



Protocols and Forms for Soil and Water Monitoring in Mining Communities AUA Center for Responsible Mining

I. Objectives

This document provides simple standard guidance on forms to be completed for documentation of soil and water monitoring in communities that are in close proximity to mining and mineral processing operations. The Annexes to this document include the forms that will be completed as part of sampling, testing, and reporting. The requirement for such documentation is set forth in ISO 17025, titled “General requirements for the competence of testing and calibration laboratories.”

There are no single protocol forms that are universally adopted. Each laboratory developed its form based on the objectives of a given task/study. However, several ISO and U.S. Environmental Protection Agency (EPA) standards, in particular, ISO 17025, ISO 5667, ISO 10381, EPA IWRG 701-2009, are considered relevant guides to designing the monitoring protocols and forms (see Annex 1 for details). These protocols are used in developing the forms to be used by the AUA Center for Responsible Mining’s soil and water monitoring of mining communities.

The forms that are developed include:

- Community Form (Annex 2),
- Interview Summary Form with Local Representatives (Annex 3),
- Soil Sampling Protocol (Annex 4),
- Water Sampling Protocol (Annex 5),
- Chain of Custody Form (Annex 6),
- Soil Test Results Form (Annex 7),
- Water Test Results Form (Annex 8),
- Calibration Sheet for the Water and Soil Tests (Annex 9),
- Quality Control Form (Annex 10),
- Laboratory Audit Checklist (Annex 11).

II. Forms for collecting general information about the subject community (Annex 2 and 3)

The background information about a subject community should be documented for interpretation of the results and assessment of the anthropogenic impacts on the environment and public health. For this purpose, the Community Form (see Annex 2) and Interview Summary Form with Local Representatives (see Annex 3) are designed, which include the information about the purpose, date and location of study, population size, number of schools, kindergartens, testing areas, description of pollution sources in the community, as well as a brief description of operating companies, which may or not may be responsible for environmental pollution in the community. It should be noted that the information reported in the Annex 2 and 3 forms, is not official and is the opinion of the person interviewed. However, the documented information may consist of useful remarks that could lead to additional areas of investigation.



The Forms need to be numerated using the following format:

dd-mmm-yy- community ID

Where: dd= day of study,
mmm=month of study,
yy=year of study,
community ID= identification number of a subject community.

Each subject community should have its own number in a database of the study to link between all sampling and testing protocols and forms. The community ID will consist of four numbers- the first two numbers related to Regions (Marzes) of Armenia and the second two numbers related to community from the study list. The regions and communities are numerated in alphabetical order.

For example: 05-Oct-15-0101 refers to the Community or Interview Summary Form from №01 Region (Ararat Marz) and №01 community in that region (Ararat town), filled in 05 October 2015.

The Community Form (Annex 2) consists of the general information about the community, which should be filled before site visit to avoid spending a lot of time on sampling site. The official data of communities population size, number of adults and children is available on the web site of the National Statistical Service of the Republic of Armenia (<http://armstat.am/en/>); and data on the number of schools and kindergartens in the community is available on the web site of the Ministry of Education and Science of the Republic of Armenia (<http://www.edu.am/>).

The pollution source description part in the Community Form, as well as the Interview Summary Form should be filled *in situ*. The interview with a local representative may be recorded by a device after getting the permission from the person to be interviewed. The person to be interviewed shall be informed about the scientific term of the interview and the recording should not be used publicly. The short notes and relevant time on recording should be marked under each question in the interviewed form.

III. Reporting the sampling procedure (see Annex 4, 5 and 6)

Sampling is defined as the process of removing a portion, intended to be representative, of a land and water body in the study area for the purpose of examination for various defined characteristics. Thus, the sampling procedure must be documented in the appropriate forms and protocols, which is an integral part of sampling quality control techniques. The complete overview of quality assurance applied to water sampling can be found in ISO 5667 part 14.

Water /Soil sampling protocols

The sampling protocols (see Annex 4 and 5) consist of a background information about sampling site (description, scheme of area, etc.) and can be used to identify and quantify errors associated with sampling, as required by ISO 5667 (for water) and ISO 10381 (for soil). The sampling protocols include information about propose, location, date of sampling, the ID, number and type of samples, as well as water/soil temperature, pH and conductivity measured *in situ*. The sampling protocols needs to be numerated in a following format:

dd-mmm-yy-Community ID-(soil or water)Sampling Site ID- sample number



Where: dd= day of study,
mmm= month of study,
yy= year of study,
Community ID= identification number of a subject community,
Sampling Site ID= identification number of a school or kindergarten.

