The Thirteenth Senior Technical Managers' Meeting
of the Acid Deposition Monitoring Network in East Asia
30-31 August 2012, Hanoi, Vietnam

Quality Management Guidebook

for

the Acid Deposition Monitoring Network in East Asia

2013

October 2012

Network Center for the EANET

Quality Management Guidebook for the EANET

Table of contents

Appendix 1 : Template of the National Monitoring Plan
Appendix 2 : Examples of check list for site/laboratory audit

Abbreviation in this document

EC:	Electric conductivity
NH_4^+	Ammonium ion
Na^+	Sodium ion
K^+:	Potassium ion
Ca^{2+}:	Calcium ion
Mg^{2+}:	Magnesium ion
Al^{3+}:	Aluminum ion
SO_4^{2-}:	Sulphate ion
NO_3^-:	Nitrate ion
Cl^-:	Chloride ion
PO_4^{3-}:	Phosphate ion
SO_2:	Sulphur dioxide
NO_2:	Nitrogen dioxide
NO:	Nitrogen oxide
O_3:	Ozone
HNO_3:	Nitric acid
NH_3:	Ammonia
HCl:	Hydrochloric acid
PM:	Particulate matter
pH(H_2O)	pH value of adhered water in soil sample
pH(KCl)	pH value including exchangeable hydrogen ion in soil sample
ECEC:	Effective cation exchangeable capacity
T–C:	Total carbon content
T–N:	Total nitrogen content
DOC:	Dissolved organic carbon
TOC:	Total organic carbon
COD:	Chemical oxygen demand
DO:	Dissolved oxygen
TSP:	Total suspended particulates
SS:	Suspended solids
SCOR:	Scientific Committee on Oceanic Research
UNESCO:	United Nations Educational, Scientific and Cultural Organization

1 Introduction

Acid deposition is a general term that includes more than simply acid rain. Acid deposition is primarily the result of emissions of sulphur dioxide (SO_2) and nitrogen oxides (NOx) that can be transformed into dry or moist secondary pollutants such as sulfuric acid (H_2SO_4), ammonium (NH_4^+), nitrate (NO_3^-) and nitric acid (HNO_3) as they are transported in the atmosphere over distances of hundreds to thousands of kilometers.

Acid Deposition Monitoring Network in East Asia (EANET) was established as a regional cooperative initiative to promote efforts for environmental sustainability. The First Session of the Intergovernmental Meeting (IG1) on the EANET was held in March 1998 in Yokohama, Japan. Based on the agreement at the IG1, EANET was started the preparatory phase activities in April 1998. And this activity has been already implemented for more than 10 years.

The cooperative activities of EANET participating countries based on developed national monitoring plans include the implementation of monitoring of wet deposition, dry deposition, inland aquatic environment, and soil and vegetation in line with the guidelines and other technical documents with the conducting of quality assurance/quality control (QA/QC) programs as an important part of the monitoring activities. It is expected that the participating countries create a common understanding on the status of the acid deposition problems through EANET activities, which will become a scientific basis for taking further steps to tackle the problems.

EANET has made progress and important achievements in monitoring, data acquisition and management, research, and other technical issues. The EANET development covered the main goals and objectives of the network. The measurements collected for ten years are able to draw more precise and definite conclusions on temporal and spatial variations of atmospheric deposition.

There is general agreement that improvements on monitoring and data quality are among the most important directions for EANET to focus on. Progress in these areas should provide a more solid basis for advanced assessment of acid deposition and related environmental problems.

A part of the EANET activities are summarized as follows:

1) Each participating country developed and implements their national monitoring plans. Acid deposition monitoring is implemented in accordance with the monitoring guidelines, technical manuals and other technical documents adopted by the Network.
2) The monitoring data and other information submitted by participating countries is compiled, evaluated and stored by the Network Center.
3) In order to obtain monitoring data of high quality, the quality assurance/quality control (QA/QC) programs are implemented in full collaboration among the participating countries.

Based on the experiences of the EANET monitoring activities during past 10 years, securing the high quality monitoring data and their comparability are significantly requested and the need of the establishment of common quality management scheme is raised.

This guideline is expected to be utilised among the monitoring laboratories and activities in the participating countries of EANET in order to keep and improve their quality of monitoring data to be reliable and comparable not only in the EANET activities, but also in the international acid deposition monitoring activities.
Suggestions and recommendations were described in the guidebook to ensure the quality of the monitoring data in the participating countries and expected to be used as one of the textbook for training the personnel who are in charge of the acid deposition monitoring.

2 Quality Management System

The National Center for EANET should establish its quality management system to ensure its quality assurance and quality control (QA/QC) activities. The quality management bodies shall be prepare their QA/QC programs to ensure their quality management activities.

2.1 Scope

General recommendations are described in this guidebook for the monitoring activities of the National Center including sampling.
This guidebook was prepared to be used in the monitoring laboratories to establish their Quality Management System (QMS), and also to be utilized for confirming and approving these laboratories by the National Center for EANET.

2.2 Objectives of QA/QC programs

Considering the significance of possible future problems regarding acid deposition, it becomes increasingly important to obtain accurate and precise data on acid deposition. With this recognition, many countries of the world have already initiated their acid deposition monitoring programs. However, informed decisions cannot be made on the basis of unreliable data, and therefore certain levels of data quality should be assured. A monitoring system without adequate QA/QC runs the risk of not being able to control the quality of data, and not being able to assure accuracy and precision. QA/QC has thus become essential part of all measurement systems in general, and acid deposition monitoring in particular, because it requires especially high international comparability of data.

For uses of acid deposition data in recent years, such as assessment of spatial distributions and temporal trends, research on acid deposition related processes and impacts on aquatic and terrestrial ecosystems, and the development and evaluation of long-range transport and transmission models, it is especially important that measured data satisfy specified levels of reliability with necessary information on measurement methods.

The objectives of this QA/QC program are to obtain reliable data that can be comparable among the countries of the East Asian region, as well as with other networks by ensuring data accuracy, precision, representativeness and completeness in acid deposition monitoring.

2.3 Definitions of QA/QC programs

Quality control is defined as "the routine use of procedures designed to achieve and maintain a specified level of quality for a measurement system". Quality Assurance is defined as "a set of

coordinated actions such as plans, specifications, and policies used to assure that a measurement program can be quantifiable and produce data of known quality".

According to the United States Environmental Protection Agency, the difference between quality control and quality assurance is the following: quality control is a "system of activities to provide a quality product" and quality assurance is a "system of activities to provide assurance that the quality control system is performing adequately. In other words, quality assurance is quality control for quality control".

To assure specific data quality, QC activities should be implemented for all the steps of the measurement activities, from sample collection to data reporting. The QA/QC programs should include QA/QC activities for all the components of the measurement/analysis systems, i.e. the field (sampling sites), laboratory, data management and data reporting processes. All QA/QC activities should be documented.

2.4 Role of relevant entities

The roles of relevant entities of QA/QC activities during the preparatory phase are shown in Figure 2.1.

