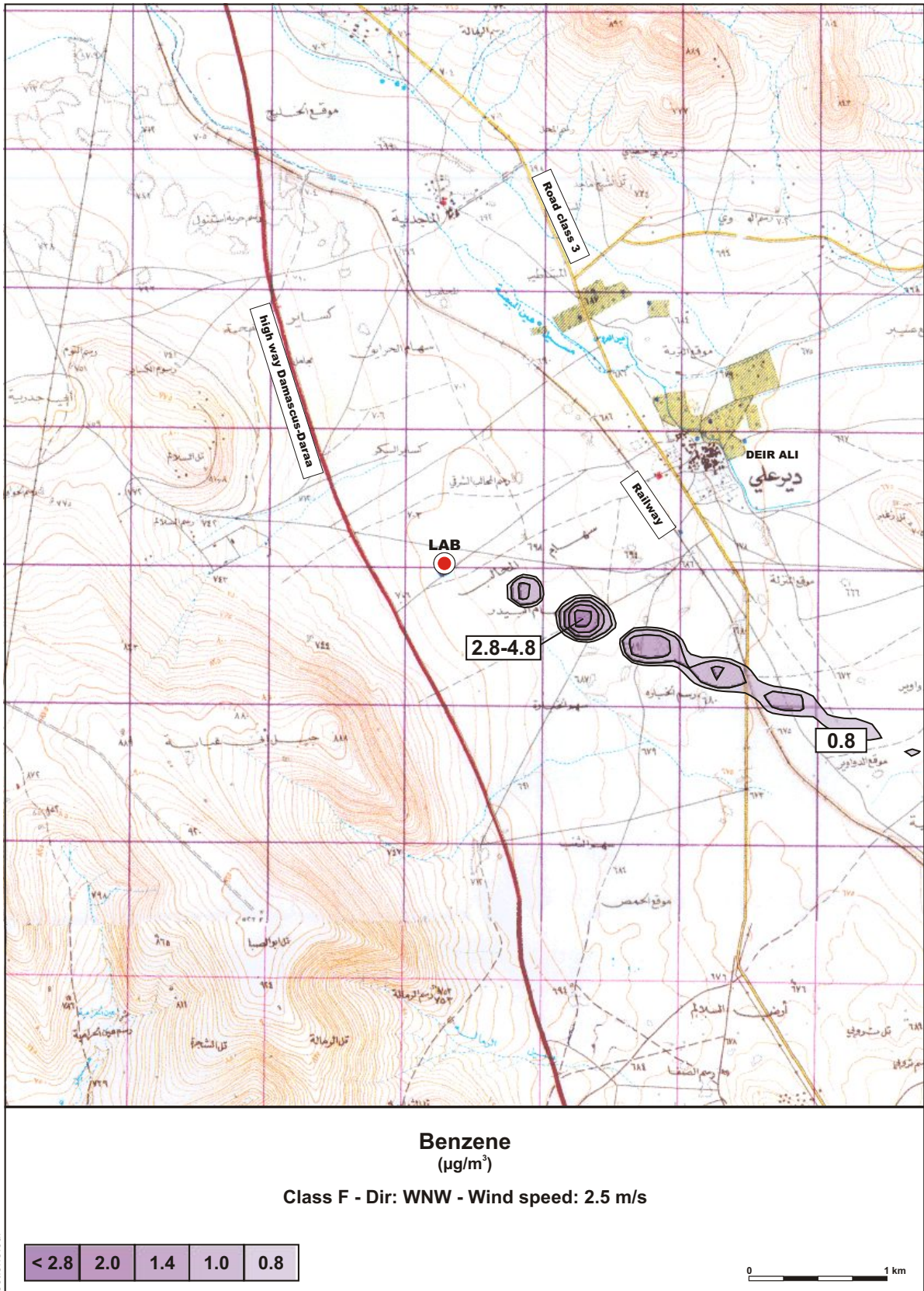


Fig. 5.1f: Pollutant dispersion maps



Some general observations can be done:

- The highest value for every pollutant is obtained, as usually occurs, in correspondence of the most unstable class (A), with maximum point position at a distance of about 500 m from sources (the lowest one);
- In neutral stability condition (class D), maximum values sensibly lower for every pollutant than in class A are obtained, with maximum point position at about the same distance (600 m from the sources);
- In stable conditions (class F) the minimum value for every pollutant is obtained, with the most far maximum point positions (from 2100 to 4500 m from the sources; the position range is due to different emission composition and velocities among the stacks).