Each school and kindergarten, as well as subject community, should have its own number in a database of the study. The sampling site ID will consist of two numbers related to appropriate school or kindergarten in the study list for each subject community.

For example: 05-Oct-15-0101-s02-01 means that the sampling protocol refers to №01 Region (Ararat Marz), №01 community in that region (Ararat town), №01 soil sample in №02 kindergarten/school was taken in 05 October 2015.

Chain of Custody Form

According to ISO 17025 requirement, the sampling details should be recorded on the bottles and packages, as well as documented on the Chain of Custody Form (see Annex 6) to assure the traceability and the control over the samples during entire duration of sample handling and processing. The condition and duration of samples transportation should be mentioned in the Chain of Custody Form. The Form should be numerated with the same principles as the one used for the Community Form (see above) and signed by the sampling staff and confirmed by laboratory staff.

IV. Reporting the test results (see Annex 7 and 8)

To ensure consistence of data collection bases of the analyses Soil and Water test results forms are designed (see Annex 7 and 8). The forms include information about the testing method, relevant international standard, equipment name, the measurement range for each measuring parameter. The Water/Soil test results forms should be numerated with the same principle as stated in Section III above.

Before start of analyses of the samples, the equipment must be calibrated per ISO 17025 requirements. The calibration results of the equipment(s) should be recorded in the Calibration Sheet (see Annex 9). If the equipment needs to be calibrated several times during the period when samples are analyzed, each results of calibration should be recorded in the Calibration Sheet. The Calibration Sheet will have the same number as the Community Form or Interview Summary Form.

V. Quality control (see Annex 9, 10 and 11)

ISO 17025 is requested to apply quality control to all analyses conducted. These is the part of the internal audit of the laboratory and a way to identify and quantify errors associated with laboratory measurements. The quality control forms are given in Annex 9, 10 and 11.



ISO and EPA standards used: ISO 5667, 10381, and 17025 and EPA IWRG 701-2009

ISO 5667

<https://www.iso.org/obp/ui/#iso:std:iso:5667:-1:ed-2:v1:en>

ISO 5667 consists of the following parts, under the general title Water quality sampling:

- *Part 1: Guidance on the design of sampling programmes and sampling techniques*
- *Part 2: Guidance on sampling techniques (this standard has been revised by: ISO 5667-1:2006)*
- *Part 3: Guidance on the preservation and handling of water samples*
- *Part 4: Guidance on sampling from lakes, natural and man-made*
- *Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems*
- *Part 6: Guidance on sampling of rivers and streams*
- *Part 7: Guidance on sampling of water and steam in boiler plants*
- *Part 8: Guidance on the sampling of wet deposition*
- *Part 9: Guidance on sampling from marine waters*
- *Part 10: Guidance on sampling of waste waters*
- *Part 11: Guidance on sampling of groundwaters*
- *Part 12: Guidance on sampling of bottom sediments*
- *Part 13: Guidance on sampling of sludges from sewage and water treatment works*
- *Part 14: Guidance on quality assurance of environmental water sampling and handling*
- *Part 15: Guidance on preservation and handling of sludge and sediment samples*
- *Part 16: Guidance on biotesting of samples*
- *Part 17: Guidance on sampling of suspended sediments*
- *Part 18: Guidance on sampling of groundwater at contaminated sites (this standard has been revised by: ISO 5667-11:2009)*
- *Part 19: Guidance on sampling of marine sediments*
- *Part 20: Guidance on the use of sampling data for decision making — Compliance with thresholds and classification systems*
- *Part 21: Guidance on sampling of drinking water distributed by tankers or means other than distribution pipes*
- *Part 22: Guidance on the design and installation of groundwater monitoring points*
- *Part 23: Guidance on passive sampling in surface waters*

ISO 10381

<https://www.iso.org/obp/ui/#iso:std:iso:10381:-2:ed-1:v1:en>

ISO 10381 consists of the following parts, under the general title Soil quality - Sampling:

