CHAPTER 11

Compliance of the Maltese Air Monitoring Network with the National and European Air Quality Legislation

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Introduction

This article summarises the results of an evaluation performed to the air monitoring network of Malta in 2012 where the following elements were evaluated in comparison with national and European legal requirements: the classification of zones and agglomerations in the island, the number, type and location of fixed monitoring stations, the data reporting and the reference methods used for the analysis of parameters.

Legislation Framework

The Directive 2008/50/EC is the most important European law together with the Directive 2004/107/EC relating the Arsenic, Cadmium, Mercury, Nickel and Benzo(a) pyrene that remains in force. Directive 2008/50/EC provides common standards and standardiseised measurement techniques at European level for the assessment of air quality and establishment of different zones that help identify dimensions and characteristics of ecosystems and populations subject to air pollution and also to predict magnitude and duration of exposure. The limit and target values for the concentration of ozone have not changed from Directive 2002/3/EC. The Maltese national legislation on air quality and emission control of pollutants transposes both European Directives to the Maltese regulation L.N. 478/2010.

The law is structured by defining three groups of pollutant which respectively correspond to:

- Group A of pollutants: pollutants of Directive 2008/50/EC except ozone (meaning sulfur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM10 and PM2.5), lead, benzene and carbon monoxide;)
- Group B of pollutants: pollutants regulated by Directive 2004/107/EC except polycyclic aromatic hydrocarbons (Arsenic, Cadmium, Nickel and Benzo(a) pyrene;)
- Group C of pollutants: polycyclic aromatic hydrocarbons regulated by 2004/107/CE.Theme i / II, etc

Air Monitoring Network in Malta

The ambient air monitoring in Malta is formed by two networks: fixed stations (Gharb, Msida, Zejtun, Kordin and Attard) and diffusion tubes (about 134 monitoring sites). Figure 1shows the spatial locations of all the sampling points. Both the networks are managed by MEPA (i.e. Air Quality Unit) which is constituted by an air quality manager and four technicians.

The current network was analysed and compared the minimum requirements of representativeness (number and location of sampling stations, pollutants monitored, delineation of agglomeration, data capture and reference methods) established by the L.N.478/2010. The methodology and results of this evaluation is detailed in the sections below.

Maltese Agglomeration and Zone Classification

Based on the first requirements established by the Directive 2008/50/EC, as well as by the L.N. 478/2010, the competent authority shall divide the entire territory in zones and agglomerations. In Malta, this assessment was performed by Stacey and Bush (2002) and published in August 2002 through the document Preliminary Assessment of Air Quality in Malta, which complies with the legislation that was in force at the time (Council Directive 96/62/EC and subsequent Daughter Directives).

To delineate the agglomeration, Stacey and Bush (2002) applied a 100 m buffer around all the continuous urban areas present on the Maltese islands, in such a way that, the urban areas distant from each other more than 200 m, will not be encountered within the main agglomeration.

Stacey and Bush finally identified two main distinct zones in Malta:

- Valletta and Sliema agglomeration that include the main urban and industrial centres present in Malta
- Maltese zone: the rest of the territory not falling under the agglomeration

The Figures 1 and 2 show the classification performed by Stacey and Bush in 2002.

Figure 1: Urban areas with an indication of the 100m buffer zone made by Bush and Stacey for the identification of the main agglomeration

