The European Union's IPA 2010 programme for Albania

Technical Assistance for Strengthening the Capacity of the Ministry of Environment, Forests and Water Administration in Albania for Law Drafting and Enforcement of National Environmental Legislation

(EuropeAid/130987/C/SER/AL)

NEA Development Plan
Annex on laboratory
Activity C

This project is funded by the European Union

SELEA PROJECT
Strengthening Environment Law Enforcement in Albania

Project title:	Technical Assistance for Strengthening the Capacity of the Ministry of Environment, Forests and Water Administration in Albania for Law Drafting and Enforcement of National Environmental Legislation	
Project number:	Europe Aid/130987/C/SER/AL;	
Contract no.	2011/275-693	
Country:	Republic of Albania	
	Beneficiary	**Contractor**
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Date of Report:	24 June 2013	
Title:	**NEA Development Plan, annex on laboratory development**	
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Acknowledgement
The project team wishes to express its gratitude to all resource persons and experts from all institutions and stakeholders involved in the collection of data and information and to all persons and bodies that have supported the development of this Report. Special thanks are extended to the directors of the Ministry of Environment, Forests and Water Administration and the National Environment Agency.

Grontmij planning connecting respecting the future Agrotec

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LIST OF ABBREVIATIONS

AAS	Atomic Absorbance Spectrometer/Spectrophotometry
AGS	Albanian Geological Survey
BOD	Biological Oxygen Demand
CEMSA	Consolidation of the Environmental Monitoring System in Albania
COD	Chemical Oxygen Demand
EQR	Ecological Quality Ratio
EUD	EU Delegation in Albania
FNS	Faculty of Natural Sciences of Tirana University
GC	Gas Chromatography
GC-MS	Gas Chromatography-Mass Spectrometry
HEPA	High Efficiency Particulate (filters)
INPAEL	Implementation of the National Plan for the Approximation of Environmental Legislation
ISO	International Standards Organisation
JRC	Joint Research Centre (agency of DG Research)
LC-MS	Liquid Chromatography-Mass Spectrometry
NEA	National Environmental Agency
OC	Organochlorine
PAH	Polycyclic Aromatic Hydrocarbons
pH	Measure of water acidity or alkalinity
RO	Reverse Osmosis
SELEA	Strengthening Environment Law Enforcement in Albania
SIM	Subscriber Information Module (for mobile phones)
SOP	Standard Operating Procedure
StEMA	Strengthening of the Environmental Monitoring System in Albania
UPS	Uninterruptible Power Supply
UV	Ultra-Violet
WFD	Water Framework Directive

SUMMARY

This report describes the present status of the NEA laboratory and the investment needed to allow it to conduct monitoring programmes in good compliance with the Environmental Acquis for water and air. Details are given of all assumptions made and phased implementation is discussed. As long as the total number of samples remains the same there is little impact on the overall costs if the sampling site locations are changed. Thus programmes will be flexible. The only additional staff required is a part-time electronic and mechanical technician for the air programme. All costs are at May 2013 prices and exclude VAT.

It is not possible for the laboratory to function properly in its current accommodation. It requires approximately 210 m^2 of useable floor space, plus stores and offices, and the installation of specialist facilities including a clean room for metals analysis and at least three high-quality fume cupboards. It has not been possible to assess the cost of providing the empty laboratory shell, divided into rooms but otherwise containing only a full air conditioning system. Outfitting the shell with benches, fume cupboards, a clean room, and the necessary basic equipment will cost 151.9 keuro. Capital expenditure on items for immediate use would be 56.9 keuro, while longer-term capital investment of about 315 keuro is identified for air and water monitoring. A few other small recurring and non-recurring costs are described.

The marginal costs of individual minimum monitoring programmes has been calculated, including laboratory consumables, fuel for travel, and staff subsistence in locations remote from Tirana. Full implementation costs of the suggested programme are shown in Table 1. The required routine working budget for the laboratory is 135.5 keuro/year. First year costs for water consumables are high because the priority organic pollutants programme is initiated.

Table 1: Summary of monitoring costs

Sector	Capital year 1 (keuro)	Capital year 2 (keuro)	Consumables, fuel, staff subsistence (keuro)		Training (keuro)	Other costs[1] year 1 (keuro)	Other costs[2] Future (keuro)
			Year 1	Year 2+			
Laboratory	151.9	0	1.0	1.0	0	Not known[3]	maintenance
Water	9.4	3.9	99.1	57.2	40	10	200
Air	24.5	0	56.4	75.2	30	2	132.6
Flow	19.5	0	0	0	1	0	batteries
Biomonitoring	3.5	0	3.3	2.1	60	0	0
Totals	**208.8**	**3.9**	**159.8**	**135.5**	**131**	**12**	**332.6**

[1] The IT costs of the laboratory are not included. There is a separate SELEA project report covering this area.

[2] The figures given are mostly for capital investment in new instruments after the initial monitoring programmes have been shown to be successful. An additional annual budget for instrument repair and maintenance is required; this may average 5 keuro/year but with unpredictable frequency and cost. Similarly, instrument replacements will be needed due either to complete failure or technological advance, but this cannot readily be estimated.

[3] The rental/purchase and reconstruction costs of the laboratory building (plus installation of air conditioning) cannot be estimated with any accuracy.

1. INTRODUCTION

This report sets out capital and operating budgets for the basic laboratory facilities required for monitoring the state of the Albanian environment, taking into account the needs of the citizens of Albania, the need to inform the political decision process and the requirements set down in EU legislation. If implemented it would facilitate partial compliance with the monitoring requirements in the ambient air and water framework directives, with fully validated results available to inform Albanian government policy making and for reporting to the Commission.

The current laboratory facilities are completely inadequate for this purpose. A minimum but realistic specification for a suitable lab is presented. It was not possible to estimate the cost of providing the basic empty shell of the laboratory, but the necessary facilities to be installed and the additional equipment required are itemised and costed. In addition, detailed minimum operational budgets are given for water and air analysis, for surface water flow monitoring, and for the development of biomonitoring procedures.
The estimated cost given here for the water monitoring programme allows for taking and analysing 570 samples/year. The existing Eight-Cities and Pogradec surveys account for 402 of these, but their sampling sites are based on historical considerations which do not fit well with the requirements of the Water Framework Directive (WFD) to generate data as an input to deciding effective allocation of environmental expenditure. Changing the sites to comply with WFD principles is necessary and would have minimal impact on the overall cost but does not form part of this report's remit; continuation of the current Lake Pogradec survey should be reviewed taking into account Albania's obligations under the 2004 international treaty with Macedonia (*faolex.fao.org/docs/pdf/bi-69075E.pdf*). Similarly, the Ambient Air Quality Directive specifications must be applied when positioning the air monitoring stations; note that the proposed budget contains a one-off charge of8 keuro for moving two of the stations to new and more appropriate locations.

1.1. ASSUMPTIONS MADE IN THE PREPARATION OF THIS REPORT

That in support of the Agency's functions the laboratory will require:

1. to increase capacity for analysis of basic water parameters.
2. to establish and routinely employ standard methods for metal analysis in surface waters, using the graphite furnace atomic absorption spectrophotometer purchased in 2011 by INPAEL.
3. to establish and routinely employ standard methods for analysis of priority organic pollutants in surface waters, using the gas chromatograph-mass spectrometer purchased in 2008 by StEMA.
4. to operate its static and mobile air monitoring stations continuously under normal circumstances, and to carry out occasional passive tube programmes.
5. to carry out routine hydrometrological monitoring.
6. to gain the capacity to carry out elementary biological monitoring, based on macroinvertebrates.
7. to accredit all methods of analysis employed routinely in the laboratory.
8. to investigate pollution accidents and other non-routine situations.
9. to be allocated a budget adequate to allow its proper functioning in its agreed role, with only major instrument purchases being funded by donors.