- *Part 1: Guidance on the design of sampling programmes*
- *Part 2: Guidance on sampling techniques*
- *Part 3: Guidance on safety*
- *Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites*
- *Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination*
- *Part 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*
- *Part 7: Guidance on sampling of soil gas*
- *Part 8: Guidance on sampling of stockpiles*

ISO 17025

<https://www.iso.org/obp/ui/#iso:std:iso-iec:17025:ed-2:v1:en>

EPA IWRG 701-2009

<http://www.epa.vic.gov.au/~media/Publications/IWRG701.pdf>



COMMUNITY FORM

No _____

Purpose of the sampling: _____

Institution: _____

Completed by: _____ Name, surname Sample collected by: _____ Name, surname

Date: _____ Day/month/year Local time: _____

Location: _____ Region Community

Community population size: _____, out of which _____ Total Adults Children

Number of schools without kindergartens: _____ Number of kindergartens: _____

Photo(s) number(s): _____

Number of testing areas: _____ Testing areas ID: _____

POLLUTION SOURCES DESCRIPTION

No	Pollution source	Responsible organization	Isolation from public	Distance/location from the community	Risk impact

Measures taken to reduce the impacts on the environment: Yes (Planned/Currently being implemented) No

If yes, describe: _____

Risk for population health of nearby community: Yes No

Explain _____

Additional notes: document below any other information or observations you made



No _____

INTERVIEW SUMMARY FORM WITH LOCAL REPRESENTATIVES

Purpose of the sampling: _____

Institution: _____

Completed by: _____ **Date:** _____ **Local time:** _____
Name, surname Day/month/year

Location: _____
Region Community

Full name of interviewer(s): _____
Local authority/health care provider/active members of community/etc.

Contacts of the interviewer(s): _____
Telephone number/address/e-mail/etc.

INTERVIEW TOPICS

1. Short description of industrial development of the community: _____
Short notes

2. The environmental issues in the community: _____
Short notes

3. The main enterprises who may be the reason for environmental pollution of the community: _____
Short notes

4. The exposure pathways of the community: _____
Short notes

5. Any seasonal phenomena related to environmental pollution in the community: _____
Short notes



6. Indicate the location and short note about the landfills, mines, tailing dams, burial places of chemicals and other toxic sites in the community, if any: _____

Short notes

7. Any risks for population related to the rise of pollution level in the community (increase in the specific disease, increase in incidence rate, cancer level in the population, etc.): _____

Short notes

8. Any interesting stories related to the toxic site: _____

Short notes

9. Any steps that the local authority or others took to reduce the environmental and health risks posed by the toxic site: _____

Short notes

10. Any steps that the local authority or others planned to reduce the environmental and health risks posed by the toxic site: _____

Short notes

11. Other: _____

Short notes



SOIL SAMPLING PROTOCOL

№ _____

Purpose of the sampling: _____

Institution: _____

Collected by: _____ Completed by: _____
Name, surname Name, surname

Date: _____ Local time: _____ Number of Children: _____
Day/month/year

Location: _____ Numbers of sampling points: _____
Region Community

Testing area: _____ Sample number(s): _____

Photo(s) number: _____

SITE DESCRIPTION

Air temperature: _____ °C (at site) Precipitation: _____ (at site)

Weather: Sunny Cloudy Partly Cloudy Raining Foggy

Land Use: Urban Suburban Agricultural Pasture Forest School yard Other _____

Land covered by: Grass Sand Other _____

Waste existence: No Yes, specify: Manure Plastic Construction waste Industrial waste Other _____

Pollution sources: _____

Distance from pollution sources, km: _____

Numbers of sampling points	Coordinates	Soil temperature, °C	pH	Conductivity
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			
	Lat. Lon.			

Additional Notes: document below any other information or observations you made



Scheme of soil sampling area:

No _____





WATER SAMPLING PROTOCOL № _____

Purpose of the sampling: _____

Institution: _____

Collected by: _____ **Completed by:** _____
Name, surname *Name, surname*

Date: _____ **Local time:** _____
Day/month/year

Location: _____ **Sampling number(s):** _____
Region *Community*

Water source: _____
Name/location/etc.