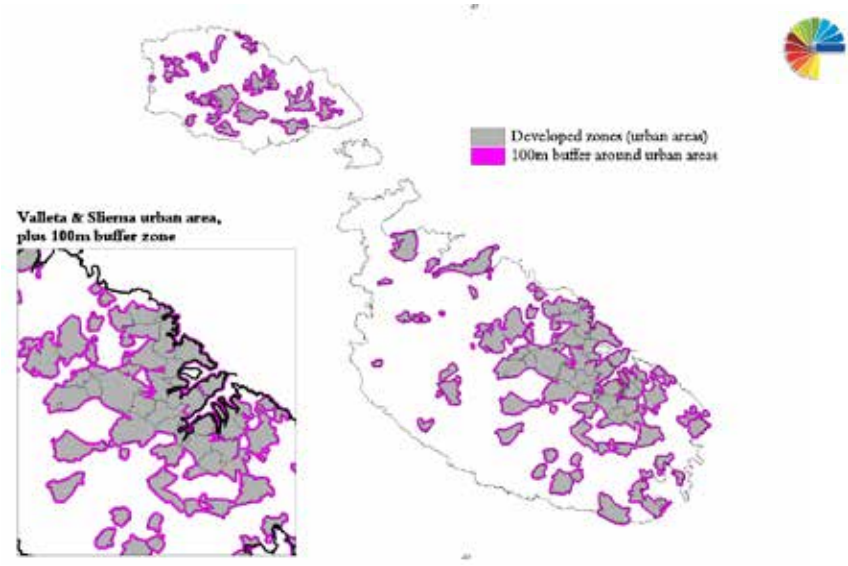
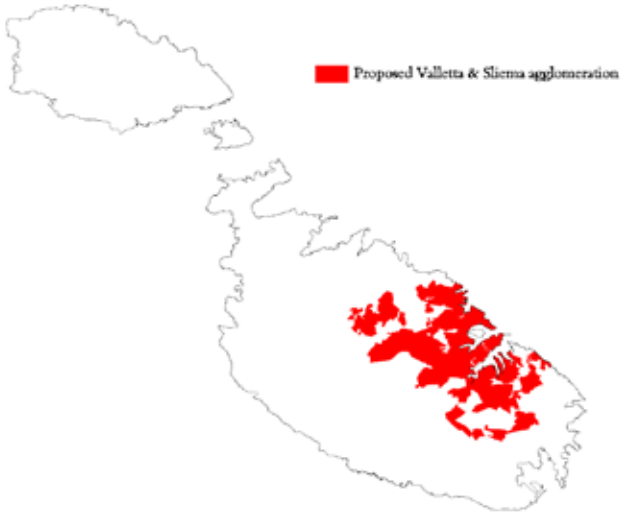


Figure 2: Final extension of the Valletta & Sliema agglomeration



Source: Stacey & Bush, (2002)

Type and Number of Stations

According the European Directives, there are two variables that determine the type of station to be established: type of area and emission

Type of area:

- Urban area: continuously built-up meaning complete (or at least highly predominant) building-up of the street front side by building with at least two floors;
- Suburban: largely built-up urban area. 'Largely built-up' is defined as contiguous settlement of detached buildings of any sise with a building density less than for 'continuously built-up' area; and
- Rural area: all areas that do not fulfil the criteria for urban or suburban areas. Rural areas can be subdivided further, based upon the distance to major sources or source areas:

o Near city area: within 10km from the border of an urban or suburban area (there is one only found in Malta);

o Regional area: 10-50 km from major source areas; and

o Remote area: >50 km from major source areas.

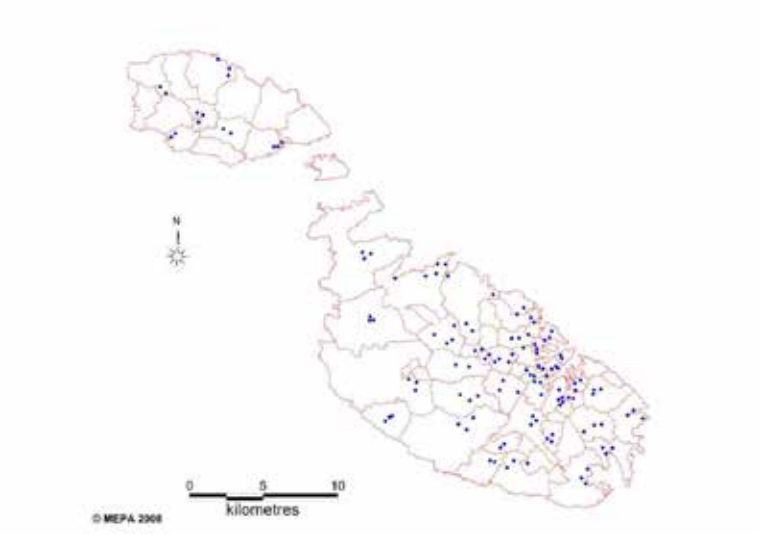
Types of station in relation to dominant emission sources:

- Traffic: located such that its pollution level is determined predominantly by the emission from nearby traffic (roads, motorways, highways);
- Industrial: located such that its pollution level is influenced predominantly by the emission from nearby single industrial sources or industrial areas with many sources; and
- Background: located such that its pollution level is not influenced significantly by any single.

The actual Maltese fixed stations network is based on the preliminary air quality study made by Stacey and Bush in 2002 and analysed during the project 'Developing National Environmental Monitoring Infrastructure and Capacity'. The classification, performed by Stacey and Bush in 2002, was based on data obtained on indicative measurements obtained from short term automatic campaigns, which took place in 21 traffic stations by using mobile laboratories between 1999 and 2001 and from the results of diffusive samplers campaign carried out between 2000 and 2001 in 28 different types of stations (traffic, urban, urban background).