2. PRICES

All prices given in this report have been taken from web catalogues or after discussion with the companies concerned. The major sources have been: for equipment Cole-Parmer UK (www.coleparmer.co.uk) and for chemicals Sigma-Aldrich (http://www.sigmaaldrich.com/united-kingdom.html). To a large extent this is because these companies cite their prices on their web catalogues. It may be possible to make economies by purchasing elsewhere. Prices are given without VAT unless otherwise stated. Those provided in GBP have been converted to EUR using the rate 1.20. Prices were as found in April 2013. For GC-MS analysis of priority organic pollutants, a list of consumables prepared for the EUD in late 2009 was reviewed and extensively modified. More than 70% of the 190 items identified were individually price-checked in April 2013. This showed that laboratory goods (and particularly glassware) over this period had a much higher than average inflation rate, typically 40-50 %. Consequently for the minority of items on this list which could not be price-checked this year, a uniform 50 % increase was applied.

The validity of all quoted costs depends on:

- VAT remaining unchanged at 20 %.
- The GBP/EUR rate remaining at or close to 1.20.
- Appropriate adjustment for inflation after April 2013. To facilitate updating of their commercial charges, it is recommended that the Agency finance office keeps a list of key laboratory consumables and checks their prices annually.

3. LABORATORY STAFF

In December 2012 the laboratory became part of one of the five administrative units of the reorganised NEA, the Department of Civil & Environmental Quality. It now has ten posts: Lab manager, eight specialists, and one laboratory attendant (specialised cleaner). The nine graduate posts are currently occupied by 6 chemists, 1 chemical engineer / environmental chemist, 1 biochemist, and 1 historian / geographer. The chemists are appropriately qualified but it is difficult to understand employment of a historian.

Another clear problem is the rigid job demarcation seen in the lab. There is for example no interaction between the air and water sector staff, and no benchwork done by the sampling team. Job descriptions have been prepared for the laboratory emphasising flexibility and co-operation, and this is a very important requirement for a small organisation. Knowledge of instruments and procedures must be spread across the staff. It is essential that experience is not lost when people leave the lab or are absent for whatever reason, and it is also essential that individuals can move readily between tasks in order to compensate for peaks and troughs in demand and in response to emergencies. Lab staff must always be prepared to work as a team and move between areas as required by the needs of the job.

This report was prepared on the basis that no additional staff would be needed to cover the described programmes, with one exception – recruitment of a half-time electronic and mechanical technician to ensure proper functioning of the Agency's air monitoring stations. Having an electronics engineer available would be highly useful for all areas of the lab's activities.

4. LABORATORY ACCOMMODATION

It is imperative that the lab should move to better accommodation. As previously reported, the current lab space is completely inadequate for anything more ambitious than the existing programme of basic water parameter analysis. It is entirely unsuitable for effective use of the laboratory's two major instruments: the atomic absorption spectrophotometer (AAS) and the gas chromatograph-mass spectrometer (GC-MS). There is no possibility for improving the condition of the laboratory building, and in addition much more space is required for the lab to fulfil its potential.

The present laboratory has two rooms, one for sample preparation and the other for instrumental analysis. This division is a basic requirement in modern analysis. Each of the two rooms has an area of 38 m^2. The sample preparation section is particularly poor. It has four bench runs, each of about 3 m, which allows for a maximum of four working chemists; after the recent reorganisation the lab has nine scientific staff. The remainder of the work space is taken up with free-standing equipment such as fridges, freezers, incubators and glass-drying cabinet, and other static facilities including the balance enclosure, glassware washing up area, and fume cupboards.

Apart from bench space, there are several other limiting factors in the current setup. In particular, fume cupboard facilities for extraction of toxic vapours are completely inadequate and badly corroded. This corrosion is in any case undesirable but it also gives rise to insurmountable technical problems with the atomic absorption spectrophotometer. An additional problem is that the cabinets under the fume cupboards (used for storage of acids) were not designed for that purpose and are becoming rotten due to attack by acid fumes. Furthermore, the glass washing provision is cramped and does not allow for proper decontamination and cleaning of apparatus. In addition, general storage space is extremely limited and the quality of cupboards and drawer units is poor with doors often not closing properly.

One other difficulty, which is important for trace-level analysis of organic compounds, is the impossibility of providing a separate area for preparation of the high-concentration standard solutions required as the starting point for instrument calibration. Separation is long-established good practice as it reduces the chance of contaminating the whole lab with the very chemicals which are being analysed at low concentrations in environmental samples.

The current Agency building has some storage rooms on the ground floor which could be converted to provide an additional 50 % of laboratory space, but this would still be insufficient and there are other fundamental problems including their contamination with chemicals used for forestry experiments. In addition to the limitations outlined above, internalisation of air, hydrometry and bio-monitoring make extra demands on space.

As a consequence, if the lab has any future as a modern and effective tool for the Agency it urgently requires new accommodation much larger than the current situation.

4.1 SPACE REQUIREMENTS FOR NEW LABORATORY ACCOMMODATION

The starting point is the work load anticipated. With the assumptions outlined above, if the lab is to be effective it needs to:

- Expand its current programme of basic water parameter (nutrients, etc.) analysis, providing adequate working space in two separate laboratories for six analysts, with improved fume cupboard and glass-washing facilities;
- Provide clean room and fume cupboard facilities for analysis of metals at background concentrations in surface and other waters;
- Provide adequate working space, fume hoods, and fume cupboards for trace-level analysis of organic contaminants such as the organochlorine pesticides and polycyclic aromatic hydrocarbons on the list of priority substances;
- Provide a working area with basic technical facilities for support of the air monitoring programme;
- Provide a room and basic facilities for development of the biomonitoring programme;
- Provide a separate room for the balances;
- Provide a separate room for preparation of high-concentration standards;
- Allow limited additional space for the sampling and hydrometrology programmes;
- Provide adequate racked storage rooms for consumable items, with a separate ventilated safe area for organic solvents and waste solvents.

Typically, each analyst requires 3 m of individual linear bench space (ca 7.5 m^2 floor space, including aisles). In addition there must be extra bench provision for shared facilities such as pH meters, sample extraction apparatus (e.g. Soxhlets) and centrifuges, plus ca 1.5 m^2 of floor space per analyst for free-standing equipment such as fridges, freezers and incubators, etc.

Including fume cupboard space and additional aisles, the main sample preparation area should therefore be a total of 90 m^2, split into two separate rooms (estimate, 56 and 34 m^2 respectively) to allow for activities which cannot be carried out alongside each other in a single laboratory. One example would be any work requiring the use of ammonia, as this must not be present in a room used for analysis of ammonium ion in water. Mains water and drainage should be provided to one bench run in each lab. Consideration should be given to providing a further modest area of say 20 m^2, to permit a likely future expansion of the workload.

It is standard practice to separate delicate measuring instruments (GC-MS, UV-visible spectrophotometer, etc.) from the sample preparation area, again to avoid their potential contamination or attack by the acids and solvents employed in preparation methods. The 38 m^2 instrument area available in the present laboratory is adequate for current needs but does not allow for deployment of additional large instruments such as a high performance liquid chromatography-mass spectrometry, which will be necessary in the future. It is suggested that 50 m^2 should be allocated to instruments in a new laboratory.

There is also a requirement for five additional separate small rooms: for balances (as required for accreditation); for the preparation of standard solutions, in order to minimise the possibility of contamination of the whole laboratory as discussed above; for glass washing and drying, which again should be kept apart from the general laboratory space to reduce the possibility of contamination; a clean room for metals analysis, as discussed below; a room for biomonitoring room with space for long-term storage of samples preserved in ethanol; and a small technical laboratory for air monitoring. The total area of these rooms should be 60-75 m^2.