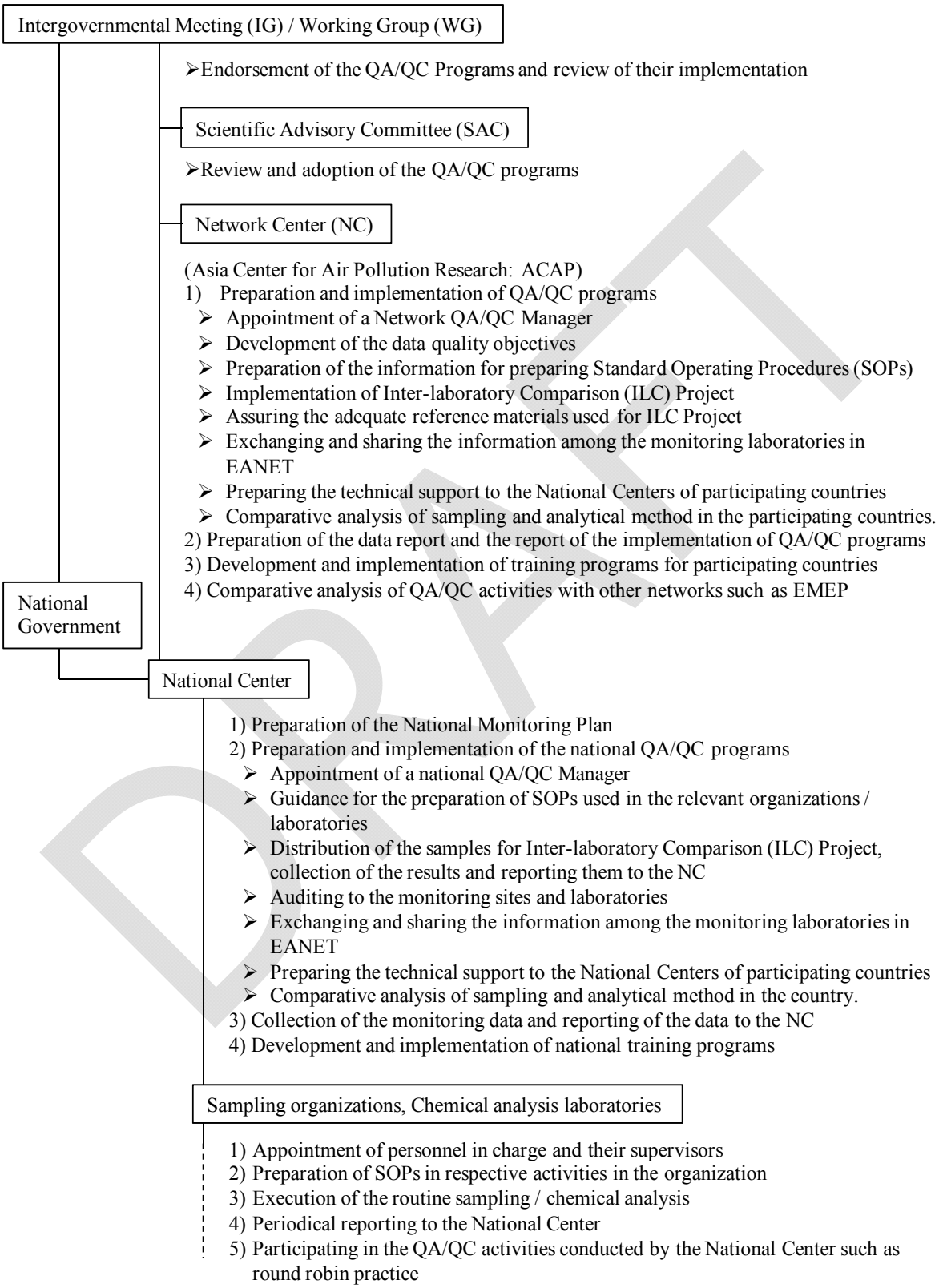


Figure 2.1 Roles of Relevant Entities

2.5 Organization

2.5.1 Network Center

The Network Center carries out the tasks under the guidance of the Intergovernmental Meeting to handle scientific and technical matters of the EANET activities and to facilitate cooperation among the participating countries in a transparent manner. The tasks of the Network Center related to the QA/QC activities are described below:

a) Preparation and implementation of the QA/QC program:
   i) Appointment of a Network QA/QC Manager,
   ii) Development of data quality objectives,
   iii) Provision of information for preparing Standard Operating Procedures (SOPs)
   iv) Exchange of information and technical support for the National Centers, and,
   v) Implementation of the Inter-laboratory Comparison Project;
b) Compilation, evaluation, storage and analysis of monitoring data and related information; and,
c) Development and implementation of education/training programs for those engaged in the EANET activities.

2.5.2 Network Quality Assurance/Quality Control (QA/QC) Manager

Network QA/QC manager who belongs to the Network Center has a responsibility to implement the QA/QC activities of the Network Center.

2.5.3 National Center

The National Center and the monitoring laboratories shall be designated by the National Focal Point of each participating country. The National Center is requested to implement the following tasks:

a) preparation of a national monitoring plan;
b) collection, analysis and evaluation of national monitoring data;
c) submission of monitoring data to the Network Center; and,
d) implementation of the national segment of the QA/QC programs:
   i) appointment of a National QA/QC Manager to implement national QA/QC programs,
   ii) field comparison of sampling method,
   iii) comparison of chemical analysis methods,
   iv) inter-laboratory comparison, and,
   v) auditing of monitoring sites and laboratories; and,
e) compilation, evaluation and storage of, and access to information;
f) preparation of a report on the state of the acid deposition problem; and,
g) other relevant activities.

2.5.4 National QA/QC Manager

The National QA/QC Manager is designated by the National Center to implement the national QA/QC programs.

2.5.5 Technical manager

The National Center should appoint a responsible technical manager to keep and improve the technical skills of the laboratories. Primary task of the technical manager is to deal with the technical problems.

2.6 Custody of record

2.6.1 General item

The National Center and the laboratories should prepare the protocols for the identification of quality and technical records, compilation of the information, storage of these information, maintenance and rejection.

The records shall be easy to read and keep then in the appropriate conditions to avoid any damage, degradation and/or loss.

2.6.2 Technical records

The National Center and the laboratories shall store their original data, the records for keeping the traceability, calibration records, records of the staffs and reports in an appropriate manner.

The responsible staff, such as technical manager and/or National QA/QC Manager, who checks and/or approves the specified records, shall be apparently identified in each record.

2.7 Technical requirements

2.7.1 General item

Many elements define the accuracy and reliability of the measurement in the laboratory. These elements contain contribution from the following items:

a) Human factor;
b) Facility and circumstances;
c) Methodology and its validation;
d) Instruments and equipment;
e) Traceability of the measurement;
f) Sampling; and,
g) Handling of the samples and their measured data.

The extent of the contribution to the overall uncertainty of the data from above items can be different according to the individual measurement. The laboratory should take these items into account to carry out the measurement.

2.7.2 Human factor

2.7.2.1 Personnel

The technical manager should ensure the ability of each personnel related to the operation of the specified facility, measurement, evaluation of the analytical results and reporting.

All of the personnel should be trained and educated, and the technical manager should qualify the personnel based on the verification as the need arise.

2.7.2.2 Education and training

The technical manager should set the goal of the education, training and skills for the personnel. The results of the education and training should be recorded.

The operation of whole monitoring activities should be carried out by the qualified personnel.

2.7.3 Facility and circumstances

Every environmental condition for the operation should be fit to the quality requirement of the measurement to avoid any data to be voided.

2.7.4 Methodology and its validation

The laboratory should adopt appropriate methods for the monitoring. The methods shall contain the procedures for sampling, handling, transportation, storage and preparation.

The laboratory also expected to prepare the directions for the monitoring when there may be some skeptical about the results of the monitoring.

The methodological manuals shall be kept new version and can be used easily by the technical staff. Any deviation of the methods from the technical manual shall be validated, allowed and accepted by the National QA/QC Manager.

2.7.5 Custody of the data

Data processing and transcription should be properly reviewed with the systematic method.

When the laboratory uses computer or any other automatic data processing system for the compilation of the data, processing, recording, reporting, storage and retrieval, the laboratory should ensure the following items:

a) The software which are developed by the laboratory should be documented in detail and validated properly; and,
b) The procedure for protecting the data has been established and utilised;

2.7.6 Facilities

The laboratory should possess all of the facilities and instruments for required activities such as sampling and measurement. The facilities and its software should satisfy the required specifications and should be operated by the qualified technical staff.