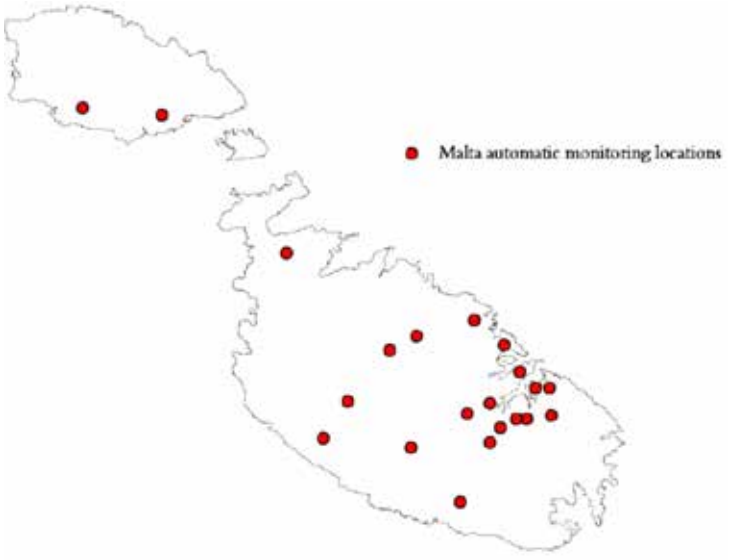
The locations of the indicative measurements and diffusion tubes are shown in the Figures 3 and4.

Figure 3: Malta diffusion tube network



Source: Mepa.org.mt, 2017

Figure 4: Malta automatic monitoring locations



Source: Stacey & Bush, (2002)

The results of the monitoring campaigns are summariseised below:

- Nitrogen dioxide: Exceedances of the Upper Assessment Thresholds (UAT) were obtained both from the diffusion tubes campaigns, (annual averages) and from the automatic monitoring (hourly averages) in the Maltese Zone and in the Valletta & Sliema Agglomeration. According to the legislation in force at that time, monitoring of nitrogen dioxide for the protection of human health was necessary in both the zones. Precisely, the recommendation results from this preliminary assessment were:
    - Two fixed NO2 monitoring stations are required within the Valletta and Sliema agglomeration; and
    - One fixed NO2 monitoring station is required within the Malta zone.
    - Benzene: Exceedances of the Upper Assessment Threshold (UAT) were obtained both from the diffusion tubes campaigns, (annual averages) and from the automatic monitoring (hourly averages) in the Maltese Zone and in the Valletta & Sliema Agglomeration. According to the legislation in force at that time, monitoring of benzene dioxide for the protection of human health was necessary in both the zones. Precisely, the recommendation results from this preliminary assessment were:
    - Two fixed Benzene monitoring stations are required within the Valletta and Sliema agglomeration; and
    - One fixed Benzene monitoring station is required within the Malta zone.
- Sulphur dioxide: Exceedances of the UAT were obtained only in the agglomeration and only from the automatic monitoring data since the limit value for this pollutant was based on the hour concentration; because of this, the diffusion tubes could not be used for this assessment. However, high concentration values were also measured in the Maltese Zone, on an annual basis, by using the diffusion tubes. The conclusion of this assessment suggested that, for the protection of human health, monitoring of this pollutant was necessary in both zones. Precisely, the recommendation results from this preliminary assessment were:
    - Two fixed SO2 monitoring stations are required within the Valletta and Sliema agglomeration; and
    - One fixed SO2 monitoring station is required within the Malta zone at a point identified as the location of maximum ground level concentration arising from Marsa power station.
- PM10: Exceedances of the UAT were obtained from the automatic monitoring station through the automatic beta-attenuation technique. Exceedances were recorded both in the Maltese zones and in the Valletta & Sliema Agglomeration. The recommendation results from this preliminary assessment were:

    - Two fixed PM10 monitoring stations are required within the Valletta and Sliema agglomeration; and
    - One fixed PM10 monitoring station is required within the Malta zone at a point identified as the location of maximum ground level concentration arising from Marsa power station.
- Lead: the necessity to monitor lead was estimated according to the Maltese inventory of pollutant emission, since data on this pollutant was not available at that time. A pro capita rate of lead emission was estimated and it resulted 300% greater than the rate estimated in UK. Moreover, the presence of many emission sources for lead (e.g. prevalence of cars fuelled by leaded petrol), recommended to install monitoring sites in both Valletta & Sliema Agglomeration and Maltese Zone. The conclusions of this assessment were:
    - Two fixed lead monitoring stations are required within the Valletta and Sliema agglomeration; and
    - One fixed lead monitoring station is required within the Malta zone.
- Carbon monoxide: Exceedances of the UAT were obtained, by using automatic infrared absorption monitor, in Valletta and Sliema agglomeration. However, the Maltese inventory of emissions showed a pro capita rate of emission of the pollutant greater that the rate recorded in the rest of Europe and particularly in UK. Thus, considering also the lack of long-term fixed monitoring within the Malta zone, it is proposed that, monitoring for the protection of human health is also required within this zone. The conclusions of this assessment were:
    - Two fixed CO monitoring stations are required within the Valletta and Sliema agglomeration
    - One fixed CO monitoring station is required within the Malta zone
- Ozone: From the indicative measurements provided by the diffusive sampler network, this assessment concluded that, given the magnitude of the annual average data measured, an exceedance of the Long-Term Objective (LTO) for ozone (8-hour average) is possible within both in the Valletta and Sliema agglomeration and the Malta zone. So, the Ozone monitoring was considered necessary in both the zones:
    - One fixed ozone monitoring stations is required within the Valletta and Sliema agglomeration at an urban background/suburban location; and
    - One fixed ozone monitoring station is required within the Malta zone at a suburban or rural location.

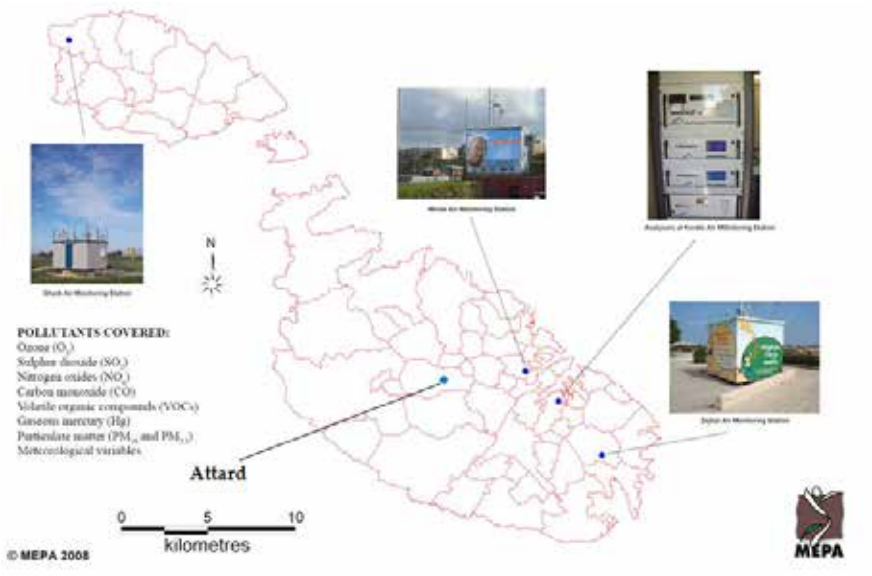
In accordance with the preliminary assessment study recommendations, suitability for installation and own judgment, MEPA identified five locations where to install fixed real-time monitoring stations. Tables 1 to 3 report the classification of each station according to the Directive 2008/50/EC and the monitored parameters.

Table 1: Classification of the real-time monitoring stations in Malta

	NAME OF THE STATION	*CLASSIFICATION OF STATIONS*
VALLETTA/SLIEMA AGGLOMERATION	Msida	Traffic location
	Żejtun	Suburban background
	Attard	Urban background
	Kordin	Urban industrial: (Point of max ground level concentration for plume from Marsa power station)
MALTA ZONE	Għarb	Rural background

Source: Stacey & Bush, (2002)

Figure 5: Location of the real-time monitoring stations in Malta



Source: Mepa.org.mt, 2017

Table 2: Monitored parameters at Valletta & Sliema Agglomeration

Żejtun	***Attard***
Monitored parameters	*Monitored parameters*
PM_{10} and $PM_{2.5}$	O_3
SO_2	
$NO\text{-}NO_2\text{-}NO_x$	
O_3	
CO	
Metals (Ni, Cd, Pb, As)	
Metal (Hg)	
VOC	
PAHs	