The highest values in the maps are obtained for SO₂, due to SO₂ highest emission values.

In Class A when the absolute highest value is obtained, the area interested by significant values is small.

Deir Ali should not be interested by any effects. Taking into account eventual different direction wind that could maximize the effects on Deir Ali the values should be of magnitude 1-10 µg/ m³. Same values can be estimated in correspondence of farms, south of LAB site.

In class D, the dispersion map is longer than in class A, with values approximately equal to 30 µg/ m³ at 1-2 km distance from the sources. Taking into account eventual different direction wind that could maximize the effects on Deir Ali the values should be of magnitude 10-30 µg/ m³. Values in the range 1-10 µg/m³ or less can be estimated in correspondence of farms, south of LAB site.

In class E, the dispersion map shows that neither Deir Ali nor the farms are interested by significant values. Taking into account eventual different direction wind that could maximize the effects on Deir Ali the values should be of magnitude 10-25 µg/ m³. Values less than 1 µg/m³ can be estimated in correspondence of farms, south of LAB site.

The previous observations can be qualitatively done also for the other pollutants, but with lower concentration values.



For benzene soil concentration evaluation, in the following table the maximum values obtained for all meteo conditions are reported and in the following figure two dispersion pollutant maps are reported.

<i>Meteo conditions</i>		<i>Maximum concentration</i> ($\mu\text{g}/\text{m}^3$)	<i>Max.concentration point distance from sources</i> (meters)
A	2.5	0.7	200
D	5	1.2	450
F	2.5	4.8	1000
F	5	2.4	1000

As visible by examining the dispersion maps, in class A the emissions are rapidly dispersed and the area interested by some appreciable concentration is very small and near to the plant. In class F a longer distance (up to Deir Ali with wind from WSW) is reached by concentration values, equal or less $1.5 \mu\text{g}/\text{m}^3$.

C) COMPARISON BETWEEN PRESENT AND FUTURE SITUATION AND WITH REFERENCE AIR QUALITY VALUES

In the present situation the only significant air pollution source is the highway traffic. Its influence can be estimated as limited to some hundred meters around the road track.

So, considering that prevailing wind are WNW or in alternative W in provenience, the main effects of highway traffic should be almost exhausted in correspondence of maximum concentration points due to LAB emissions.

In this situation no significant interference or sum between the two effects, that can lead to concentration values higher than reference values, should be present.

Air quality references values, described in Sec.2, par.2.2.2.2, are reported in the following table.



<i>Air quality reference standards</i>		
Parameter	Measure time	mg/mc (T 25°C)
CO	15 min	100
	30 min	60
	1 h	30
	8 h	10
O3	1 h	0.15-0.2
	8 h	0.10-0.12
NO2	1 h	0.4
	24 h	0.15
SO2	24 h	0.125
	1 year	0.050
T.S.P.	24 h	0.120
PM 10	24 h	0.070
Benzene	1 year	0.010

The concentration values obtained by simulations are to be referred to the specific meteo conditions considered, that can change many times in a day and from day to day. The calculated values can be compared correctly to short-term reference values (1hour, 30 min): the comparison shows that the reference values are well respected for all pollutants.

For SO₂ no short term reference values is given; however the maximum calculated values are sensibly lower than the reference value for 24 hour.

Taking into account reference SO₂ value for long period (1 year) it is reasonable to suppose that mean annual concentration values, not calculated with simulations, but resulting from many different meteo conditions occurrences, among which the ones chosen for simulations are to be considered representative, could respect also mean annual reference value for SO₂. However, in inhabited areas (Deir Ali and farms) the expected values are lower than the maximum expected ones (see comments in previous point C in the present paragraph).