The record of operation for each significant facility or instrument and software should be maintained

at least including following items:

a) Identification of each facility and instrument;
b) Name of the manufacturer, identification of the type and serial number or any other identification;
c) Confirmation of the compatibility of the facilities to the specification for the implementation of monitoring;
d) Date of calibration and its expiration date; and,
e) Records of failure, replacement of the consumable parts, modification or repairmen.

2.8 Handling of samples

The laboratory should prepare the sample handling procedures for transport, reception, handling, preservation, storage, holding and/or disposal.
The samples should be identified by labeling specific codes and the codes should be kept throughout whole process of the monitoring. The codes are expected to avoid any confusion for handling the samples.

When the laboratory receives the samples, any kinds of bad conditions or deviation from the provision of the methods shall be recorded.

The laboratory should prepare the proper storage area and its operating procedure to prevent any degradation, loss and/or damage.

2.9 Custody of the monitoring procedures

The most significant activities to keep the quality of monitoring data are preservation of the chain of custody for whole process. The meaning of the chain of custody is the documentation showing the full process of monitoring data acquisition including sampling, transfer of sample, sample storage, handling and disposition of physical or electronic materials.
The original records of sampling and its observation, sample transport, storage, extraction and/or preparation of samples, daily check of the analytical instruments, derived data with sufficient information, record of calibration and copies of issued report should be preserved.
Each record of monitoring should include sufficient information and make the repetitive testing easy with almost same conditions as previous testing. These records can be realized the qualified personnel for each process, such as sampling, measurement and reviewing of the results.

Every observed results, data and calculation should be prepared when these parameters are produced and identified.

The example of the chain of custody is shown in Form 2.6.1.

2.10 Preparation of standard operating procedures (SOPs)

SOPs are the procedures used in all the processes of the monitoring system, i.e. in the field (sampling site), laboratory and data management areas. SOPs provide a method to ensure that all personnel follow the same procedures to avoid variance of data quality between personnel in charge, and that they conduct their works with scientific sound understanding of QA/QC. Each of the sampling and chemical analysis organizations or laboratories should make effort to prepare SOPs that meet the actual conditions of respective organizations in consideration of the Technical Manuals and the national QA/QC programs. The SOPs should be prepared to be specifically and clearly addressed even for beginners by careful reviewing, and updated timely in accordance with the latest technical and administrative advances.

SOPs should be prepared for all elements of operation starting from the provision of sampling through data reporting, in accordance with the Technical Manuals to minimize difference of precision by different analysts. It is important to ensure that SOPs be written to reflect the actual operational details. Even if samplers or analytical instruments conform to the monitoring manual, their manufacturers and/or types may be different in different sampling organizations or analytical laboratories. SOPs should be customized for each organization/laboratory. Individual SOPs should clearly describe the scope of application, designation of operational staff, their supervisors, and reporting formats etc. Additions and/or deletions to the table may be needed to ensure the individual SOPs apply to each organization.
The majour items to be included in the SOPs for each monitoring media are described as follows.

1. Sampling
  1.1. Appointment of sampling staff and their supervisors
  1.2. Check of possible changes around the sampling sites
    1) Local situation (new construction of emission and contamination sources etc.)
    2) On-site situation
  1.3. Check of sampling instruments apparatus
    1) Appearance of sampler (check for corrosion etc.)
    2) Operation of sampler (rain sensor, moving of lid, documentation of repair of sampler)
    3) Collection efficiency (comparison with standard rain gauge)
    4) Cleaning of sampling parts
  1.4. Sampling methods
    1) Sampler (including documentation of check and maintenance)
    2) Sampling interval (sampling dates)
    3) Change of sample vessels

4) Addition of biocide

2. Sample transportation and storage
2.1. Transportation of samples
2.2. Sample storage
1) On-site storage
2) Laboratory storage

3. Measurement and chemical analysis
3.1. Appointment of analysis staff and their supervisors for each item
3.2. Training plan
3.3. Pure water
1) Daily maintenance
2) Documentation of maintenance
3.4. Measurement by instruments
1) Measuring conditions of instruments
2) Calibration
3) Performance tests (sensitivity, stability, interference and its removal, documentation of repair)
4) Calculation of lowest detection limits and lowest determination limits
5) Documentation of maintenance
3.5. Operating procedures for measurements
1) Preparation of calibration curves
2) Measurement/analysis of samples
3) Repeated measurements/analyses
4) Check of sensitivity fluctuation
3.6. Treatment of measurement results
1) Calculation of concentrations
2) Measurement of sensitivity fluctuation
3) Repeat measurements/analyses
4) Calculation of ion balances
5) Comparison of measured and calculated electric conductivity

4. Quality assurance and quality control
4.1. Evaluation of sample collection
1) Comparison of precipitation amount with standard rain gauge
2) Evaluation of ion balance
3) Evaluation of conductivities
4.2. Evaluation of reliability

1) Evaluation of sensitivity fluctuations
2) Evaluation of repeated measurements/analyses
3) Evaluation of field blanks
4) Comparison between measured data and lowest detection and determination limits

4.3. Evaluation of results
1) Representativeness of sampling sites
2) Evaluation of sample validity
3) Evaluation of completeness for the sampling period
4) Determination of total precision

5. Management of sampling instruments, laboratory, measurement/analysis instruments and reagent/glassware

5.1. Management of sampling instruments
1) Appointment of management stuff and their supervisors
2) Documentation of names of manufacturers, types, manufacture dates and operation methods
3) Daily and regular maintenance and inspection methods (including troubleshooting, parts supply and recording)

5.2. Laboratory management
1) Appointment of management staff and their supervisors
2) Daily and regular maintenance and inspection methods (including items and recording format)

5.3. Management of measurement/analysis instruments
1) Appointment of responsible staff for each instrument, and overall measurement
2) Documentation of names of manufacturers, types, manufacture dates and operation methods
3) Daily and regular maintenance and inspection methods (including troubleshooting, parts supply and recording)

5.4. Management of reagents, standard materials, etc.
1) Appointment of management staff and their supervisors
2) Receiving and disposal of reagents (recording format of dates, manufacturer names, dealers, purity, degree of standard and valid period)

5.5. Management of glassware and polyethylene vessels
1) Appointment of management staff and their supervisors
2) Cleaning methods
3) Storage
4) Confirmation of cleanliness

6. External audit
1) Check of sampling sites
2) Measurement of field blank values

3) Operation check of samplers
4) Evaluation of the results of quality control
5) Evaluation of the measured results

2.11 Training and education

The technical manager should set the goal of education and training for improving the technical skills and knowledge of the technical staff. The laboratory should specify the significance of the education and training and should provide the opportunities of participation of the personnel in training with apparent objectives and procedures.
After the implementation of the education and/or training, the effectiveness of the education and/or training for the technical staff shall be evaluated.

2.12 Site / laboratory audit

The National Center should carry out an annual technical audit for each site to ensure that the on-site criteria are being met and to provide an opportunity for a detailed review of the site including the condition of the infrastructure and status of the instrumentation. Such site visits encourage communication between the National Center and site operators facilitating problem solving, technical upgrades and training. A site performance audit should be implemented in accordance with the corresponding technical documents.

The laboratory operations should also be audited by the National Center with similar frequencies to the site and sampling audit. Focus is placed on sample handling, capability of the instrumentation, the SOPs, and all QA/QC activities and their records and the log book.
The audit practice should be clearly reported and stored for further discussion and long-term evaluations of the QA/QC of the long-term monitoring operation.

3 Preparation of the National Monitoring Plan

3.1 Outline of National Monitoring Plan

The participating countries of EANET are required to submit the following information as their National Monitoring Plan to the Network Center.