Msida	***Kordin***
Monitored parameters	*Monitored parameters*
PM_{10} and $PM_{2.5}$	PM_{10}
SO_2	SO_2
$NO\text{-}NO_2\text{-}NO_x$	$NO\text{-}NO_2\text{-}NO_x$
O_3	O_3
CO	CO
Metals (Ni, Cd, Pb, As)	Metals (Ni, Cd, Pb)
VOC	
PAHs	PAHs

Source: Mepa.org.mt, 2017

Table 3: Monitored parameters at Maltese Zone

Gharb
Monitored parameters
PM_{10} and $PM_{2.5}$
SO_2
$NO\text{-}NO_2\text{-}NO_x$
O_3
CO
Metals (Ni, Cd, Pb)
Metal (As)
Ions
EC and OC
VOC

Source: Mepa.org.mt, 2017

Air Quality Assessment, Data Capture and Minimum Number of Sampling Points required

According to Regulation 8(2) of L.N.478/2010 "classification of the zones shall be reviewed at least every 5 years", Malta might not be in full compliance with the legislation requirements, however the following aspects have to be considered:

- The population of the Valletta & Sliema agglomeration and Maltese zone has been estimated in 2011 to be well below the threshold of 250,000 inhabitants (source MEPA personal communication) ; and
- The number of fixed stations are more than the minimum requirements for the current population, even considering the worst case scenario (max. concentrations > UAT).

In order to optimise the Maltese air monitoring network, a preliminary analysis of the pollutant levels measured by all the fixed stations in the past 5 years (2008 – 2011) was performed, as required by the law.

The main consideration, after this preliminary evaluation of the data collected by all the fixed stations, is that the minimum data capture, as defined by the directive for each pollutant, is almost never reached.

Table 4 depicts the respective thresholds for measurements in fixed sites are listed:

Table 4: Minimum data capture for the pollutants monitored

Compound	*Data capture (%)*
Sulphur dioxide	90
Nitrogen oxides	90
Carbon monoxide	90
Benzene	90
PM10 and PM2.5	90
Ozone	90 (summer) and 75 (winter)
Benzo[a]pyrene	90

Source: Mepa.org.mt, 2013

During the period 2008-2011, the percentage of valid data was calculated for each pollutant specified in the Directives.

Table 5: Data Capture by station between 2008-2011)

	Year	*PM10*	*PM2.5*	*NO2*	*SO2*	*Benzene*	*CO2*
GHARB	2008	85%*	89%*	89%*	97%	74%*	61%*
	2009	38%*	28%*	76%*	76%*	55%*	42%*
	2010	89%*	81%*	84%*	90%	76%*	95%
	2011	96%	93%	97%	87%*	84%	49%*
MSIDA	2008	65%*	83%*	33%*	65%*	64%*	72%*
	2009	86%*	86%*	56%*	81%*	89%*	86%*
	2010	93%	81%*	86%*	60%*	63%*	40%*
	2011	73%*	79%*	90%	53%*	63%*	79%*
ŻEJTUN	2008	42%*	27%*	21%*	64%*	69%*	48%*
	2009	88%*	67%*	-	63%*	86%*	58%*
	2010	88%*	86%*	-	75%*	69%*	4%*
	2011	61%*	87%*	90%	25%*	-	87%*
KORDIN	2008	-	89%*	-	-	-	-
	2009	50%*	28%*	49%*	42%*	-	69%*
	2010	11%*	81%*	69%*	39%*	-	63%*
	2011	49%*	93%	96%	60%*	66%	93%

Source: Mepa.org.mt, 2013

Table 6: Ozone data captures in the fixed stations over the period 2008-2011

	Ozone	
	Year	*% Valid data*
GHARB	2008-2010	90%
MSIDA	2008-2010	90%
MSIDA	2009-2011	80%*
ŻEJTUN	2008-2010	92%
ŻEJTUN	2009-2011	81%*

Source: Mepa.org.mt, 2013

As can be noticed from Tables 5 and 6, the minimum data capture was not met for the majority of the pollutants, and in some cases, the percentage of valid data was very low (When the minimum data capture is not reached, the value is marked with an upper asterisk). Nonetheless, it is noticed a good improvement of the number of valid data in the last few years, especially in 2011. This consideration cannot be done for group B pollutants since no data are available for 2011.