Benzene air quality annual values is always respected, even with meteo worst conditions.



<i>Parameter</i>	<i>Measure time</i>	<i>Reference values ($\mu\text{g}/\text{mc}$)</i>	<i>Maximum expected values ($\mu\text{g}/\text{mc}$)</i>
CO	15 min	100,000	1.1-2.4
	30 min	60,000	
	1 h	30,000	
	8 h	10,000	
O3	1 h	150-200	---
	8 h	100-120	
NO2	1 h	400	8-23
	24 h	150	
SO2	24 h	125	23-78
	1 year	50	
T.S.P.	24 h	120	1.3-4.4
PM 10	24 h	70	
Benzene	1 year	10	0.7-4.8



5.2.2 Water

Water supply

No surface water is available in the area. All the water needs are supplied by groundwater.

As mentioned in Sec.3 water consumption for LAB site is equal to 24 m³/hour (maximum), which will be supplied by five wells inside Daaboul propriety.

Remembering that main groundwater flow direction in the area is approximately from North to South, LAB site supplying should not interfere with main wells supplying present in the area (North-East of Deir Ali and near the most important inhabited centres North of LAB site, like Al-Kissweh, see also next **Fig.5.2**, already reported in sec.4).

Waste water

Industrial waste water from companies located around Damascus are typically piped or trucked to the municipal waste water treatment plant. Daaboul LAB's original permit was based on this. Due to the amounts of waste water to be trucked (up to 15 cubic meters per hour), the distance of the transport (30-40 Kilometres), as well as relative low contamination level of the waste water it was in early February 2002 decided to design and build a full waste water treatment plant on-site.

The waste water treated in the on-site plant will comply with World Bank guidelines and will be used for irrigation of new green areas within Daaboul's own premises, and/or for outside irrigations projects according to permits obtained.

The design and construction of the waste water treatment plant is delayed according to the LAB plant implementation schedule and it might, in an interim period during the commissioning, be necessary to use the municipal waste water treatment system.

5.2.3 Land

LAB project will occupy about 50,800 m². No previous use of LAB site is documented.

Soil and subsoil will be protected from contamination due to eventual leakages of hazardous materials by paving process areas and providing tankfarm with paved dikes and curbes.