In addition, space is needed for storage of consumables and separate, ventilated, storage of new and used solvents, as discussed below. A realistic provision is two rooms, each of 20 m^2.

Three offices are also required, one for the head of lab and two others, each for four junior staff. Excluding offices, a total floor area of about 250 m^2 is required for the laboratory. When evaluating potential laboratory accommodation consideration should be given to the likely long-term increase in demand for environmental analyses, with the eventual need for limited additional laboratory space.

4.2 LABORATORY SHELL

The starting point for this report is with a suitable building purchased or rented, and the basic laboratory shell completed, i.e. with building work to divide the space up into separate laboratories finished and air conditioning installed. These elements could not be priced. However, most other costs are assessed below.

4.3 LABORATORY FURNITURE

The current laboratory furniture has ill-fitting doors and drawers and is generally of poor quality. It is recommended that it is not moved to the new laboratory. With the space requirements outlined above there will be a need for ca 92 linear metres of benching, with approximately the same amount of two-tier open shelving at the back. About one-third of this should be left for knee-holes, with ca 20 linear metres of cupboards, 30 linear metres of drawers and 10 linear metres of cabinets for solvents, acids and alkalis. For the long-term utility of the lab it is important not to use the cheapest units. At an estimated 200 and 500 euro per linear metre of cupboards and drawer units respectively (including bench tops), the cost of these would be ca 19000 euro. Given the quantities required, it is likely that a substantial discount could be obtained, still maintaining the necessary quality. The solvent and acid/alkali storage will cost ca 2600 euro.

There will be additional unknown costs for the shelving, which should resist bowing, unlike the present shelves. Bench tops for the most part should be of chemical-resistant plastic laminate, which should be tested against common solvents before installation. The exception is the bench top for the balance room, where a specialist low-vibration system (of unknown cost) is preferred. A possible alternative is to use a thick granite slab of high mass, at ca 600 euro. An approximate total price for the laboratory furniture is 30000 euro, which does not allow for fitting. The clean room has special requirements described below and costed separately.

4.4 FUME CUPBOARDS AND HOODS

Much chemical analysis involves solvents and acids injurious to health which must be used inside fume cupboards or similar ventilation systems. Properly designed and built cupboards are needed to replace the inadequate ones in use now. Fume cupboards need to be easy to work at, with counterbalanced sashes; have a regulated air-flow; be made of glass fibre-reinforced plastic to be resistant to attack by acids or solvents; have individual air extraction systems designed to be acid and solvent resistant (and spark-free);

be simple to clean; and incorporate access to water, electricity and gases. They should stand on storage cabinets which have been designed to resist attack by acids and solvents. An absolute minimum of three such systems is required, one each dedicated for organics and metals analyses and another for general lab use; four would be preferred, to provide flexibility and development potential. Suitable fume cupboards are expected to cost ca 12000 euro each ex VAT. They would have a minimum working width of 1.2 m, and be supplied complete with extraction system and storage cabinets underneath the working surface.

Cheaper fume cupboards are available, but it must be emphasised that short-term savings here would be likely to have severe impacts on the long-term effectiveness of the lab. The fume cupboards should provide electrical power outlets, and be connected to the water supply and drainage systems. Additionally, the fume cupboard for trace metals work should have a piped supply of purified water, as discussed below. An supplementary solvent vapour extraction system is required for the organic compounds analysis work area, to allow use of solvents for extractions, etc. This will cost ca 3,000 euro, much less than another fume cupboard. The fume cupboard and hood costs have been included under 'capital equipment'.

4.5 CLEAN ROOM FOR METALS ANALYSIS

Detection limits for metals in surface water need to be at the 1 ppb (= 1 µg/L) level. It is widely accepted that trace metal determinations at this concentration have to be performed under clean room conditions if they are to be reliable and thus the new laboratory must have a small clean room. The US EPA has provided "Guidance on establishing trace metal clean rooms in existing buildings", (http://yosemite.epa.gov/water/owrccatalog.nsf/0/ee39840eba06441885256b0600723b6f?OpenDocument.

Basically, the room (ceiling, walls and benching) must be clad in virgin polypropylene or polyethylene plastic sheeting, sealed with silicone. Virgin polyolefins must be used rather than products containing recycled material, or other plastics, because many general-grade plastics contain metal compounds as processing aids. All metal fittings should be eliminated; unavoidable metal objects (screw heads, copper piping for argon, etc.) should either be covered over with duct tape, or painted with a thick coat of epoxy resin.

There should be a small entrance chamber, also lined with plastic, having a sink unit for washing hands and removing dust from any item to be taken into the clean area (two prime sources of contamination), with a sticky mat on the floor to trap particles, and provision for changing into lab coats reserved solely for use in the clean room. Everything should be done to minimise the spread of dust into the clan room. The door between the general laboratory and the entrance lobby should be kept as far from laboratory foot traffic as possible. The door between the entrance chamber and the actual clean room should be made of transparent vertical plastic slats. This prevents the movement of air created when opening and closing a standard door, hence reducing the spread of dust. Similarly, the whole layout of the clean room should be designed to minimise staff movement inside. Over-shoes and hair mob-caps must be put on inside the entrance chamber before going into the clean room itself and, when working on sample preparation, a face mask too. Disposable gloves which are powder-free must always be worn. Storage for these items should be provided in the entrance chamber. There must be a polypropylene cupboard for storage of acids – not a metal one. Doubly-distilled water should be piped in and stored in plastic containers which should regularly be emptied.

The clean room must be provided with a supply of high efficiency particulates (HEPA) filtered and temperature-controlled air (plastic ductwork) under positive pressure, and equipped with an externally-vented (again, plastic ductwork) HEPA-laminar flow cabinet of plastic construction for sample preparation. This should be placed near to the outlet for the filtered air, which is likely to be the cleanest area in the room. Access must be restricted; only the minimum of approved staff should enter, after full training in clean room procedures. Cleaning should be carried out by these staff. Any activity which creates dust must be avoided; thus, for example, surfaces should be wiped down with dust-free sticky wipes. Transfer of equipment and samples to the normal (non-clean) laboratory should be kept to the minimum. For safety reasons there should be an internal window into an adjacent laboratory.

The basic clean room without ventilation but otherwise specified as above should cost less than 5000 euro to set up. A basic HEPA-laminar flow cabinet will cost ca 5000 euro, with replacement filters needed approximately only every two years because of its dust-free environment. The positive-pressure ventilation system will cost around 8000 euro, with annual HEPA filter replacement. Another HEPA filter must be fitted above the AAS instrument, to provide a dust-free air flow protecting standards and samples from contamination, at a cost of about 5000 euro and again needing annual change of filter. These filters cost about 500 euro each; 2.5 filters will be required each year. Two cupboards made from polypropylene (NOT metal) are required for storage of acids, each costing 950 euro. Thus the total capital charge for initial installation is around 25000 euro which has been included under ‘capital equipment’, with annual consumables of 1250 euro. Both prices are exclusive of VAT. It has not been possible to get exact costings for any of these items, but the numbers given are realistic estimates.

4.6 ROOM FOR BIOMONITORING

Only standard facilities are required, except for the precautions necessary for safe storage of biological specimens preserved with ethanol, a highly flammable solvent. A storage cabinet providing 30 minutes fire resistance, and suitable for holding several years’ worth of samples, can be obtained for 980 euro; this has been included under ‘capital equipment’.

4.7 STORAGE ROOMS

The laboratory will need secure storage space for consumables, including acids and both unused and waste solvents. There are 13 different solvents and 5 acids to be accommodated. The storage room should include space with racks for about 200 standard 2.5 litre bottles (a total of 500 litres), and also for several 25 L drums for waste solvent, and it must be ventilated for safety using a spark-free system. It is not clear how waste solvents may be disposed of, but the Agency must set a good example here. It is assumed that the racks currently in use would be transferred to the new laboratory.