However, analysis of the LAT, UAT and LTO was carried out in the Table 7 to have at least an indicative overview of the air quality in Malta in the most recent period

Table 7: Summary classification of zones and agglomerations on the basis of Lowest Assessment Threshold (LAT)T and UAT

	VALLETTA & SLIEMA AGGLOMERATION	*MALTESE ZONE*
GROUP A		
SO2	<LAT	<LAT
NO2	>UAT	<LAT
PM10	>UAT	>UAT
PM2,5	>UAT	LAT<value<UAT
PB	<LAT	<LAT
BENZENE	LAT<value<UAT	<LAT
CO	<LAT	<LAT
GROUP B	<LAT	<LAT
OZONE	>LTO	>LTO

Source: Mepa.org.mt, 2013

From Table 7, a compliance analysis is carried out to evaluate whether the minimum sampling points requirement is actually fulfilled or not (Table 8) Considering the poor dataset obtained from the fixed stations in the past 5 years, the worst case scenario was taken, i.e. the UAT are exceeded for all the pollutants in both zones. The other input information for the determination of the minimum number of fixed stations is the population, (is below the 250,000 inhabitants both in the Valletta and Sliema agglomeration and Maltese zone) in accordance with the last demographic survey performed in 2011 by MEPA.

Table 8: Comparison between the minimum numbers of sampling points (L.N.478/2010) and the fixed stations actually installed in Malta

	MINIMUM NUMBERS OF SAMPLING POINTS (NO2, NOX, SO2, BENZENE, LEAD AND CO)	*MALTA AIR MONITORING FIXED STATIONS*
VALLETTA & SLIEMA AGGLOMERATION	1	3
MALTESE ZONE	1	1

	Minimum numbers of sampling points PM[1] (sum of PM10&PM2.5)	*Malta air monitoring fixed stations[2]*
Valletta & Sliema agglomeration	*2*	*5*
Maltese zone	*1*	*2*

	Minimum numbers of sampling points[3]		*Malta air monitoring fixed stations*	
	As, Cd, Ni	*B(a)P*	*As, Cd, Ni*	*B(a)P*
Valletta & Sliema agglomeration	1	1	3	3
Maltese zone	1	1	1	0

Source: Mepa.org.mt, 2013

In the Maltese zone, there is no fixed station currently installed for benzo(a)pyrene monitoring but, as stated in the L.N.478/2010 that transposed Directive 2004/107/EC, this monitoring can be carried out even by random sampling provided the number of measurements is sufficient to enable the levels to be determined. According to this preliminary air quality assessment, the concentration levels of Group B pollutants are all below the LAT, except for Msida for Benzo(a)pyrene and Nickel in one year. However, considering the low data captures that do not allow a complete assessment and assuming the worst case scenario (concentration of at least one group B pollutant above UAT), Malta would need only one fixed station for the entire country since the population is below 749,000 inhabitants (as established in the Annex 3 section 4 of the Directive 2004/107/EC).

Location of Sampling Points

The fixed stations' locations, in addition to be in compliance with the minimum number of monitoring sites for all the pollutants within the agglomerations or zones, shall be in compliance with the criteria for macroscale and microscale locations of the sampling.

Criteria for location of the sampling points on a macro-scale

Group A pollutants

The first macro-scale siting criteria for Group A pollutants are the following (Schedule 3 part b-1 of L.N. 478/2010).

Sampling points directed at the protection of human health shall be sited in such a way as to provide data on the following:

- The areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s); and
- Levels in other areas within the zones and agglomeration which are representative of the exposure of the general population.
- Within the Valletta & Sliema Agglomeration
- Near Msida station, the population is mainly exposed to vehicular traffic pollution;
- Near Kordin station, the resident population is mainly exposed to pollutants derived from the presence of many industrial activities in the surrounding zone; besides this station has been chosen to monitor the max ground concentration of pollutants derived from Marsa power station; and
- Attard e Żejtun stations are urban background stations which means that its pollution level is not influenced by any single source or street, but rather by the integrated contribution from all sources upwind of the station (source Guidance

on the Annexes to the Decision 97/101/EC as revised by Decision 2001/752/EC, released by EC in 2002). Thus, this station represents well the average pollution level in the identified zone or agglomeration.

Thus, the fixed stations in the agglomeration are in compliance with the criteria mentioned above.

The situation is different in the Maltese Zone, where Għarb represents better the air quality in a rural background zone and thus it mainly assesses the background level of the different pollutants away from relevant pollution sources, but it is not representative of the maximum levels of concentration to which the population of the Maltese zone is exposed. However, as already explained previously, Żejtun station can well represent the average exposure of the population living in the main centres of the Maltese zone to the main air pollutants.