Water type: *Drinking* *Irrigation* *River* *Channel* *Other* _____

Longitude: _____ **Latitude:** _____ **Elevation:** _____

SITE DESCRIPTION

Air temperature: _____ °C (at site) **Water temperature:** _____ °C (at site) **pH:** _____

Weather: *Sunny* *Cloudy* *Partly* *Cloudy* *Raining* *Foggy* **Precipitation:** _____ (at site)

Land Use: *Urban* *Suburban* *Agricultural* *Pasture* *Forest* *School yard* *Other* _____

River bottom substrate: *Boulders* *Rubble* *Gravel* *Sand* *Silt* *Clay*

Surface oils: *None* *Some* *Lots*

Water odor: *Normal* *Sewage* *Petroleum* *Chemical* *Other* _____

Waste existence: *No* *Yes, specify: Manure* *Plastic* *Construction waste* *Industrial waste* *Other* _____

Pollution sources: _____

Distance from pollution sources, km: _____

Additional Notes: *document below any other information or observations you made*



№ _____

CHAIN-OF-CUSTODY FORM

I acknowledge the transportation of _____ water samples and _____ soil samples, taken from _____ study area for the analyses of the following parameters:

- Heavy metals Dissolved oxygen pH Conductivity Other _____

There are _____ bottles for each water sample, as follows:

Bottles type and quantity	Preservation of the water sample	Transportation	Testing parameters

Total ___ bottles and ___ field blank bottle(s) and ___ replicate sample's bottle(s) for all water samples.

There are _____ package of soil samples for each testing area, as follows:

Testing area and ID	Package type and numbers	Preservation of the soil sample	Transportation	Testing parameters

Total ___ package of soil samples and ___ control soil sample(s) and ___ replicate sample(s) for the testing area.

Signed	
Full name	
Position	
Date	
Laboratory(s) reference for the samples are (laboratory name/room number/person)	
Comments	



SOIL TEST RESULTS FORM № _____

Sampling site: _____

Institution: _____

Tested by: _____
Name, surname

Date of sampling: _____ Date of analysis: _____
Day/month/year Day/month/year

MEASUREMENT RESULTS (mg/kg)

Testing Parameter	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Comments
<i>Method/standard</i>	<i>Trace20, Metalyser HM2000 Deluxe (Soils)/ISO 19730:2008</i>					
<i>Measurement range</i>	<i>10-500</i>	<i>5-500</i>	<i>10-500</i>	<i>5-500</i>	<i>5-500</i>	
<i>Norms (Armenia/EPA)</i>	<i>2.0/25</i>	<i>NA/85</i>	<i>3.0/250</i>	<i>32/400</i>	<i>2.1/NA</i>	
Numbers of sampling points						

Additional Notes: document below any other information or observations you made



WATER TEST RESULTS FORM № _____

Sampling site: _____

Institution: _____

Tested by: _____
Name, surnameDate of sampling: _____
Day/month/yearDate of analysis: _____
Day/month/year**SITE DESCRIPTION**

Testing parameter	Measurement result	Method/standard	Measurement range, ppb
Cadmium (Cd)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	3-500
Lead (Pb)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-500
Arsenic (As) III		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-500
Arsenic (As) III+V		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	10-500
Mercury (Hg)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-500
Zinc (Zn)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-500
Copper (Cu)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-500
Manganese (Mn)		Trace ₂₀ , Metalyser HM2000 Deluxe /DIN 38406-16	5-200
Aluminum (Al)		Trace ₂₀ , HM2000 Metalometer/--	10-250
Bor (B)		Trace ₂₀ , HM2000 Metalometer/--	100-2000
Chromium (Cr)VI		Trace ₂₀ , HM2000 Metalometer/--	20-2000
Iron (Fe)		Trace ₂₀ , HM2000 Metalometer/--	20-3000
Nickel (Ni)		Trace ₂₀ , HM2000 Metalometer/--	100-2000
Copper (Cu)		Trace ₂₀ , HM2000 Metalometer/--	50-5000
Manganese (Mn)		Trace ₂₀ , HM2000 Metalometer/--	100-18000

Additional Notes: document below any other information or observations you made



CALIBRATION SHEET FOR THE WATER AND SOIL TESTS

Institution/laboratory: _____

Tested by: _____
Name, surname

CAL. № 1

Equipment: Trace2o, Metalyser HM2000 Deluxe Type of tests: water
soil
Name/series/type

Date of calibration: _____ Date of samples analyses: _____
Day/month/year *Day/month/year*