4.8 AIR CONDITIONING

As part of the requirements for accreditation the whole laboratory needs to be maintained at a constant temperature for optimal functioning of instruments and sample preparation methods. The air conditioning system must be designed taking into account the air flow requirements of the fume cupboards, and of the clean room. It has not been possible to estimate a cost.

4.9 GAS LINES

Separate lines for helium, argon and nitrogen are required with suitable secure anchor points for cylinders outside the building. Cylinders must be made safe from theft and covered to protect the gauges from rain and dust. It is unlikely that flame AAS will be employed, so there is no need for an acetylene line. If the second GC is used it may be necessary to provide an additional line for hydrogen to the flame ionisation detector. There should be space for two cylinders each of nitrogen, argon, helium and hydrogen; and at least two spare places for any future needs. Gases must be piped to the GC-MS and AAS instruments, and to the fume cupboards. There is a nitrogen generator standing in the lab, but it is not known if this is in operating condition. The gases should be distributed via laboratory-grade copper tubing free from contamination by grease, oil, chemicals or particles and care taken during installation not to introduce contamination. Gas lines must be laid out neatly and with sufficient additional length at each end to accommodate potential minor changes in instrument location or a need to cut off short pieces of tubing because of damage. The gas lines in the current laboratory cost about 250 euro, but the new facilities will require about double the hardware and more careful installation. An estimated cost is 1000 euro.

4.10 LABORATORY WATER

A reverse-osmosis (RO) water supply should be fed to a new double still and to the recommended automatic glassware washing machine for use in the final rinse cycle. Water should be piped from the storage tank directly to points of use, including the clean room, fume cupboard for metals analysis, and glassware washing machine. The piping should be virgin-grade polypropylene to avoid contaminants leaching into the water. For the same reason any joints should be made with care to ensure no contact of water with the sealing compound.

4.11 ELECTRICITY SUPPLY

The current laboratory has been calculated to have a power load in the region of 40 kW if all the instruments were to be used simultaneously. This would be more likely in the new lab and it is recommended that its wiring be rated at this level. Some three-phase sockets should be available.

Continuity of supply is essential. The need for, and cost of provision and installation of, a generator and UPS should be evaluated depending on the expected frequency and duration of outages at the new laboratory accommodation, and on the needs of accreditation, which demands a stable supply. If the location suffers only infrequent short-term power cuts, then provision of UPS systems to critical instruments may suffice. One of these, the GC-MS, already has a UPS. The situation should be discussed with the Directorate of Accreditation. Even if a generator / UPS is not installed, it would be prudent to keep the lab wiring separated from any associated offices, particularly if the whole Agency is co-located. This would permit simple installation of a generator at a later date if it were to be found necessary. The power demand for the offices – particularly heating in the winter – is likely to be much greater than for the lab alone. In addition, space should be reserved for sitting a future generator / UPS system.

Note that the generator previously supplied to the Agency and so far unused is of insufficient capacity (17 kW) and if needed it would be preferable to supply another one capable of sustaining a minimum load of at least 30 kW.

4.12 INTERNET CONNECTION TO OFFICES AND INSTRUMENT LABS

The whole laboratory should be networked - it is expected that the lab will be connected to the government system. Networking is vital to a modern lab. It facilitates backup of data. Instrument software requires updating over the net, and problem solving often needs a connection close to the instrument to permit VOIP calls to technical assistance staff in other countries.

4.13 MAINS WATER AND DRAINAGE

There are no specific requirements for the main water supply, but ideally the drains should discharge directly into the main sewerage system to avoid potential problems in downstream accommodation of the Agency or other organisations if leaks were to occur. Taps and a sink should be provided in each room except for the balance and standard preparation areas and stores.

5. CAPITAL EQUIPMENT

A certain amount of new capital equipment will be required. All prices given here are ex VAT.

5.1 REQUIRED TO SET UP THE LABORATORY AS A WHOLE:

- Fume cupboards and bench fume hoods, as described above. Estimated cost 39000 euro
- Trace metals clean room, as specified above, estimated capital cost 25000 euro, with filter replacements at 1250 euro/year.
- Water purification system. The current water still is very old and badly corroded. It is leaking steam through the casing. It urgently needs replacing with a combined reverse-osmosis (RO) water feed to a double still capable of delivering 5 litres/hour. There should be a specialised water storage tank to ensure the water once purified remains free from contaminants and from algal growth. This is particularly important for metals analysis. Estimated cost, 15000 euro with annual running costs (excluding electricity and water charges) of ca 200 euro for RO membranes.
- Laboratory glassware washing machine. Using a machine ensures a uniform and high level of cleanliness of glassware which is important for minimising background contamination and achieving consistent results. Domestic or restaurant dishwashers are not suitable because of the specialised requirements and shapes of glassware. Estimated cost, 6000 euro, with annual running costs of ca 200 euro for detergents etc.
- Ceramic hotplates to replace current heavily corroded items (which should not be transferred to a new lab) and improve the trace element background levels in the lab. Estimated cost, 4 x 500 euro.
- Muffle furnace. Another heavily corroded item, which at the moment is working but which might be expected to cause problems soon, and which is elevating the metals background. It should not be transferred to a new lab. Estimated cost, 4,000 euro.
- Storage cabinets for flammable solvents, 30 minutes fire resistance, 1500 x 1200 x 550 mm x 5; one for biomonitoring, 4 (one for waste solvents) for organic analysis. Estimated cost 980 euro each = 4,900 euro.
- UPS – for the purpose of this report it is assumed a laboratory-wide generator / UPS backup system will be necessary, costing perhaps 25,000 euro to purchase and install, in large part due to the necessary separation of circuits to the lab from those to the offices. Without a generator, individual instruments and computers would require UPS provision at an estimated total cost of 8,000 euro.

5.2 REQUIRED FOR ORGANIC CONTAMINANT ANALYSIS:

- Rotary evaporator and vacuum pump. Although a system was supplied in 2008, this became heavily corroded due to storage in an area subject to acid fumes, and is not useable. The glassware should be salvaged for spares. Estimated cost, 4,000 euro.
- Rotary shaker for extraction of pesticides and PAH from water. Complete with rubber mat and spring wire rack, with a maximum load of ≥ 10 kg. Estimated cost, 2,900 euro.
- The major limitation of GC-MS is that the technique can be applied only to volatile organic compounds. This restriction is removed with liquid chromatography-mass spectrometry (LC-MS) which in the past ten years has been developed to become an essential tool for trace organic

analysis. After several years' successful operation of the GC-MS it is recommended that the situation is reviewed to assess whether the laboratory be provided with an LC-MS unit. This would be a substantial investment; estimated cost, 200,000 euro.

5.3 REQUIRED FOR TRACE METALS ANALYSIS:

- Hydride generator module for AAS for analysis of trace levels of mercury. To fit Agilent 240-AA model. Estimated cost with accessories, 3,100 euro.

5.4 REQUIRED FOR AIR MONITORING

- Portable calibrator. Estimated cost 24,500 euro.
- Full set of transfer standards. Estimated cost 50,500 euro.
- Spare set of monitoring instruments. Estimated cost 64,100 euro.

5.5 REQUIRED FOR FLOW MONITORING:

- OTT Qliner or similar Doppler device for mobile watercourse flow monitoring, with spare battery. Estimated cost, 19,500 euro.

5.6 REQUIRED FOR BIOMONITORING

- Stereomicroscope: Binocular head, 45° inclined with built-in digital camera, wide field eyepiece WF10X/20mm 4:1 Zoom ratio, WD = 80mm. Magnification range: 10X-40X. Complete with imaging software. Estimated cost, 3,500 euro.