Group B pollutants

The Group B pollutants are monitored in 4 fixed stations (Għarb, Msida, Kordin and Żejtun) and furthermore MEPA performs spot campaigns to detect metal concentrations in different zones. This implies that Malta is more than complaint with the monitoring requirements even considering that the criteria for macro-scale localization are similar to those for Group A and thus considerations expressed above are valid.

The only differences are related to the monitoring station at the traffic-oriented site which must be representative of a 200m2 instead of 100m length of a street segment. The station in Msida can be considered a well representative monitoring station also for metals and B(a)P.

Besides, Group B pollutants are monitored in correspondence with sampling points for PM10, as recommended by the L.N. 478/2010.

Thus, it can be affirmed that the Group B pollutants respect all the criteria for macroscale siting.

Ozone

Regarding Ozone, the following classification for the determination of the different territorial zones and agglomerations should be followed (Table 9):

Table 9: Criteria for classifying and locating sampling points for assessments of ozone concentrations

Macroscale siting

Type of station	Objectives of measurement	Representativeness (1)	Macroscale siting criteria
Urban	Protection of human health: to assess the exposure of the urban population to ozone, i.e. where population density and ozone concentration are relatively high and representative of the exposure of the general population	A few km^2	Away from the influence of local emissions such as traffic, petrol stations, etc.; vented locations where well mixed levels can be measured; locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas characteristic of educational, sports or recreation facilities
Suburban	Protection of human health and vegetation: to assess the exposure of the population and vegetation located in the outskirts of the agglomeration, where the highest ozone levels, to which the population and vegetation are likely to be directly or indirectly exposed occur	Some tens of km^2	At a certain distance from the area of maximum emissions, downwind following the main wind direction/directions during conditions favourable to ozone formation; where population, sensitive crops or natural ecosystems located in the outer fringe of an agglomeration are exposed to high ozone levels; where appropriate, some suburban stations also upwind of the area of maximum emissions, in order to determine the regional background levels of ozone
Rural	Protection of human health and vegetation: to assess the exposure of population, crops and natural ecosystems to sub-regional scale ozone concentrations	Sub-regional levels (some hundreds of km^2)	Stations can be located in small settlements and/or areas with natural ecosystems, forests or crops; representative for ozone away from the influence of immediate local emissions such as industrial installations and roads; at open area sites, but not on summits of higher mountains
Rural background	Protection of vegetation and human health: to assess the exposure of crops and natural ecosystems to regional-scale ozone concentrations as well as exposure of the population	Regional/ national/ continental levels (1 000 to 10 000 km^2)	Station located in areas with lower population density, e.g. with natural ecosystems, forests, at a distance of at least 20 km from urban and industrial areas and away from local emissions; avoid locations which are subject to locally enhanced formation of ground-near inversion conditions, also summits of higher mountains; coastal sites with pronounced diurnal wind cycles of local character are not recommended.

(1) Sampling points should, where possible, be representative of similar locations not in their immediate vicinity.

Source: Council Directive 2008/50/EC. Annex VIII

Table 10 reports the minimum number of sampling points for Ozone according to the different types of zone classification.

Table 10: Minimum number of sampling points for fixed measurements of ozone

Table 10: Minimum number of sampling points for fixed measurements of ozone

Population	*Agglomerations (urban and suburban)*	*Other zones (suburban and rural)*	*Rural background*
< 250,000	0	1	1 station /50,000 Km^2

Source: Council Directive 2008/50/EC. Annex IX

All the 5 fixed stations are monitoring Ozone concentration and there are 2 urban stations (Kordin and Attard), 1 suburban background (Żejtun), 1 rural background (Għarb) and 1 urban traffic station (Msida). This latter is not included in the 4 types of station as defined in table 9 because it is located very close to traffic emissions which represent a characteristic to avoid when measuring ozone concentrations.

Zejtun station has been classified as suburban location following the Ozone criteria established in the Annex VII of the Directive 2008/50/EC (see and Table 10). The Directive for Malta (population below 250,000 inhabitants) imposes to install, since the Long term objective is not achieved in both the agglomeration and zone, at least one suburban and one rural background location, this latter requirement is achieved by the Gharb measurements. Thus, the Maltese fixed monitoring network results in compliance with the minimum requirements laid down in the Directive 2008/50/EC.