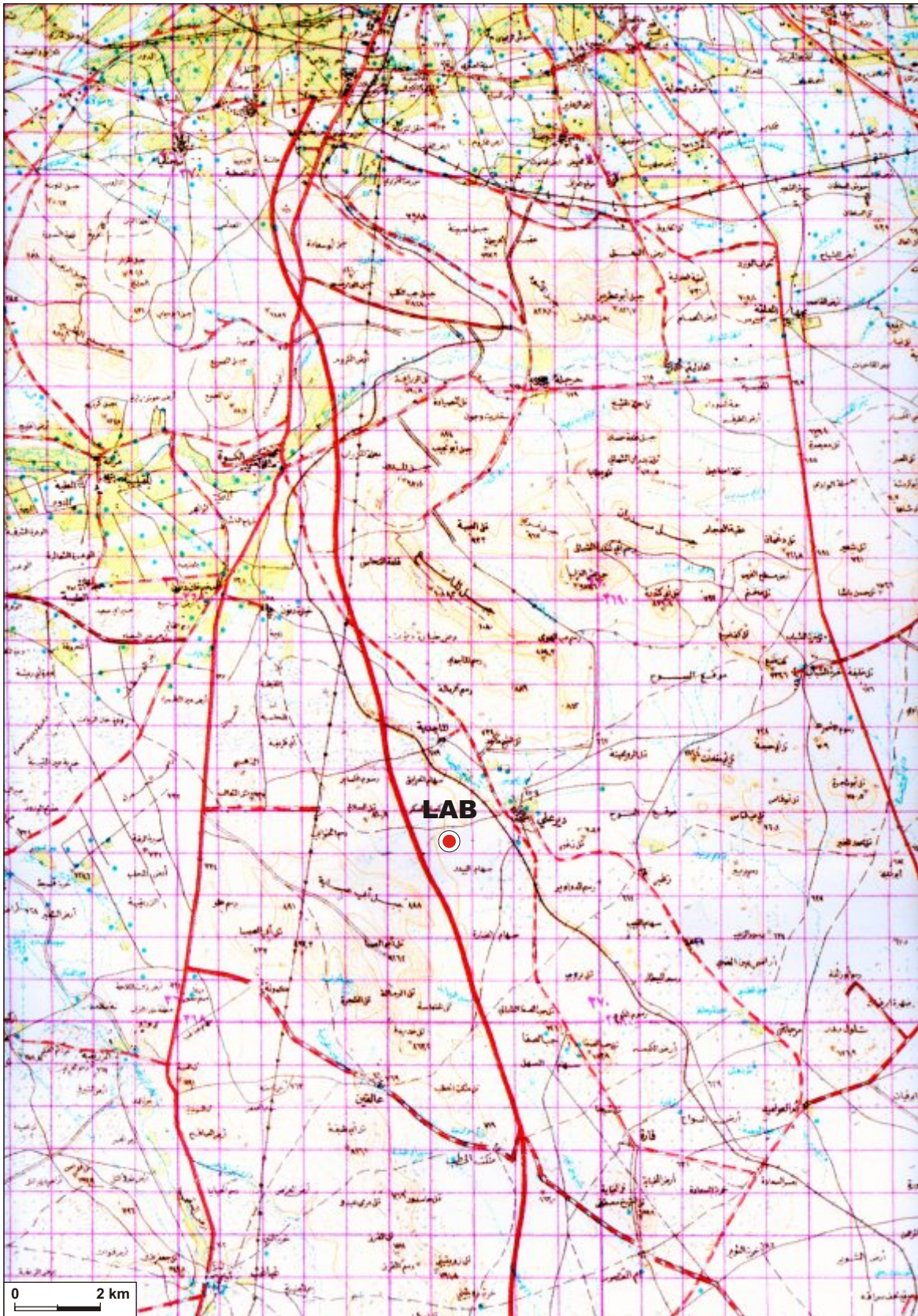


Fig. 5.2: Main wells in the area
(light blue spots)

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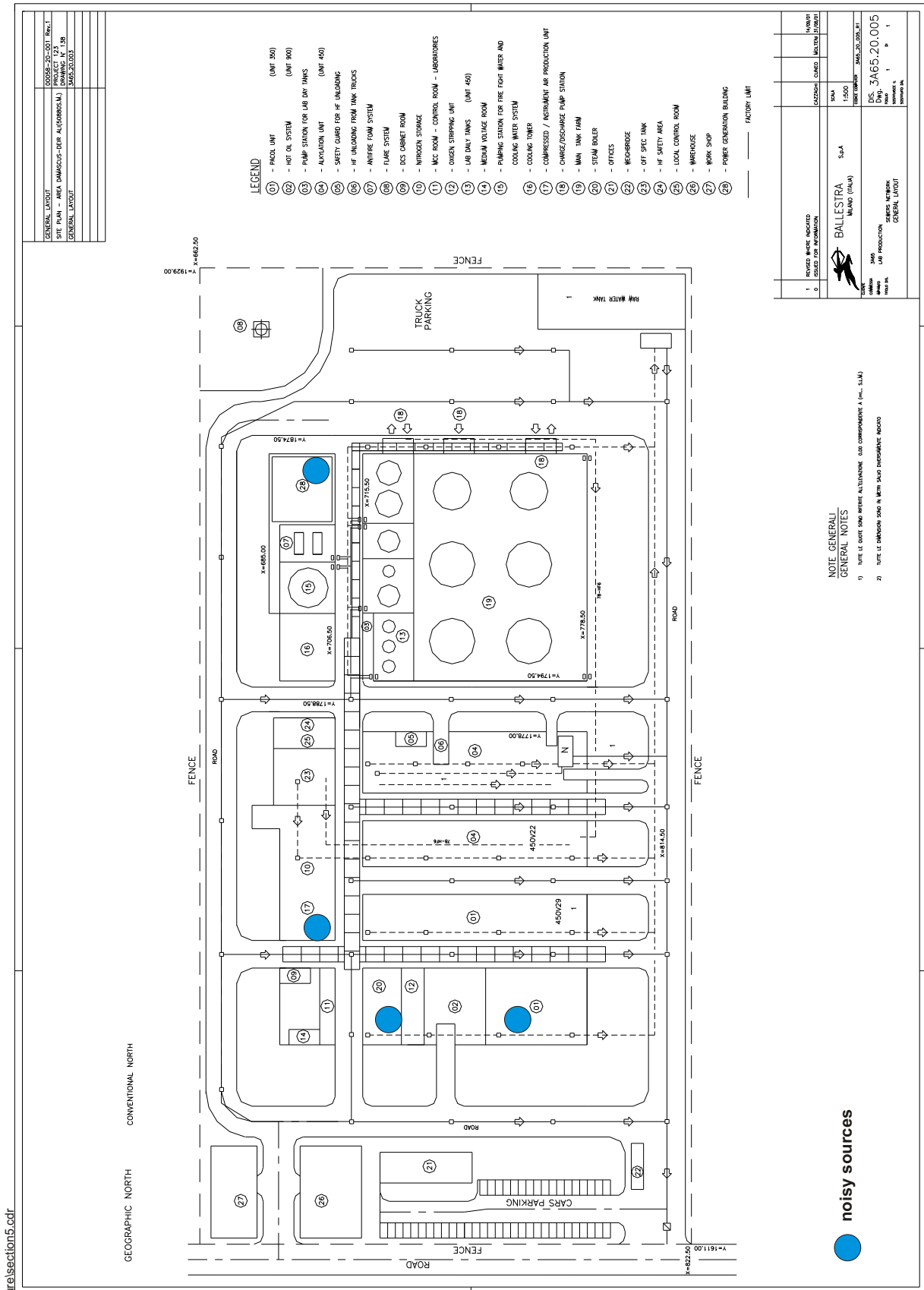