5.7 REQUIRED FOR SAMPLING

- Peristaltic pump for sample filtration. Estimated cost, 1,500 euro.
- Refrigerated containers for sample transport. Estimated cost, 1,000 euro.

6. OPERATIONAL BUDGET

Annual costs for the analytical programme of the laboratory are itemised below. The programme outlined is the most basic one compatible with at least partial fulfilment of the needs of the citizens of Albania and of EU legislation requirements. Marginal costs of analysis are given. These assume that the laboratory is present in a baseline state as defined below and account only for the additional costs of analysis.

6.1 LABORATORY BASELINE STATE FOR MARGINAL COST ASSESSMENT

Baseline state definition
The baseline state is defined as the laboratory fully staffed at its current level, in suitable new accommodation as outlined above, and equipped with an appropriate level of instruments; ready for work but not actually carrying out any analyses. The fixed costs of the baseline state include:

1. Staff pay and social security.
2. Accommodation costs – e.g. rent, maintenance;
3. Depreciation of capital equipment;
4. Utilities – water, electricity, telephone & internet;
5. Cleaning – general and glassware;
6. Vehicle maintenance and insurance (sampling);
7. Agency overheads.

Additional general costs attributable to the laboratory include:

Calibration and testing of equipment
An accreditation requirement for pipettors, balances, thermometers and spectrophotometer. This has been carried out locally so far, with a realistic 429 euro including VAT budgeted for 2013, but the Directorate of Accreditation is considering the need for international calibration which is likely to increase costs substantially.

Sampling costs
Sampling procedures need improving in two areas: chilled transport of samples to the lab requiring total expenditure of around 1,000 euro on a refrigerated container, plus appropriate batteries to power it; and sample filtering (mandatory to comply with ISO standards on sampling for ionic analytes). This requires a peristaltic pump (ca 1,500 euro). These items are listed above in the capital purchase section. Filtration is required only for the basic water parameters programme and the cost of filters is included there.

Laboratory water supply and automatic glass washer
Annual running costs for replacement of RO membranes and purchase of specialised detergents will be ca 500 euro/year.

Accreditation maintenance and extension
The Directorate of Accreditation gives special rates to Government laboratories, charging only the fees for expert evaluation visits. Maintaining accreditation for basic parameters costs ca 240 euro/year; extending

accreditation to other water methods will cost an additional similar amount for metals analysis, but potentially much more for organic contaminants if the Directorate of Accreditation cannot find local experts to carry out the technical inspections. Accreditation fees have been included under the individual analytical programmes. Accreditation for areas other than water is difficult technically and could not be considered for many years.

Reference materials
It is obligatory for accreditation to use analyte reference materials where these are available. They have limited shelf-lives. Estimated cost 300, 300, and 800 euro/year for basic parameters, metals, and organic programmes; a total of 1,400 euro/year excluding VAT. Reference materials are included in the individual programme costs detailed below.

Proficiency testing
Also obligatory for accreditation. The Directorate of Accreditation has a reduced requirement for frequency of testing compared to Member States but a realistic programme for basic parameters will cost in the region of 700 euro/year for basic parameters alone, plus 560 euro for metals and 660 euro each for OC pesticides and PAH (both priority pollutants); a total of 2580 euro/year excluding VAT. These costs are included below, in the individual programmes.

6.2 FUEL COSTS

There will be substantial fuel costs associated with running the laboratory's programme. With fuel consumption of 100 km/10 L and a fuel price of 200 lekë/L:

Water monitoring
It is assumed that the average Eight-Cities sampling trip will cover 250 km thus costing 36 euro; the annual programme of 36 visits costs 1300 euro. One Pogradec sampling visit covers 350 km; the trip will cost 50 euro; the annual programme of 12 visits costs 600 euro. Local sampling for the Ishmi project suggested below would require about 150 km travel each month, costing 260 euro/year. The total for water sampling is 2160 euro/year.

Air monitoring
The new automatic air stations are at Durrës, Korçë, Shkodër and Vlorë. With the addition of the station at Elbasan, one round of visits covers 1064 km, costing 137 euro in fuel. Maintenance requires one visit to each station per two weeks; the annual cost is therefore 3,550 euro. Calibration is carried out quarterly during one of the maintenance visits. If the Regional Environmental Office staff can be trained to carry out some of the maintenance work, annual fuel costs will be reduced.

Additional fuel costs for the mobile unit are estimated as 250 euro/year

Hydrometrological monitoring
It is assumed that each station will be visited 12 times a year; that it will be possible to monitor four stations per journey on average (Eight-Cities programme, 28 stations [eliminating the seven stations in the sea]) or three stations per journey (Pogradec programme, six river stations); and that there will be joint sampling-hydrometrology visits only to Pogradec, made possible by the two overnight stays required per visit. Otherwise, sampling and hydrometrology visits have been kept separate because of the different

periods of time required for either activity. Thus the Eight-Cities and Pogradec hydrometrology monitoring programmes will cost 3,000 euro and nil euro per year, respectively, for fuel.

Biomonitoring

It is assumed that for the next five years monitoring will be confined to the Ishmi and Erzeni river basins and cover a maximum of 20 stations, each visited two times a year, and that the average trip will cover two stations. The average distance travelled per trip is estimated as 150 km. Training will require an additional four trips per year. Thus the total fuel cost will be 300 euro per year.

Table 2: Fuel costs

Programme	Cost (euro)
Eight-Cities water	1300
Pogradec water	600
Ishmi water	260
Air	3800
Hydrometrology	3000
Biomonitoring	300
Total	**9260**

6.3 STAFF SUBSISTENCE COSTS

Each overnight stay allowance is to a maximum of 3000 lekë/night; there is also a meal allowance of 2500 lekë/24 hours where the destination is more than 100 km from Tirana. The sampling team is two people, plus the driver. Water-sampling visits to Sarandë will require an overnight stay, as will air station maintenance visits to Korçë. Each of these will cost 120 euros including meals. Visits to Pogradec will require two overnight stays and cost 240 euros, also including meals. Separate meal allowances cost 54 euro per journey and will be necessary for air station maintenance (Korçë) and water-sampling (Fier, Shkodër and Vlorë). Thus the total subsistence required for air station maintenance is 4,010 euro/year; and for water sampling 1128 and 2,880 euro/year for Eight Cities and Pogradec programmes respectively. Subsistence for hydrometrology is restricted to meal allowances for Fier, Shkodër and Vlorë, amounting to 1944 euro/year. No visit will be made to Sarandë, as the only sampling done there is from the sea.

Table 3: Staff subsistence costs

Programme	Cost (euro)
Eight-Cities water	1,128
Pogradec water	2,880
Ishmi water	nil
Air	4,010
Hydrometrology	1,944
Biomonitoring	nil
Total	**9,962**

6.4 MARGINAL COSTS OF BASIC WATER PARAMETER ANALYSES

If the laboratory in the baseline state is required to carry out analyses, then unless the internal resources (people, equipment) are exceeded there will the only extra (marginal) costs will be for reagents, replacement of broken glassware, distilled water and disposable/safety items such as tissues and gloves, plus an unquantifiable additional use of electricity and water.

The analysis of even one sample demands an irreducible set of calibration curves, blanks and controls, equivalent to perhaps 10 samples. Thus the cost per analysis is minimised if samples are processed in batches. Although there is a limit to the maximum size of a batch, from the economic viewpoint it is always desirable to group samples together. Note that labour was not taken into account.

There are no training needs for basic water parameter analysis. The Agency laboratory is fully competent in this area.