Criteria for location of the sampling points on a micro-scale

The criteria for Group A, B and Ozone are reported below:

- The flow around the inlet sampling probe shall be unrestricted (free in an arc of at least 270°) without any obstructions affecting the airflow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees and other obstacles and at least 0,5 m from the nearest building in the case of sampling points representing air quality at the building line);
- In general, the inlet sampling point shall be between 1,5 m (the breathing zone) and 4 m above the ground. Higher positions (up to 8 m) may be necessary in some circumstances. Higher siting may also be appropriate if the station is representative of a large area;

- The inlet probe shall not be positioned in the immediate vicinity of sources in order to avoid the direct intake of emissions unmixed with ambient air; and
- The sampler's exhaust outlet shall be positioned so that recirculation of exhaust air to the sampler inlet is avoided.

All the current monitoring stations comply with the criteria mentioned above, as san be seen in Figure 7.

Figure 7: Monitoring Stations

Source: www.mepa.org.mt. (2013)

There are no obstacles that can influence the correct air flow sampling, and, in all cases the nearest buildings are located at adequate distances from the sampling probe. Moreover, there are no pollution sources in proximity of the inlet of the air flow. At the Żejtun, Għarb and Msida stations the heights of the sampling inlets comply with the established requirement (i.e. distance from the ground must be between 1.5m and 4m). In Kordin, the sampling inlet is located at a height of about 10m. However, Kordin is representative of a large industrial area (which includes the Marsa power station) and thus this height from the ground is justified by the micro-scale criteria.

Reference Methods

The reference methods to determine the concentrations of the pollutants listed in the Directive 2008/50/EC ("ambient air quality and cleaner air for Europe") and Directive

2004/107/EC (relating to Arsenic, Cadmium, Mercury Nickel and PAHs) are reported table 11 that reports whether the analyser is in compliance with the EU reference method (green cell) or not (red cell). Compounds that require both field sampling and laboratory analysis are divided in two phases. In case there is no reference method specified in the EU Directive, it is reported whether the chemical analysis is accredited (blue cell) or not (yellow cell). As shown in this table, the lack of compliance is only for the PM samplers.

The automatic instruments used by MEPA to measure PM concentrations work with different monitoring techniques (Beta ray attenuation and TEOM-FDMS) compared with the reference method (gravimetric method). These two monitoring techniques measure PM concentration in with high precise and reliable results and in facts they have been proven to be equivalent to the reference methods in other Country. For example, Beta-Ray attenuation monitoring technique is demonstrated to be en equivalent method in Italy. However, the Directive 2008/50/EC requires the Member State to carry out their own demonstration of equivalence because this test can vary and give different results in each different Country.

Conclusion

Based on the air quality assessment carried out three pollutants have been identified to be the most significant in terms of potential health effects on population:

- Particulate Matter (both PM10 & PM2.5)
- NO2
- O3

These pollutants should be continuously monitored by reference instruments or equivalent and their measurements should meet the data quality objectives established by the L.N.478/2010.

The main issue found in the air monitoring networks is that the minimum data capture has not been achieved for many analysers in all the different fixed stations. Besides, the PM10 and PM2.5 automatic analysers currently installed in the fixed stations are not demonstrated to be equivalent for the site-conditions in Malta, and hence a demonstration for equivalence should be performed by an accredited body according to EN 17025.

For the rest, the Maltese fixed station network is in compliance with the monitoring requirements of the Directive 2008/50/EC regarding the sampling sites, pollutants monitored, sampling locations, zoning and air assessment of the zones or agglomerations.

Table 11: Overview of the pollutants monitored by MEPA real-time network. Source: Mepa.org.mt. (2013)

Station_name	MONITORED PARAMETERS																							
	SO_2	O_3	$NO-NO_2-NO_x$	CO	VOC					METALS									Hg	PARTICULATE MATTER				
					Benzene	Toluene	Ethyl benzene	m,p - xylene	o-xylene	As		Cd		Ni		Pb			PM10		PM2.5			
										F	L	F	L	F	L	F	L						
Gharb																								
Attard																								
Msida																								
Kordin																								
Zejtun																								

Station_name	MONITORED PARAMETERS																													
	EC &OC		IONS														PAHs													
			NH_4^+		NO_3^-		SO_4^{2-}		Cl^-		Ca^{2+}		K^+		Mg^{2+}		Na^+		Benzo[a]pyr		Dibenzoanth.		Benzoanth.		Benzo(b)flu.		Benzo(k)flu.		Indeno_123cd_pyr.		Benzo(j)flu.	
	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L	F	L
Gharb																														
Attard																														
Msida																														
Kordin																														
Zejtun																														

LEGEND:

	Compliance with EU reference methods
	Not compliance with EU reference methods
	Analysis accredited
	Analysis not accredited
F	Field sampling
L	Laboratory analysis

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