Fig. 5.3 : Location of the principal noisy sources

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5.2.4 Other components

5.2.4.1 Noise

A mathematical model has been applied in order to evaluate noise diffusion from the main sources, located inside LAB site, toward the surrounding area.

As already mentioned in Sec.3, the most noisy sources are the following ones (see also **Fig.5.3**):

- Power generators, located inside a building, near North side of LAB site, pressure level outside the building 90 dB(A);
- Steam boiler, located inside the process area, toward West side of LAB site, pressure level at 1 m distance 85 dB(A);
- Compressors, located near North side of LAB site, pressure level at 1 m distance 85 dB(A).

Raynoise, release 3.0, is the chosen mathematical model. It is designed to simulate the acoustical behaviour of any arbitrary enclosed volume, any open space or a combination of both. It takes into account wall absorption and air absorption, diffraction across screens and transmission through walls. The core of the model is a hybrid algorithm combining the Mirror Image Method and the Ray Tracing Method.

In order to apply the mathematical model, sources acoustic power has been calculated.

A calculation grid has been chosen, 2080 m long and 1840 m large, with grid steps equal to 80 m. Inside the grid the *receptors* nearest to LAB site are present: the farms near (250 m) the south side and the ceramic factory near (700 m) the north side.

RESULTS

Raynoise application (see also Input/Output files in **Annex V.2**) led to the following results, illustrated in a map (**Fig.5.4**) where equal sound pressure level (L_{ep}) ranges are reported in different colours:

- the highest values are obtained in front of the power generator building (North side), with L_{ep} of about 65 dB(A) and a maximum value of 70 dB(A); values are rapidly decreasing, along north side, with increasing distance from that building, up to under 60 dB(A) near the North-East corner;