Orthophosphate analysis costs

Current marginal costs were calculated (via an itemised and fully priced spreadsheet) for carrying out the analysis of one batch of six samples for orthophosphate in surface water using the method in ISO 6878:2004/ NEA SOP LAMP T 06. The batch of six samples is assumed to include one turbid or coloured sample; a 6-point calibration curve is included plus one control sample. The overall cost is very sensitive to the breakage rate for glassware, which has been assumed to be 0.5 %. It was found that glassware prices have risen on average by 30-50 % between 2009 and 2013.

Table 4: Cost elements for one batch of orthophosphate analyses

Item	euro	% of total
Reagents	2.49	30.4
Glassware	4.28	52.2
Other multiple-use consumables	0.79	9.6
Single-use consumables	0.64	7.8
TOTAL	**8.20**	**100.0**

It can be seen that if the laboratory has a routine workload for any given method then the cost is low of adding to the batch one additional non-urgent sample for example taken by a Regional environmental inspector and delivered to the door. In a batch of six, each sample costs 1.37 euro, but one additional orthophosphate sample included (increasing the number in the batch to seven) incurs a cost of 0.63 euro. If it is necessary for the laboratory to carry out the sampling then substantial extra costs will be incurred.

This table does not give the cost per actual sample analysed as there has to be an allowance for the control batches analysed by staff learning and becoming validated for the method, plus any repeat analyses necessary, plus the analysis of proficiency test samples. This 'overhead' is high because of the low numbers of sample batches actually analysed, and is variable according to staff turnover. It is estimated as an additional 25 %. Thus the final cost per sample for the Eight-Cities or Pogradec programmes is calculated as 1.71 euro. This is the marginal cost of analysis. If the laboratory were to be carrying out commercial analysis, then staff time and agency overheads would have to be applied before factoring in an appropriate 'profit' element. Staff time would need to include sample reception and also reporting of the results, for example.

Costs of other basic water parameter analyses

Carrying out accurate calculation for orthophosphate was very time-consuming and it was judged not necessary to perform similar exercises for all the other basic parameter methods used by the laboratory. These fall into four clear groups:

- Nutrient ion analyses (the majority) like orthophosphate, which are carried out by adding a reagent, waiting for colour development and measurement using a spectrophotometer; these were assumed to have an equal (usually slightly lower) marginal cost to orthophosphate: 1.71 euro per sample.
- Conductivity, pH, temperature and dissolved oxygen, which are measured using glass electrodes inserted into the sample; it was estimated that for the combined Eight-Cities and Pogradec programmes (1616 measurements) the electrodes need replacing approximately annually at a cost of 600 euro excluding VAT. Additional costs include buffers, conductivity standards and other consumables such as tissues and disposable gloves, bringing the total to 900 euro. The unit cost is 0.56 euro per sample per parameter using marginal pricing. There is no significant overhead.
- BOD and COD, which are carried out using proprietary instruments and reagent kits. BOD. Oxitops cost approximately 150 euro each ex VAT and last for about 400 measurements. This price includes the necessary replacement batteries. Reagents and disposables, plus a contribution to the Oxitop base trays, double the total cost to 300 euro. Adding VAT brings this to 360 euro. With a measurement batch of six including one control, and an overhead of 25 % each sample costs 1.13 euro.
- COD. The relatively high price for this analysis is due to the use of a proprietary kit. The kits cost 580 lekë per tube in June 2011 (information from NEA finance office). Adjusting for two years' s inflation at 3 %/year brings this to 4.40 euro per tube today which with 10 % control samples and training / validation overhead included becomes 6.05 euro per sample.
- Suspended solids, carried out gravimetrically, by filtration, drying and weighing. Again the key assumption is the breakage rate of the filter-holder glassware. Because these items are individually expensive (ca 270 euro) it is assumed that more care will be taken handling them; breakage was arbitrarily assigned as 0.25 %. Including overhead, the cost per sample is 1.47 euro, the filter-holder accounting for 46 % of this.

Table 5: Marginal costs for NEA basic parameter methods including VAT

Analyte	Marginal cost[1] (euro) ex VAT	Marginal cost[1] (euro) inc VAT
Orthophosphate	1.71	2.05
Total phosphate	1.71	2.05
Nitrate	1.71	2.05
Nitrite	1.71	2.05
Ammonium	1.71	2.05
pH	0.56	0.67
Conductivity	0.56	0.67
Temperature	0.56	0.67
Dissolved oxygen	0.56	0.67
BOD	1.13	1.35
COD	6.05	7.26
Suspended solids	1.47	1.77
Total	**19.44**	**23.31**

[1]This is the marginal cost for analyses of individual samples done in batches of 5 or 6 except for those carried out using electrodes, where the cost is for a single measurement.

6.5 WATER MONITORING PROGRAMME

The costs given below are for taking 570 samples and carrying out on these full basic parameter analysis, full metals analysis for the priority pollutants lead, cadmium and nickel, and partial analysis for two priority organic pollutants, organochlorine pesticides and PAH. The discussion assumes the current sampling programme is unchanged but the sampling locations are not significant and revisions would have little effect on the funding requirements as long as the total number does not increase.

Cost of the current basic water analysis programme

The total cost of consumables required to carry out basic parameter measurements for all 140 Eight Cities and 262 Pogradec samples is 2,722 and 5,093 euro respectively. Calculation of full costs requires addition of a total of 1,240 euro/year for proficiency testing, maintaining accreditation, and reference materials. Furthermore, the price of filters for water sampling to cover both Eight-Cities and Pogradec programmes is 5,628 euro/year. These are not currently used but are mandated by ISO methods for sampling ions in surface water. **Thus a realistic laboratory maintenance budget for carrying out basic parameter analysis of the current Eight-Cities and Pogradec programme samples with full compliance to ISO standards and EU requirements is 14,683 euro/year.**

When VAT is included the budget needed is 17,620, in comparison with the actual NEA laboratory VAT-inclusive budget allocation for 2013 of 2,929 euro.

The laboratory has spare capacity for basic water parameter analysis and this should be used for preliminary work directed towards WFD requirements for river basin characterisation and refocusing the Agency's efforts. It is recommended that the Ishmi river basin is evaluated first, as this is nearest to the Agency and most affected by human activity. There is some overlap with the Eight-City stations and so work on the Ishmi would probably require sampling at only an additional twelve sites. Monthly basic water parameter analysis for these involves an additional 144 samples annually; extending the frequency of sampling at the current Eight-Cities points will generate a further 24 samples per year for a total of 168. The analyses will cost 5,618 euro/year, including the necessary filters for sampling.

6.6 MARGINAL COSTS OF METALS ANALYSES

As discussed above, provision of a clean room for metals analysis is a prerequisite. Consequently metals cannot currently be determined at the concentrations expected in surface waters. A suitable clean room will cost about 24,000 euro to install in new laboratory, with running costs (replacement of filters) of around 1,250 euro/year; prices exclude VAT. There is also a requirement for a dedicated fume cupboard for cleaning glassware with acid. The fume cupboard must be totally metal-free and resistant to acids. The other requirement is a suitable supply of double-distilled water, piped directly both to the fume cupboard and to the clean room. Having a piped supply keeps the water free from contaminants which would be picked up if it had to be transferred into containers for transport.

The consumables required to operate the AAS on a daily basis have been listed in a spreadsheet. Items include argon gas for the graphite furnace, vials, replacement graphite tubes, electrodes and electrode shrouds, hollow cathode and deuterium background lamps, ultra-pure acids, and the personnel protection items required to successfully operate a clean room. Single element hollow cathode lamps give the best signal-to-noise ratios and the greatest sensitivity. They have a limited shelf-life of perhaps three years and so should not be stockpiled but replaced regularly as necessary. Lamps for the most significant environment pollutants are readily available.

Little training is required for metals analysis, as the Agency staff have most of the knowledge successfully to operate their AAS, once the clean room has been established. Moving the AAS to the new location without damage requires preliminary immobilisation of the monochromator grating and advice should be sought from Agilent.