- Information on the National Center and contact person(s)
- Information on the implementation body
- Number of monitoring sites
- Measurement parameters and monitoring interval
- Information on the participating laboratories for each monitoring activities
- Information on each monitoring site
  - ✓ Outline of the monitoring site
  - ✓ Methodologies of sample collection
  - ✓ Meteorological observation
  - ✓ Information on the situation of the monitoring site with maps

When there are some revisions in the monitoring plan, the National Monitoring Plan shall be submitted to the Network Center prior to start monitoring.

Especially, the information on the National Center and contact person(s) should be prepared not only in the national Monitoring Plan, but also in the data report of each participating country which submitted by the National Quality Assurance/Quality Control Manager (National QA/QC Manager) as shown in Form 3.1.1.

Form 3.1.1 Information on the National Center and contact persons

Prepared or reviewed date	
Country	
Organization	
Department	
Contact person	
National QA/QC Manager	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:

General information of the National Monitoring Plan should be summarized as shown in Form 3.1.2 – 3.1.4. The Form 3.1.4 should be prepared for each laboratory, individually.

Form 3.1.2 Overview of the implementation body

Created date of the plan	
Country	
Responsible organization	
Department	
Person in charge	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:

Form 3.1.3 Overview of measurement parameters and monitoring interval

Items	Measurement parameters	Monitoring interval
Wet deposition	1: pH, 2: EC, 3: NH_4^+, 4: Na^+, 5: K^+, 6: Ca^{2+}, 7: Mg^{2+}, 8: SO_4^{2-}, 9: NO_3^-, 10: Cl^-, 11: other ( )	1: daily 2: other ( )
Air concentration (Dry deposition)	1: SO_2, 2: O_3, 3: NO, 4: NO_2, 5: other gases (HNO_3, NH_3, HCl), 6: particulate matter ($PM_{2.5}$, PM_{10}), 7: components in PM	1: hourly 2: other ( )
Soil	1: pH(H_2O), 2: pH(KCl), exchangeable (3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: Al^{3+}, 8: H^+), 9: exchangeable acidity, 10: ECEC, 11: Carbonate, 12: T–C, 13: T–N, 14: SO_4^{2-}, 15: available phosphate, 16: other ( )	Monitoring period (month:_____, year:_____)
Vegetation	1: observation of tree decline, 2: description of trees, 3: other ( )	
Inland aquatic environment	1: Water Temp. 2: pH, 3: EC, 4: alkalinity (Gran's plot titration/ pH 4.8 endpoint), 5: NH_4^+, 6: Na^+, 7: K^+, 8: Ca^{2+}, 9: Mg^{2+}, 10: SO_4^{2-}, 11: NO_3^-, 12: Cl^-, 13: Transparency, 14: Water color, 15: DOC/TOC, 16: Chlorophyll a, 17: NO_2^-, 18: PO_4^{3-}, 19: total P, 20: total N, 21: DO, 22: SS, 23: Sediment (SO_4^{2-}, NO_3^-, and NH_4^+ in pore water), 24: others (,)	1.Lakes times/year 2.Rivers (streams) every month every two month times/year

Form 3.1.4(1) participating laboratories for each monitoring activity

wet deposition / air concentration (dry deposition)			
Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

Form 3.1.4(2) participating laboratories for each monitoring activity

soil and vegetation			
Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

Form 3.1.4(3) participating laboratories for each monitoring activity

inland aquatic environment			
Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

Form 3.1.4(4) participating laboratories for each monitoring activity

catchment-scale			
Organisation		Code	
Person in charge in the laboratory			
Postal address			
Contact information			
Note	Tel: Fax: E-mail:		
Organisation			

Note. If more than one laboratory is involved, describe main laboratory in charge of the stream water chemistry.

3.2 Site selection

3.2.1 Classification of the monitoring sites

EANET monitoring sites are classified into two basic categories, namely deposition monitoring sites and ecological survey sites.

Deposition monitoring sites are sampling sites to collect fundamental data on the temporal and spatial distribution of acid deposition, and are further classified into three sub-categories: remote sites, rural sites and urban sites for the objectives of the monitoring.

Ecological survey sites are those to provide basic data for assessing the effects of acidification on terrestrial ecosystems, and further classified into two sub-categories: basic survey sites and ecosystem analysis sites.

All sites in each country should be classified according to these categories. Regarding the deposition monitoring sites, at least one or more remote or rural sites should be established in a participating country in the EANET activities.

3.2.2 Deposition monitoring sites

Deposition monitoring sites in this network should be classified into three sub-categories as described above. These sub-category sites should be established according to the objectives of the monitoring.

Wet deposition monitoring, and desirably dry deposition monitoring as well, should be carried out at these sites.

In general, a deposition monitoring site should not be located in areas dominated by local emission sources and contamination sources. Coastal areas may be influenced by sea spray. Volcanic areas and hot spring resorts may receive influence by geothermal emissions such as sulphur dioxide (SO_2), hydrochloric acid (HCl) and hydrogen sulphide (H_2S), gravel roads, farmyards and tilled agricultural field by windblown soil dust, and grazing land and pasture by ammonia.

In particular, ammonia is a special problem since the emissions are mainly linked with animal husbandry and agricultural activities.

In selecting the deposition monitoring site, following consideration should be made:

- Topographic features and land use types around the sites;
- Availability of the meteorological conditions such as annual precipitation amounts and prevailing wind directions;
- Excluding the areas which dominated by local meteorological conditions such as mountaintops, cols, coastal sites with the effects from local wind;
- Excluding the areas which are subjected to the formation of stagnant air such as valleys and basins
- Considering the emission sources within 20km from the possible candidate site;
- Considering the minimization of local influences; and,
- Preparing of the records and reports concerning the detailed information around the site and the possible influence.

For all types of the sites, particular care must be taken that each site keeps representing the region of interest in terms of natural and anthropogenic emissions, and topographic features.

No sources should be confirmed to impact the site in consideration of gravel roads, tilled agricultural fields, grazing land and pasture.

Meteorological conditions, including annual precipitation amounts and prevailing wind directions, should be taken into account. For elimination of local meteorological influences, a site selection should not be made from mountaintops, cols, valleys or basins. In general, they should not be located around strong natural sources such as volcanoes unless the focus is to monitor their influences on precipitation chemistry.

Available stable electricity throughout the year is a critical point of the wet-only sampling practice. Solar power will be a solution to select a remote site whose location is topographically appropriate but

that electricity is unavailable.

3.2.2.1 Remote sites

- Remote sites should be representative of the EANET region by being located in areas, where:
  - ✓ no significant changes in land-use practices are expected for decades within a reasonable distance as will be mentioned in all directions from the site; away from majour populations and industrial centers, away from majour highways and airports; if possible on inlands, mountain ranges and majour forest reserves;
  - ✓ effects of majour natural phenomena including volcanic eruptions, forest fires and dust storms are not frequently experienced;
  - ✓ the airshed is supposed to be entirely free of the influence of local pollution sources and contains only diluted vestiges of chemical species transported from long distant sources at least 30 – 50 kilometers away.
- Remote sites are to be established for the assessment of the state of acid deposition in background areas. The monitoring data can be used to evaluate long-range transport and transmission models of acidic substances in East Asia.
- The remote sites which located at existing meteorological stations, in particular, upper wind monitoring stations, or in their vicinity are required.
- Remote sites should not be located in areas within 50 km of large emission sources such as cities, thermal power plants and majour highways.
- The remote sites should not be located in the areas within 500 m from heavy traffic roads (more than 500 vehicles/day)

3.2.2.2 Rural sites

- Rural sites should be located:
  - ✓ in areas sufficiently far away from population and industrial centers, and the site is free from the effect of large local sources of air pollution throughout most of the year.
- Rural sites are to be established for the assessment of the state of acid deposition in rural areas or inlands.
- The monitoring data can be used, for instance, to evaluate the effects of acid deposition on agricultural crops and forests.
- The location of these sites should be selected in areas with minour influence from local emission and contamination sources.
- The rural sites should be sites away from significant stationary and mobile sources, and should be free from these influences to the extent possible.
- Some rural sites which generally satisfy the criteria for remote sites may also be used to evaluate long-range transport and deposition models of acidic substances.
- Rural sites should not be located in areas within 20 km of large emission sources.
- The rural sites should not be located in the areas within 500 m from heavy traffic roads (more than 500 vehicles/day)

3.2.2.3 Urban sites

- Urban sites are to be established for the assessment of the state of acid deposition in urban areas.
- Urban and industrialised areas, and the areas in the close vicinity of such areas, can be included.
- The monitoring data can be used such as the evaluation of the effects of acid deposition on buildings and historical monuments.
- Monitoring data at these sites may also be available for the assessment of acidity of precipitation and the trends in urban areas.