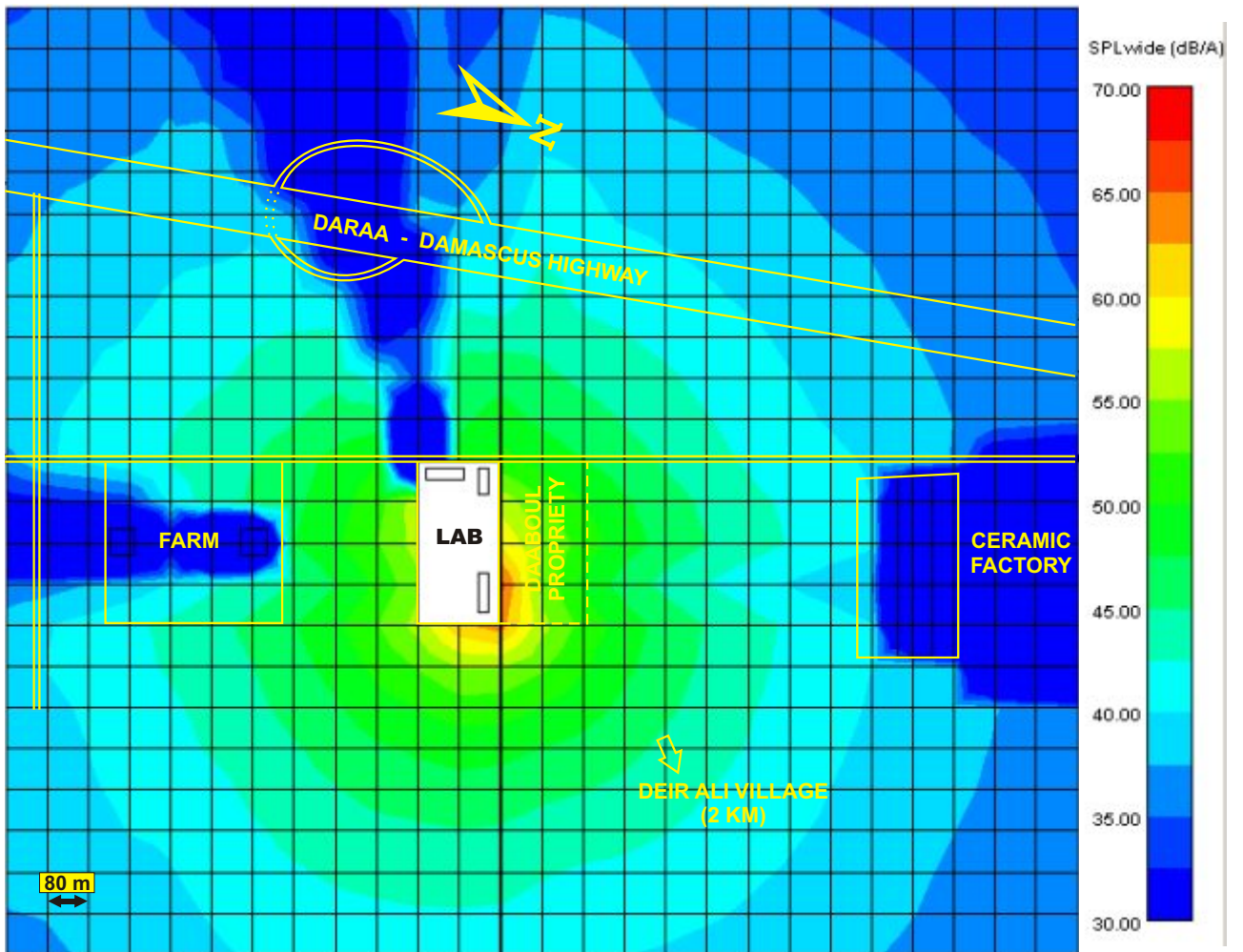


Fig. 5.4 : Sound pressure lines in dBA



- along East side the maximum value is 57 dB(A), along South side the maximum value is about 55 dB(A), along the East side values rang from 55 to 70 (again near power generator building);
- Lep near the *receptors* is approximately 30 dB(A).

Comparison with existing situation shows that with plant operating no sensible differences in noise levels, due to continuous sources, should be present. In fact noise from existing sources (highway traffic) is estimated in about 60 dB(A) at the receptors (see Sec.4, par.4.3.3.1).

Comparing the results obtained with guideline indications (see Sec.2, par.2.2.2.3) the reference value of 70 dB(A) for industrial zones is respected and the reference values for residential zone, 55 dB(A) during the day and 45 dB(A) in the night are respected.