In year 1, setting up costs will be 12,500 euro. In subsequent years annual running costs at 2013 prices will be 10.3 euro. The running cost is similar to the setup cost because the lab already has stocks of the more expensive consumables. This will cover the analysis of 1000 samples/year in duplicate at a cost of 12.4 euro/sample (with VAT included). This sample throughput is greater than the number of samples in the laboratory’s agreed workload for the Eight-Cities and Pogradec programmes together with the suggested Ishmi project.

Development of metals programme

Once the analyses of lead, cadmium and nickel have been validated, consideration should be given to mercury, also on the list of priority pollutants. This requires specialised equipment – a cold vapour accessory for the laboratory AAS, as described in the list of capital items, which could be budgeted for in year 3 after the move to a new laboratory. Mercury analysis presents special difficulties because of a tendency of the element to absorb to containers and equipment and it is recommended that training assistance be given in the Agency by an appropriate expert for 10-15 days.

6.7 MARGINAL COSTS OF ORGANIC CONTAMINANTS ANALYSES

Successful trace level analysis of organic compounds, such as OC pesticides and PAH, requires attention to detail. Contamination of the working area is a constant possibility and great care is necessary to avoid this. Best practice requires a separate room dedicated for standard preparation. Dispensing solid or high concentration standards should be avoided where possible; if absolutely necessary then the preliminary weighing should be done at a location remote from the preparation area used for routine samples and also separated from the normal balance room. Dilution of standards is best carried out by weight to limit contact of concentrated standards with syringes or pipettors. A set of dispensers should be kept separate and reserved just for this purpose. They should be marked to ensure they are readily identifiable.

There also needs to be a fume cupboard dedicated to organic analysis, where the rotary evaporator and other extract reduction equipment can be set up permanently. An additional solvent fume extraction system should be installed on the organic analysis workbench for operations involving low level emissions of solvent vapours, freeing up fume cupboard space, which is always at a premium. Suitable systems are available for about 3,000 euro. It is important that the device extraction fan is designed for use with flammable organic solvents (spark-free).

The GC-MS instrument itself has been standing unused for over four years and is likely to require servicing. When the two associated PCs were tested recently they were found not to work, probably because the hard drive heads had seized to the data-storage platters. It is recommended that the instrument is left in the old Agency building until the new laboratory has been commissioned and is ready for use. At that time, Agilent should be contacted and asked to send a service engineer to supervise the move, to reinstall the device in the new lab, and to provide a short basic training course on its operation. This is likely to cost around 10,000 euro. If that is not possible then the chemistry department at FNS has the same GC-MS model and could be contracted to provide basic assistance at a more modest price.

A spreadsheet list of about 200 items necessary to begin carrying out trace level organic analysis has been prepared as mentioned above. This contains everything required for analysis of PAH (ISO 28540:2011) and of OC pesticides (based on extraction and clean-up procedures in ISO 6468:1996), with a few additional supplies to enable the laboratory to have some chance of responding effectively to unexpected events such as industrial accidents. The total cost of providing these start-up items is 61,200 euro. A number of small pieces of equipment are included in the list, such as a sample concentrator, ultrasonic bath, and vortex mixer. Apart from the orbital shaker listed above under capital items, none of these exceeds 1000 euro; all are essential and if they cannot be included in a single tender they must be purchased separately. Annual running costs thereafter are calculated as 22,600 euro, allowing for the analysis of approximately 250 samples per year each for OC pesticides and PAH at an average cost of ca 54 euro/sample (including VAT). This calculation contains an allowance in the second year and thereafter of 1,000 euro/year for accreditation. The cost is difficult to assess accurately because of uncertainties about the availability of local experts whom the Directorate of Accreditation could use to review the competence of the lab, as discussed above.

Carrying out this kind of analysis is difficult and requires much experience of appropriate techniques and methodologies. It is recommended therefore that immediately after the provision of laboratory accommodation, facilities and consumables as outlined in this report, and after establishing that the Agency's GC-MS is in good working order, a suitable expert be requested to provide a 10-week training programme in the Agency lab at a cost of approximately 36,000 euro. Following on from this, it would also be highly desirable for the senior Agency analyst working on organic compounds to undertake a four-week study visit to a major EU laboratory specialising in this type of work.

6.8 MARGINAL COSTS OF CARRYING OUT HYDROMETROLOGY MONITORING

Proper interpretation of physico-chemical monitoring of surface waters requires information on their flow rates. The Agency has never carried out hydrometrology monitoring; the necessary work has been subcontracted either to the former Hydrometrology Institute or to the Albanian Geological Survey. The AGS provided an informal quotation in October 2012 of 75 euros per single measurement for sites located in the Ishmi river basin.

In order to internalise hydrometrology monitoring, it will be necessary to purchase a suitable instrument for the Agency at a cost of 19,800 euro, including spare battery. The Greek agent for this equipment has stated a price of 1,000 euro for a staff training programme. Apart from staff time, the other costs associated with internalising the programme are fuel for transport and the staff subsistence allowance for meals as specified above.

The Agency is already committed to the Eight-Cities and Pogradec programmes for surface water. Eliminating the monitoring sites in lakes or the sea, complete hydrometrology monitoring requires 174 measurements, 72 on the shores of Lake Pogradec and 112 for Eight-City stations. It has been calculated above that taking measurements at all these sites would require 1,900 euro for fuel and 4,008 euro for subsistence. Thus the marginal cost of internalisation would be approximately 34 euro per station, a saving of 41 euro on the AGS price. The capital cost of the instrument and training would be defrayed after 513 measurements or three years even if only the Eight-Cities and Pogradec programmes require flow monitoring. It is therefore recommended that an instrument such as the device mentioned above is supplied to the Agency together with the necessary training course.

6.9 MARGINAL COSTS OF BIOMONITORING

There is a clear need to familiarise Agency and other Albanian biologists with the requirements of the Water Framework Directive in relation to biomonitoring. The only work done now in relation to the WFD in Albania is funded by SELEA. The FNS carried out some limited evaluations in relation to the Erzen project organised by INPAEL, and the staff there have their own research programmes. Training is needed to start the process of implementing this part of the WFD. In discussion with Jesper Ansbaek (Environmental Economist Expert, SELEA Project) the following initial objectives were established:

- Collection of present knowledge about macroinvertebrates communities in Albanian Rivers.
- Supplementing the present knowledge about macroinvertebrates communities in Albanian Rivers and identification of indicator species reflecting the macroinvertebrates communities in Albanian Rivers.
- Establishing metrics to calculate ecological quality ratios (EQR) for macroinvertebrates communities in Albanian Rivers and to use EQR values to establish status classification.

It is recommended that over the next five years there should be training visits by an appropriate senior expert to Tirana in the spring and autumn of each year, of 10 working days per visit, totalling 100 days. The Agency biochemist / biologist should be trained together with a junior colleague, and the staff at FNS and any other appropriate institutions invited to participate. The basic concepts should be transferred in Years 1 and 2; in years 3 and 4 the trainees should be guided towards developing an overview of the Erzen river basin; and in Year 5 should present to the trainer the results of an evaluation of the Ishmi basin. Ideally, Year 5 would mark the start of a twinning project between the Agency and a major EU institution working in this area.

The setup costs for the Agency are low. Apart from the stereomicroscope described above at 3,500 euro excluding VAT, Year 1 consumable costs are 3,300 euro, and subsequently 2,100 euro/year, both excluding VAT. The list of items includes kick nets for collecting samples, trays, archiving bottles, ethanol for preservation, petri dishes, wading boots for rivers, etc. There will be fuel costs of around 300 euro/year and no staff subsistence charges.