3.2.2.4 Local criteria

The criteria for locating samplers in remote sites, rural sites and sites in ecological area are as follows:

- An open, flat, grassy area far enough from trees, hills and other obstructions to avoid effects on sampling. No objects should be within a few meters of the sampler, and no objects should shade the sampler;
- The horizontal distance between a large obstruction and the sampler should be at least twice the obstruction height, or the top of an obstruction as viewed from the collector should be less than 30^{o} above the horizon;
- The sampler should be free from local emission and contamination sources such as waste disposal sites, incinerators, parking lots, open storage of agricultural products and domestic heating. Regions within 100 m of these emission and contamination sources should be excluded; and,
- The horizontal distance between sampler and rain gauge (and dry deposition sampler) should be greater than 2 meters. The rain gauge and the wet deposition sampler should cross the direction of the prevailing wind during precipitation events.

3.2.3 Ecological survey sites

Ecosystem analysis sites are to be established for the assessment of acid deposition impacts on whole ecosystems through application of, for instance, terrestrial ecosystem analysis and/or catchment analysis.

The location of these sites should be selected in areas where terrestrial ecosystems are sensitive to changes in atmospheric acidity. Some of these sites should also be located in ecologically conserved areas.

Elemental dynamics in ecosystems should be surveyed, and environmental sensitivity to acid deposition should be estimated at these sites.

Acid deposition models may also be developed for these sites.

3.2.3.1 Basic survey of soil and forest

The soil and vegetation monitoring could be an establishment of baseline data, and also early detection of possible impacts of acid deposition, particularly on plants and forest ecosystems.

Soil and forest properties may be characterized by area specific factors such as climate, geological and geographical features. For the evaluation of data in soil and forest monitoring, these area specific factors should be reported.

Preliminary surveys should be carried out to select sites for permanent monitoring. Preliminary

surveys should be conducts over extensive areas to select sites for continuous monitoring to detect possible impacts of acid deposition on forest ecosystem.

The geographical range of such surveys should cover the area within a radius of approximately 50 km of deposition monitoring sites.

1) Establishment of permanent monitoring sites

The following criteria should also be considered for the selection of soil and forest monitoring sites:

- Two forest sites, whose soils have different sensitivities to acid deposition, are recommended to be selected. When there are some difficulties to find the soils which have different sensitivities, selecting only one site is also acceptable.
- Each site should be established in a continuous forest area of more than one hectare. If the area is surrounded with a suitable shelter belt, 0.2 hectare is sufficient.
- Sites must be accessible for surveying over a long period (decades). The sites on which land use patterns do not change over this period of observation should be selected.
- A common tree species or the dominant vegetation type between the sites will be expected to be selected.

2) Characterisation of basic survey site

The soil and forest monitoring should be carried out in a basic survey site. When some symptoms would be detected in the basic survey site, intensive survey for clarification of the implication with acid deposition would be carried out.

3) Collection of information on soils, vegetation and other characteristics.

The following information on soils, vegetation, geography, and meteorology should be collected in the preliminary surveys. Fieldwork should be carried out if necessary. Information on the monitoring sites should be recorded correctly, and the characteristics of the sites in the country should be clarified.

Collection of the comparable maps with standardised international taxonomy of soil and vegetation is recommended.

Soil and vegetation classification should be unified according to the "FAO/UNESCO Soil Map of the World (FAO/UNESCO. 1977)".

a) **Soil information**

Most East Asian countries already have their own soil maps. However, these maps are sometimes described using specific soil units in individual countries.

For the comparison purpose, collection of the comparable maps with standardised international taxonomy of soil and vegetation, such as the FAO/UNESCO Soil Map of the World is recommended.

When these information are not available, it is expected that the maps in each country will be accompanied by columnar sections of representative soil profiles and analytical data, which clarify the nature of the soils.

Mineralogical composition and land use history are also useful.

The soil maps using a scale of 1:50,000, preferably 1:25,000, should be collected to carried out preliminary survey.

Note:

- ✓ *If any soil maps are not available for the areas of preliminary surveys, fieldwork should be carried out to collect geological, geographical and/or land-use information.*
- ✓ *Surface geological maps, geographical maps and land-use maps may also be available for the evaluation of characteristics of monitoring sites.*
- ✓ *Any kinds of relevant available information should be collected for the preliminary survey.*

b) **Vegetation information**

Most East Asian countries have already had their own vegetation (plant-sociological) maps, Physiognomic vegetation maps and/or land-use maps. As mentioned above, the collection of maps which correspond to the international taxonomy, such as "FAO/UNESCO Soil Map of the World" is expected for comparison purpose.

Note:

- ✓ *If any vegetation maps are not available for the areas of preliminary surveys, using aerial photographs and/or satellite images which shows vegetation is also effective.*

c) **Climate and meteorological information**

Each country should use meteorological observation stations to collect meteorological data, including temperature, precipitation, evapotranspiration, wind direction, wind velocity and insolation (e.g. photosynthetically active radiation, PAR). Especially annual mean temperature and annual precipitation should be required for more than 10 years in the past. These meteorological data will be collected from the observation stations in the area within a radius of approximately 50 km of deposition monitoring sites.

All the items of climate and meteorological information for the preliminary surveys are not mandatory. The items, which can be obtained in accordance with the procedures of the meteorological monitoring system of each country, could be used.

d) **Selection of plots for soil monitoring**

When forest monitoring sites are selected, two forest sites, whose soils have different sensitivities to acid deposition, is recommended to be selected.

Several plots, at least two plots, occupying areas from 5 m-square to 10 m-square, should be selected randomly at each monitoring site (each soil type).

For establishment of plots, soil profile description should be carried out.

In the plot, five sub-plots, each occupying 1 m-square, are selected in principle at the center and on the diagonal lines of the plot.

3.2.3.2 Basic survey for inland and aquatic environment

a) **Criteria for site selection of lakes and/or revers (streams)**

- ➢ Lakes will be selected as monitoring sites.
- ➢ When the appropriate lakes are not available, rivers (streams) that are potentially susceptible to acidification and have little artificial influence should be selected.
- ➢ The sampling point should be representative in the water bodies.
- ➢ The representativeness of the sampling site concerning to the water quality of the water body

should be confirmed by analyzing relevant items of surface water in several points (more than five sites including the center of the water body) within a half year from starting of sampling

- In the case that there are islands at the center of site, the detailed survey is needed to decide a representative point in the site.
- It is desirable that the monthly and ten-day period variations be investigated to evaluate the representativeness of a sampling site (more than 4 times, in each season).
- For the time being, on-site measurement of water temperature, electric conductivity and pH values can be deemed as a substitute method for these investigations.

i) **Criteria of lakes**

- The selection of harmonic lakes which are considered to be potentially susceptible to acidification is recommended.
- The priority of selecting natural lakes is much higher than that of artificial lakes.
- When the management such as dredge is carried out, effects of the management should carefully be investigated.
- Oligotrophic or Mesotrophic of harmonic lake is recommended (as shown in Table 3.2.1).
- When there is no harmonic lake, dystrophic lakes could be selected for monitoring. In this case, however, appropriate monitoring methods should be further investigated.
- Choosing the monitoring lakes which are harmonic type with low BOD, COD, or TOC (inorganic acidic lakes, organic acidic lakes or alkaline-based eutrophic lakes is not good for the monitoring) is expected.
- The monitoring lakes having a maximum depth of approximately 10 m or less, a water retention time of 1 year or less, water area from 1 hectare to 100 hectares, low alkalinity (less than 200 μeq L^{-1}) or electric conductivity (less than 10 mS m^{-1}), minimal anthropogenic water pollution and no coverage of the surface with aquatic plants are also preferable.
- The catchment area in the lakes is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation. The access from the site to the laboratory is desirable to be short for preventing change of the sample qualities.