5.2.4.2 Landscape

In the following figures, some photographs of LAB site, with yard activities now in progress and the principal structures already visible, are reported (**Fig.5.5**).

In **Fig.5.6** a wide view of LAB site from the highway is shown:

- on the left side, quite far, the Ceramic factory is visible,
- in the middle, LAB site is visible,
- on the right side the farms are visible.

In LAB site the highest structures (process units and equipments) are in the West zone (toward the highway).

The new plant, even if it is a 'greenfield' one, is not the first industrial structure in the area.

Its visibility is mainly limited to the immediate surroundings, being the area plain for a long extension along North-South direction and for 1.5-2 kilometres from the site along East-West direction.

Existing landscape don't present features of particular value which can be disturbed by the new plant introduction.



5.2.4.3 *Flora and fauna, ecosystems*

As mentioned in sec.4 no particular vegetal or animal species are present in the area. As clearly visible from photographs previously shown in the present section and also sec.4 (4.3.3.2) LAB site is located in a desert, partially rocky area.



Fig. 5.5a: Plant work progress and principal structures



Fig. 5.5b: Some details of Bulgarian plant

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Fig. 5.6: Visual impact of LAB site



5.3 Impact assessment synthesis

In the following table main issues of environmental impact assessment is summarized.

Environmental Factor/ Component	Main Project Interference with Environment	Notes on Impacts
Air	<p>Air emissions from fuel oil combustion.</p> <p>Organic substances evaporation losses from tanks.</p> <p>Minor contributions due LPG and waste gases combustion in flare.</p> <p>Minor contributions from traffic from and towards the site (about 15-20 trucks/day).</p>	<p>Increase of pollutant emissions in the area.</p> <p>Pollutant concentrations at soil level due to new emissions from main sources (stacks, tankfarm) will be lower than the following:</p> <p>Syrian guideline values: SO₂ < 125 µg/m³ (24 hours) < 50 µg/m³ (1 year) NO₂ < 150 µg/m³ (24 hours) < 400 µg/m³ (1 year) CO < 10 mg/m³ (8 hours), European limit for Benzene: < 10 µg/m³ (1 year) and World Bank guidelines: T.S.P < 70 µg/m³ (24 hours) PM₁₀ < 50 µg/m³ (24 hours).</p>
Water	<p>Groundwater use mainly for cooling towers and demineralisation operations.</p>	<p>Increase in groundwater use.</p> <p>Main groundwater flow direction in the area is approximately from North to South; LAB site supplying should not interfere with main wells supplying already present in the area (Deir Ali, Al Kissweh)</p>
	<p>Waste water discharges</p>	<p>A comprehensive wastewater treatment plant will be built on-site. The wastewater treated in the on-site plant will comply with World Bank guidelines and will be used for irrigation of new green areas within Daaboul's own premises, and/or for outside irrigations projects according to permits obtained.</p>



Environmental Factor/ Component	Main Project Interference with Environment	Notes on Impacts
Waste production	Calcium Fluoride sludge production (from neutralization basins). It could be recovered in external factories. Exhausted catalysts can be completely recovered by the Suppliers.	No impact in disposal plant if a complete waste recovery is done.
Noise	Noise emissions from some equipments (compressors, furnaces, power generators). Minor contributions from traffic from and towards the site (about 15-20 trucks/day).	No sensible noise impact is expected at receptors (farms, ceramic factory) nearest to LAB site.
Land use Soil and Subsoil	Occupation of about 50,800 m ² . Incidental leakages are collected by pavements and sewer networks in process area. In tankfarm, paved dikes and curbs are provided for incidental leakages containment.	No previous use of the site is documented. Soil contamination is prevented by adequate soil paving and proper operation.
Landscape	The plant is a greenfield one. Next to it another industrial plant is already present.	Existing landscape don't present features of particular value which can be disturbed by the new plant introduction. Its visibility is mainly limited to the immediate surroundings.
Flora and Fauna, Ecosystems	The site area is a rocky debris one. No vegetal associations or fauna species are present.	No impact is expected.