6.10 MARGINAL COSTS OF AIR MONITORING

Much of this section is derived from the SELEA 'Proposal for capacity building at NEA with a focus on air quality monitoring', dated March 2013. This anticipates recruitment of one part-time additional technician for the laboratory, to become responsible for maintenance and repair of both electronic and mechanical components of the stations. It is expected that the necessary tools will cost 2,000 euro.

The immediate priority for air monitoring is to get the Agency's current network of stations working effectively, initially the four new automatic stations and then the other two static stations. The mobile unit will be required to be fully functional for calibration of all the other stations, as discussed below. The costing included here assumes a starting point with all the equipment working properly. This may require some initial unknown expenditure on repairs as the technician described above might not be immediately available and could also require specialist training.

Substantial training amounting to 30,000 euro is recommended in the SELEA report and it is clear that there should be close cooperation with the Institute of Public Health, currently running two similar monitoring stations under WHO funding.

Consumables for each station cost 8,228 euro/year (information from spreadsheet provided by Joachim Seewoester, CEMSA, who has considerable experience in the operation of similar stations). This includes calibration gases, filters, pump maintenance, instrument lamp replacement, etc.

Additional running costs per station are electricity, at 960 euro/year (information from NEA); and SIMs for remote data transmission, at 240 euro/year (information from agreed 2012 maintenance contract, adjusted to 2013 prices). Thus the annual consumables cost per station is ca 9,400 euro/year; for the four new automatic stations this amounts to 37,600 euro/year. However, the mobile unit is required to transport the calibration system to these four stations and it makes no sense getting the unit roadworthy without also ensuring its instruments are functional. Thus including the mobile unit's consumables and its vehicle costs as detailed above, the annual total is 48,600 euro. For all seven stations the amount required is 67,400 euro/year. It is recommended that the two old stations are brought back into use after the programme for the automatic stations has been shown to be fully functional.

Extra costs for the mobile station amount to approximately 1000 euro/year after deduction of unnecessary SIM charges (based on 400 euro/year insurance and vehicle maintenance charges are estimated at 600 euro/year). Fuel costs are already taken into account in the calculations above.

There are additional calibration costs. The SELEA proposal estimates expenditure of 10,000 euro on a portable calibrator, while Envimet indicates that a 'stationary' calibrator would cost 24,500 euro. It is unclear whether these items are functionally equivalent, so the higher cost has been assumed here. The calibrator would be transported in the mobile unit to each of the other stations, four times a year, for inter-comparison. At some stage, as required by EU air legislation, it will become necessary for the Agency's stations to be recalibrated regularly using 'standard transfer' instruments, which again would be transported to the static stations in the mobile unit. A full set of these instruments costs 50,500 euro (information from Envimet) and they will themselves require annual calibration at an international reference laboratory. The JRC centre at Ispra, Italy, is the EU's principle reference laboratory for air. The cost of this process is unknown but including transport possibly in the region of 3,000 euro/year.

After the first year's operation and having gained experience, it will be necessary to relocate two of the automatic stations, for which 8,000 euro will be required, including electricity connection and burglar alarms. Repairs are also required to the two original NEA stations at unknown cost but 10,000 euro assumed.

When the Agency air monitoring station network is fully operational it will have seven stations. In the longer term, and depending on the effectiveness of the recommended technical support at the Agency, purchase of a complete set of spare monitoring instruments (64,100 euro) might be considered. This would ensure near-continuous operation of the stations, avoiding long gaps in data should faulty instruments need to be sent back to the manufacturer for repair.

The network will never be able to cover all the air monitoring requirements for Albania and there will be a need for occasional passive tube campaigns in specific areas of the country. These tubes cost around 20 euro each and as an initial estimate there will be a requirement for 50 per year, costing 1,000 euro.

There will also be an increasing need for inspectors to be equipped with portable gas monitors for use at industrial sites. Instruments for a range of common gases are available at 400-500 euro each, while multi-gas monitors cost 2,000-5,000 euro. Detection limits of individual monitors would need checking to ensure they are suitable, and they would all require regular external calibration at additional cost, perhaps 1,000 euro/year. The alternative is to use short-term single-use detector tubes such as those supplied by Dräger, whose hand-operated pumps sampling 100 mL per stroke cost around 500 euro and the individual tests are 7-10 euro each. Assuming supply of one multi-gas monitor costing 3,500 euro to each regional office, and one calibration system, the total expenditure would be an initial outlay of 42,000 euro plus 1,000 euro/year for calibration. This information is included for completeness but not listed in the summary as it does not relate directly to the laboratory. A similar issue will arise for field monitoring of water, where inspectors will require pH and dissolved oxygen meters.

7. GENERAL CONSIDERATIONS

7.1 AGENCY TRANSPORT

The Agency currently has one functional vehicle and one driver. It is likely that when the monitoring programme as described above is fully operational that the transport requirements will exceed this capacity. There may also be scheduling problems. These difficulties might be avoided by providing a travel allowance for staff members to use their own cars when necessary.

7.2 SUPPORT FOR INSPECTORS

It is anticipated that as the new systems for inspections and permitting settles in there will be an increasing need for the laboratory to carry out analysis of samples taken by inspectors. Training is already in hand covering many of the legal and scientific aspects of sampling. Additional costs will be incurred, covering items such as provision of gas monitors, water sampling filters, and transport of samples to the laboratory. Transport may become a limiting factor. For water samples strict conditions of time and temperature of transport have to be met. Again, this could possibly be solved by providing a travel allowance for staff members to use their own cars when necessary.

7.3 COMMERCIAL ANALYSES

Although in principle a potential good source of income for the Agency, it will be necessary to ensure that conflicts of interest are actively identified and avoided. It will also be important for the Agency to set realistic prices which still allow for a suitable profit. As discussed above one aspect of this would be to ensure that a list of current prices for consumables is maintained.

7.4 MAINTENANCE OF EQUIPMENT

Modern analytical methods are based around instruments which contain complex and proprietary electronic circuit boards. Problems are infrequent but they do occur and there is often no alternative to requesting a service visit from the manufacturer’s engineers. It is totally impossible to predict the need for servicing and no budget can be set. Due to the negligible size of the market in Albania these engineers will have to travel from other countries, and the cost will be high. It must be anticipated that occasional visits will be required at a cost in the region of 10,000 euro each and a budget allocated for this possibility.

7.5 REPLACEMENT OF EQUIPMENT

All the major and minor items of equipment will either wear out or require replacement because of technical advance. The lifetime of an instrument cannot realistically be expected to exceed 10-15 years and financial plans are required to allow for replacements. UPS batteries will also need regular renewing.

7.6 CONTINGENCIES

Although every effort has been made in the preparation of this report to identify and accurately cost all the various elements required to operate the Agency laboratory, it is certain that some items have been overlooked and that there will be unexpected above-inflation price rises in others. Examples of the latter are laboratory glassware for which prices have risen by ca 40 % since 2009, and high purity gases for which the quotation has increased by 60 % in less than one year. It is recommended that the budgets for individual work areas are kept under constant review and that an initial contingency budget of perhaps 10 % is provided for operational costs, which could be adjusted as experience dictates. A contingency fund of 20 % would be appropriate during construction and outfitting of the new laboratory.

7.7 IMPLEMENTATION

If funding cannot be obtained to implement the whole programme, it is recommended that the individual operational elements are prioritised and those with the lowest priority dropped completely until the resources do become available. It is not realistic to cut all the sub-programmes by a small amount. It is noted that the organic pollutant area is the most expensive.

With regard to the proposed new laboratory facilities, it would not be reasonable due to shortage of funds to eliminate completely any of the rooms described. Instead, if at all possible the space should be provided but left empty until funding does become available. Providing less space will severely restrict the future potential of the Agency. Ideally the laboratory should be provided with all the facilities listed plus one empty room for the increased workload that is likely to arise as Albania becomes more prosperous and more aware of the desirability of conserving the environment.