Table 3.2.1. Classification of harmonic lakes by trophic level (OECD, 1982)

Classification	TP* / mg m^{-3}	Chlorophyll-a / mg m^{-3}		Transparency / m	
		mean	max	mean	min
Extreme oligotrophic	≤ 4.0	≤ 1.0	≤ 2.5	≥ 12.0	≥ 6.0
Oligotrophic	≤ 10.0	≤ 2.5	≤ 8.0	≥ 6.0	≥ 3.0
Mesotrophic	10 ~ 35	2.5~8	8~25	6~3	3~1.5
Eutrophic	35 ~ 100	8~25	25~75	3~1.5	1.5~0.7
Hypereutrophic	≥ 100	≥ 25	≥ 75	≤ 1.5	≤ 0.7

* TP: Total Phosphorus

- Preliminary chemical analysis is recommended for site selection on items as follows,
  - ✓ Water temperature (W.T.)

- ✓ pH
- ✓ electric conductivity (EC)
- ✓ transparency
- ✓ water color
- ✓ alkalinity
- ✓ dissolved oxygen (DO)
- ✓ dissolved organic carbon (DOC) (if impossible, chemical oxygen demand (COD))
- ✓ Cations: NH_4^+, Na^+, Ca^{2+}, Mg^{2+}, K^+ and total dissolved Al
- ✓ Anions: SO_4^{2-}, NO_3^- , NO_2^-, Cl^- and PO_4^{3-}

ii) **Criteria of rivers (streams)**

- ➢ Rivers or streams that are potentially susceptible to acidification may be selected, where the impacts of human activities such as deforestation, slash-and-burn farming, stock-farming or cultivation is not being conducted or planned in the future in the upper stream area of the water sampling site.
- ➢ Streams have higher priority than rivers in the site selection to prevent the influence of other pollutions and storm runoff.
- ➢ In the case of selecting rivers, the upper streams of a river or first-order streams (as stream order) is desirable for the areas with storm events. At upper reach of the stream area, monitoring should be done at one point, and measurement of the flow is desirable.
- ➢ Choosing monitoring rivers (streams) which are natural rivers (streams), having low alkalinity (less than 200 $\mu eq\ L^{-1)}$ or electric conductivity (less than 10 $mS\ m^{-1}$) with low BOD, COD, or TOC is recommended. The recommendations for catchment properties and accessibility are the same as the lakes.
- ➢ Flow volume and ion concentrations change dramatically with intense rainfall in rivers (streams).
- ➢ Sampling should be carried out when there is no or small rainfall (below 10 mm per day) within 2 days before monitoring for average samples.
- ➢ Samples should also be collected during flood and after intensive rainfalls or snow melting, if possible. This will allow us to get more reliable information already on the stage of a plot selection. On this stage, the most important parameters to be measured are the temperature, electric conductivity, and pH values.
- ➢ The river/stream's catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation.
- ➢ Preliminary chemical analysis is recommended for site selection on items as follows,
  - ✓ Water temperature (W.T.)
  - ✓ pH
  - ✓ electric conductivity (EC)

- ✓ transparency
- ✓ water color
- ✓ alkalinity
- ✓ dissolved oxygen (DO)
- ✓ dissolved organic carbon (DOC) (if impossible, chemical oxygen demand (COD))
- ✓ Cations: NH_4^+, Na^+, Ca^{2+}, Mg^{2+}, K^+ and total dissolved Al
- ✓ Anions: SO_4^{2-}, NO_3^- , NO_2^-, Cl^- and PO_4^{3-}

➢ Recommended criteria for site selection are summarized in Table 3.2.1.

Table 3.2.1. Recommended criteria for site selection

Recommendation items	Lakes	Rivers (streams)
Alkalinity	less than 200 μeq L^{-1}	
EC	less than 10 mS m^{-1}	
Trophic level	oligotrophic	-
BOD (COD), TOC	low	
Retention time	Less than 1 year	-
Depth	Less than 10 m (max)	Less than 2 m (cross-sectional mean)
Discharge	-	< 5 m^3 s^{-1}
Water area	1~100 ha	-
Surface situation	No coverage of aquatic plants	
Human activities	No or minimal	
Recommendation items for the catchment of the site		
Location of river	Rivers in the mountain areas	
Catchment Area	< 500 ha	
Bedrock geology	Acidic or neutrality	
Vegetation	Natural	

b) **Collection of information concerning monitoring site**

➢ An inventory of lakes (including man-made reservoirs) based on their limnological significance and/or with water area of larger than 1 hectare in the area in question should first be prepared.

➢ The monitoring site should be selected from the inventory, based on the criteria for site selection. Then the following information on both the selected site and its watershed/catchment should be collected as much as possible from the past to the present.

➢ The standard format and an example of information on the site and its watershed/catchment are shown in Table 2.3 and 2.4 respectively.

➢ A colored photograph of the site is useful. An aerial view of the site is most preferable.

i) **Lakes**

➢ Characteristics of lakes

- ✓ location and location map
- ✓ elevation
- ✓ origin

- ✓ area
- ✓ shore line length,
- ✓ lake hydrologic type (seepage, closed, drainage, and reservoir)
- ✓ lake trophic type (oligotrophic, mesotrophic, eutrophic and dystrophic with indication of OECD criteria etc.)
- ✓ water depth (mean and maximum),
- ✓ water volume
- ✓ bathometric map
- ✓ range of annual water level fluctuation
- ✓ residence time of water
- ✓ lake utilization (irrigation, domestic water, electric power, fish culture, sightseeing, and others)

➢ Watersheds/Catchments

- ✓ area
- ✓ elevation and topography
- ✓ surface geology
- ✓ soil types
- ✓ vegetation,
- ✓ land use
- ✓ population
- ✓ numbers and discharge of streams (inlets and outlets),
- ✓ numbers, discharge and water qualities of spring or ground waters around the shore
- ✓ wind direction and speed (mean and prevailing)
- ✓ precipitation
- ✓ solar radiation

➢ Living organisms in lakes

- ✓ chlorophyll pigments
- ✓ fauna
- ✓ flora
- ✓ biomass of bacteria and phytoplankton,
- ✓ primary productivity of phytoplankton
- ✓ zooplankton
- ✓ fish
- ✓ benthic organisms

➢ Sediment in lakes

Physico-chemical properties:

- ✓ texture
- ✓ grain size
- ✓ volumetric water content(bulk density)

- ✓ electoric potential of hydrogen (Eh)
- ✓ organic carbon
- ✓ SO_4^{2-}
- ✓ NO_3^-
- ✓ sulfur stable isotope ratio of sulfate (if available)
- ✓ sedimentation rate (if available)

Biological properties:

- ✓ Diatom species

ii) **Rivers (streams)**

- ➢ Characteristics of rivers (streams)
  - ✓ location and location map
  - ✓ elevation
  - ✓ origin
  - ✓ area
  - ✓ range of annual discharge fluctuation (at the sampling site)
  - ✓ river utilization (irrigation, domestic water, electric power, fish culture, sightseeing, and others)
- ➢ Watershed and/or catchment of rivers (streams)
  - ✓ area
  - ✓ elevation and topography
  - ✓ surface geology
  - ✓ soil types
  - ✓ vegetation
  - ✓ land use
  - ✓ population
  - ✓ numbers, discharge and water qualities of spring or ground waters around the river
  - ✓ precipitation
  - ✓ solar radiation
  - ✓ wind direction and speed (mean and prevailing)
- ➢ Living organisms in rivers (streams)
  - ✓ fauna
  - ✓ flora
  - ✓ fish
  - ✓ benthic organisms
- ➢ Sediment in rivers (streams)

Physico-chemical properties:

- ✓ texture

- ✓ grain size
- ✓ volumetric water content(bulk density)
- ✓ electoric potential of hydrogen (Eh)
- ✓ organic carbon
- ✓ SO_4^{2-}
- ✓ NO_3^-,
- ✓ sulfur stable isotope ratio of sulfate (if available)
- ✓ sedimentation rate (if available)

Biological properties:

- ✓ attached algae (diatom species)
- ✓ chlorophyll pigments

3.2.4 Catchment study sites

Sites for the catchment-scale monitoring should be selected taking the following recommendations into account:

- ➢ A forest catchment with a stream should be selected, while the size of the catchment may depend on each situation.
- ➢ The catchment, where the water budget has been estimated, is preferable.
- ➢ Sensitivity of soil or bedrock geology to atmospheric deposition should be considered for site selection.
- ➢ If possible, the site should be in vicinity of the EANET acid deposition site to estimate atmospheric deposition amounts precisely.
- ➢ Other ecological information from nearby sites is valuable.

3.2.5 Information on the selected sites

The detailed information on the selected monitoring sites shall be prepared as a part of the National Monitoring Plan.

Related part of the National Monitoring Plan shall be prepared for each site.

3.2.5.1 Wet deposition monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.1.

Form 3.2.1 Outline of monitoring site

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	° ’ ” N S	Longitude	° ’ ” E
Altitude	m		
Height of sampling funnel	from the ground level: m from the floor of sampler installed: m		

where:

Site name: Name of the site shall be written in official English spelling.

Code: Code of the site has been set by the Network Center and informed

Site classification: Classification of the site shall be defined in accordance with the criteria described in **3.2.1**.

Latitude and longitude: These parameters should described based upon the World Geodetic System, such as WGS84 (2004).

Altitude: This parameter should be described as a height from sea level.

2) Sample collection

The format for preparing this part is shown in Form 3.2.2. This format shall be filled with the sampling information of each site.

Form 3.2.2 Sample collection

Period of sample collection	1: daily, 2: every precipitation event, 3: weekly, 4: biweekly, 5: monthly, 6: daily collection and weekly composite analysis, 7: other ( )
Sampling system	1: wet only sampler 2: other ( )
Sampler	Manufacturer: Model: Funnel diameter: mm

3) Meteorological observation

The format for preparing this part is shown in Form 3.2.3. This format shall be filled with the meteorological observation around each site.

Form 3.2.3 Meteorological observation

On site measurement of precipitation amount	Usage of rain gauge: 1: yes 2: no if yes, Manufacturer: Model: Height from the ground level: m Measurement mode: 1: tipping bucket, 2: gravimetric, 3: other ( )
On-site observation of other parameters	1: wind direction, 2: wind velocity, 3: temperature, 4: humidity, 5: solar radiation, 6: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):
	Possible obtaining data: 1: precipitation amount, 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )

4) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.2.4 – Form 3.2.6. In these forms, the surrounding conditions for each direction shall be described in the

following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of "Outline of monitoring site". And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

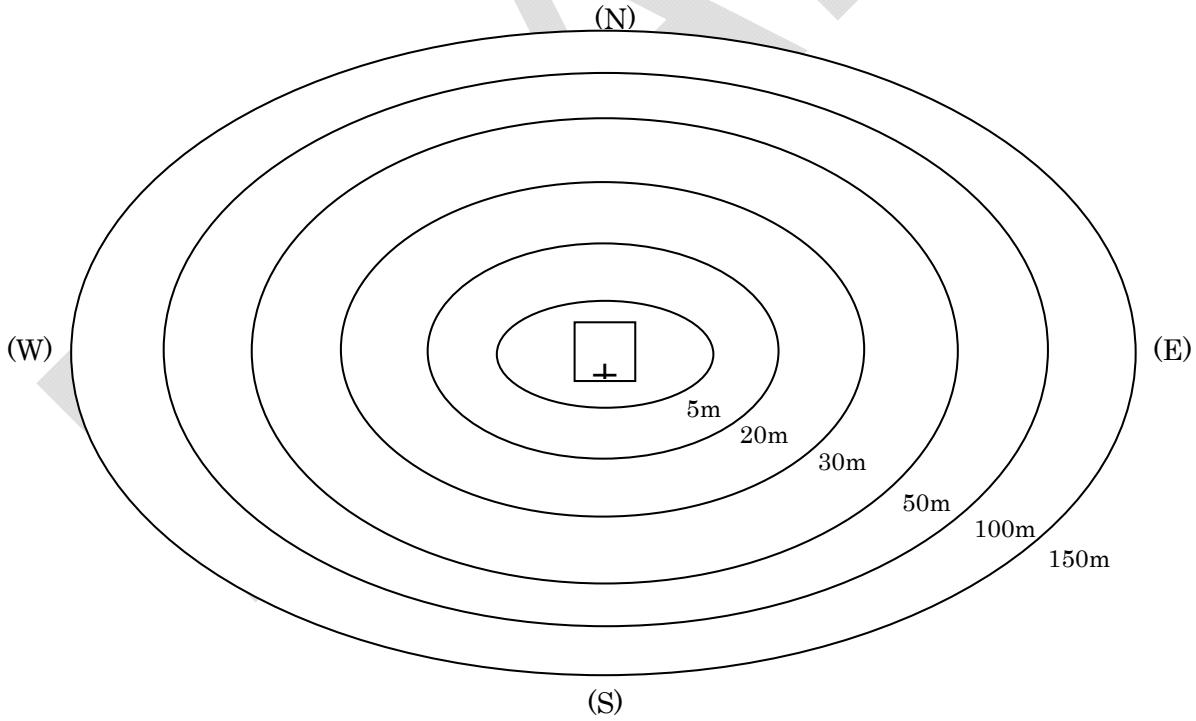
- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

Form 3.2.4 Outline of monitoring site: On-site scale (distance within 150 m)

Items	North direction (NW – NE)	East direction (NE – SE)	South direction (SE – SW)	West direction (SW – NW)
Existence of trees, poles and buildings, and the height of those				
Existence of incinerators, domestic heating, parking lots, storage of fuel and agricultural products, daily farm, and many livestocks				
Slope degree of the site	° – °	° – °	° – °	° – °
Surface condition of the site				
Existence of a forest, river, lake, marsh, farm or fields				
Existence of roads and their traffic densities*				

* Describe roads with more than 100 vehicles/day for remote sites and roads with more than 1,000 vehicles/day for urban and rural sites.