Sampling point IDs/numbers: _____

<i>Calibrated parameter</i>	Cd	Pb	As (III)	As (III+V)	Hg	Zn	Cu	Mn
<i>Calibration points/ concentrations</i>								

CAL. № 2

Equipment: Trace2o, HM2000 Deluxe /Metalometer Type of tests: water
soil
Name/series/type

Date of calibration: _____ Date of samples analyses: _____
Day/month/year *Day/month/year*

Sampling point IDs/numbers: _____

<i>Calibrated parameter</i>	Al	B	Cr (VI)	Fe	Ni	Cu	Mn
<i>Calibration points/ concentrations</i>							

CAL. № 3

Equipment: Trace2o, Metalyser HM2000 Deluxe (Soil) Type of tests: water
soil
Name/series/type

Date of calibration: _____ Date of samples analyses: _____
Day/month/year *Day/month/year*

Sampling point IDs/numbers: _____

<i>Calibrated parameter</i>	As	Cd	Cu	Pb	Hg
<i>Calibration points/ concentrations</i>					



ANALYSES QUALITY CONTROL FORM

No 1 Parameter: _____

Institution/laboratory: _____

Tested by: _____ **Duration of control:** _____
Name, surname

Equipment: _____

Table of results:

Date	No*	**C	AV	AV+SDx2	AV-SDx2	AV+SDx3	AV-SDx3

*No - The minimum number of analyses should be 10.
**C – concentration; AV-average of concentrations; SD-standard deviation.

Chart:

No 2 Parameter: _____

Institution/laboratory: _____

Tested by: _____ **Duration of control:** _____
Name, surname

Equipment: _____

Table of results:

Date	No*	**C	AV	AV+SDx2	AV-SDx2	AV+SDx3	AV-SDx3

*No - The minimum number of analyses should be 10.
**C – concentration; AV-average of concentrations; SD-standard deviation.

Chart:



LABORATORY AUDIT CHECKLIST

Lab Room Number: _____

Date of Audit: _____

Lab Assistant: _____

Auditor(s): _____

	Working	Accessible	Last checked
1. Safety Equipment			
a. fume hood	_____	_____	_____
b. eye washes	_____	_____	_____
c. fire extinguisher(s)	_____	_____	_____
2. House-keeping			
	Yes	No	If No, corrective action to be taken:
a. food, beverages and appliances absent from the laboratory?	_____	_____	_____
b. food absent from chemical refrigerators and vice versa?	_____	_____	_____
c. laboratory doors closed?	_____	_____	_____
d. floors, aisles and exits unobstructed?	_____	_____	_____
e. laboratory countertops and bench tops from chemically resistant materials?	_____	_____	_____
f. labware is appropriately cleaned?	_____	_____	_____
g. laboratory staff wears the lab coat and safety shoes?	_____	_____	_____
h. laboratory staff works with lab gloves?	_____	_____	_____
i. hand washing facilities are available in the lab?	_____	_____	_____
j. electrical equipment in good condition? Cords and power sockets are not damaged?	_____	_____	_____
3. Chemical Storage			
	Yes	No	If No, corrective action to be taken:
a. all containers appropriately labeled?	_____	_____	_____
b. chemicals stored appropriately (incompatibles separated)?	_____	_____	_____
c. standards stored under appropriate temperature?	_____	_____	_____
d. standards' expiration dates have not passed?	_____	_____	_____
4. Samples Storage			
	Yes	No	If No, corrective action to be taken:
a. all samples appropriately labeled?	_____	_____	_____
b. samples stored appropriately (separated from chemicals, refrigerated)?	_____	_____	_____
c. soil samples stored not more than 6 months?	_____	_____	_____
5. Waste Management			
	Yes	No	If No, corrective action to be taken:
a. chemical wastes tightly capped?	_____	_____	_____
b. incompatible chemicals separated?	_____	_____	_____
c. liquid chemicals equipped with secondary containment?	_____	_____	_____
d. chemical wastes labeled appropriately?	_____	_____	_____
e. sharps disposed in proper containers?	_____	_____	_____
6. Laboratory Equipment			
	Yes	No	If No, corrective action to be taken:
a. equipment in the working condition?	_____	_____	_____
b. the metrology certificate has not passed?	_____	_____	_____

Additional Notes: *document below any other information or observations you made*