On-site Scale (within 150 m)

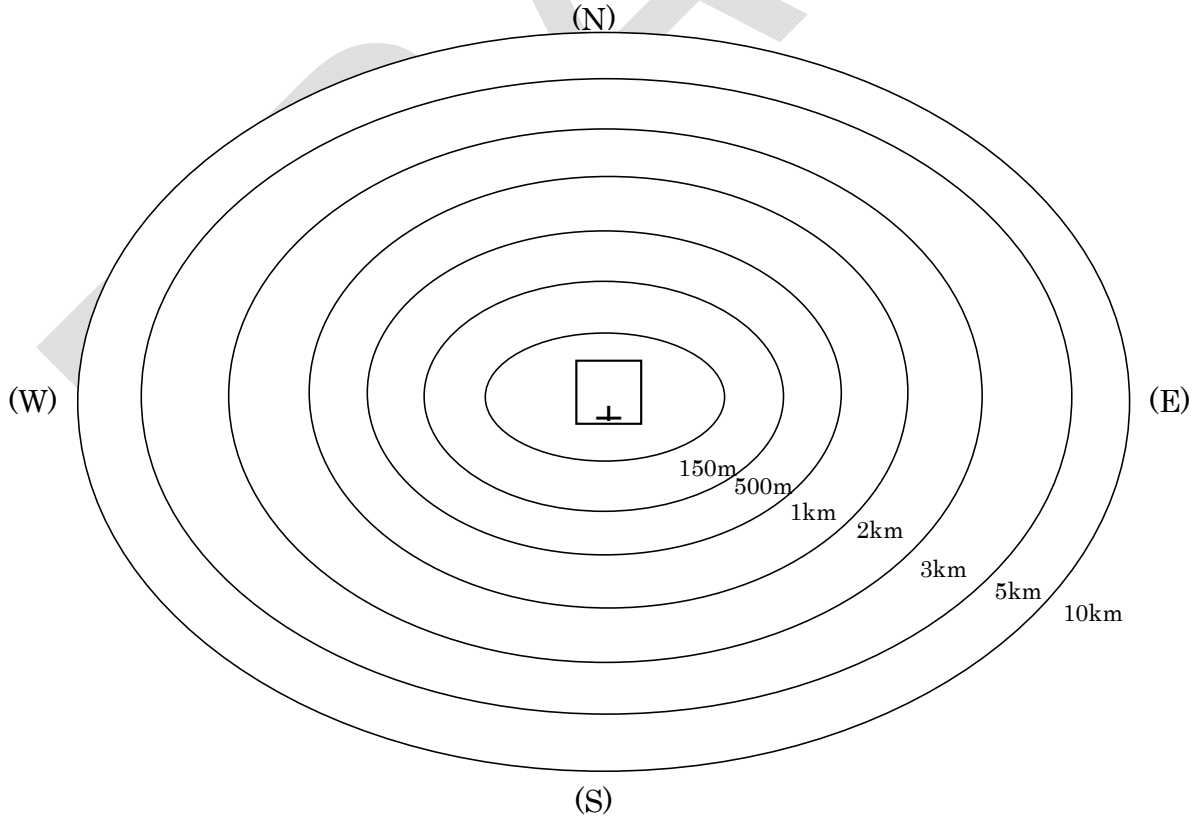


Site Name : _____

Form 3.2.5 Outline of monitoring site: Local scale (distance 150 m – 10 km)

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Information on trunk roads, expressways, and their traffic densities (with more than 5,000 vehicles/day)				
Information on airports and railways				
Information on major emission sources such as large industries, and power plants and their fuel consumptions and so on				
Information on houses/ settlements with more than 5,000 persons, and their population				
Descriptive information around the site such as topography and meteorological condition				

Local Scale (150 m – 10 km)



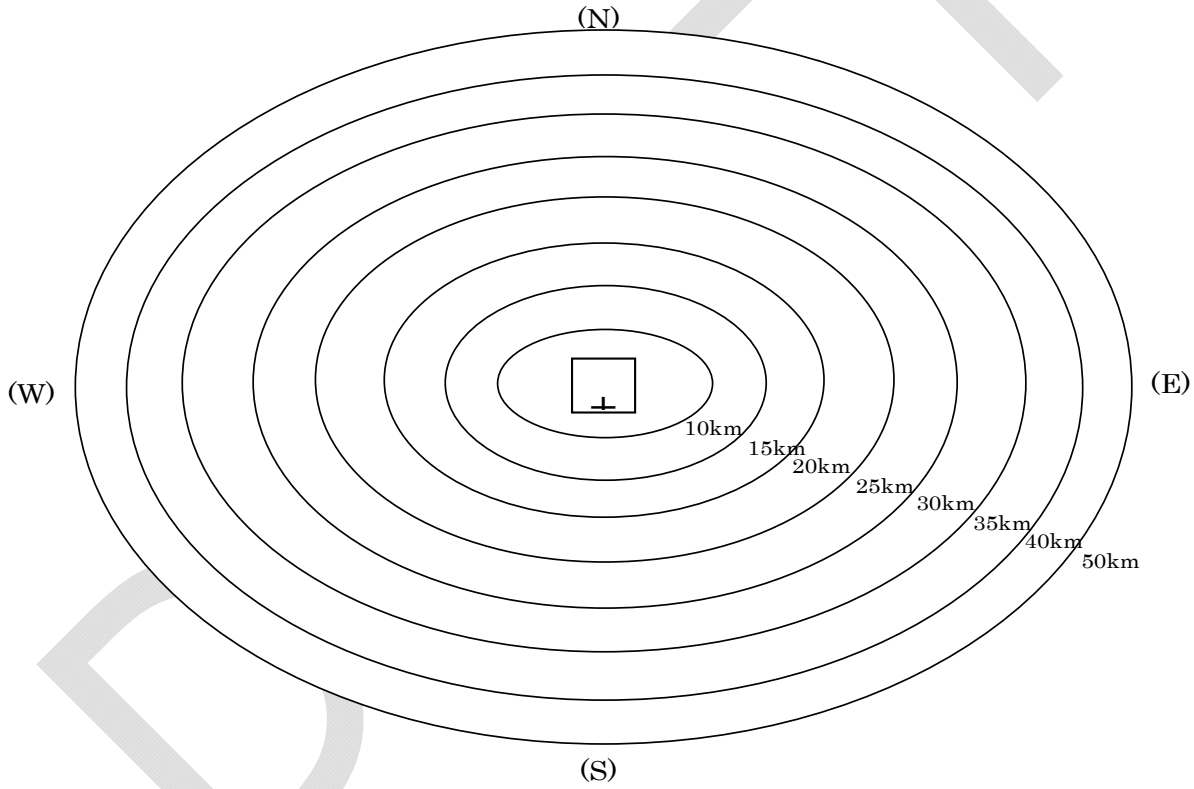
Site Name : _____

Form 3.2.6 Outline of monitoring site: Regional scale (distance 10 km – 50 km)

*: For rural site, description should be made on huge emission sources larger than 10,000 tons/y and other major pollution sources.

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Existence of main stationary air pollution sources*				
Existence of trunk roads with more than 10,000 vehicles/day, and their traffic densities				
Existence of cities with the population more than 10,000 persons				

Regional Scale (10 km – 50 km)



Site Name : _____

3.2.5.2 Dry deposition monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.7.

Form 3.2.7 Outline of monitoring site

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	° ' " N S	Longitude	° ' " E
Altitude	m		
Height of sampling funnel	from the ground level: m from the floor of sampler installed: m		

where:

Site name: Name of the site shall be written in official English spelling.

Code: Code of the site has been set by the Network Center and informed

Site classification: Classification of the site shall be defined in accordance with the criteria described in **3.1.2**.

Latitude and longitude: These parameters should described based upon the World Geodetic System, such as WGS84 (2004).

Altitude: This parameter should be described as a height from sea level.

2) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.3.4 – Form 3.3.6.

In these tables, the surrounding conditions for each direction shall be described in the following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of "Outline of monitoring site". And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

3) Outline f monitoring

The format for preparing this part is shown in Form 3.2.8 – 3.2.19 for gaseous sample collection and Form 3.2.10 – 3.2.11 for particulate sample collection. These formats shall be filled with the sampling information of each site. And Form 3.2.8 and Form 3.2.11 shall be prepared for all monitoring parameters, independently.

Form 3.2.8 Outline of monitoring (Gas)

Measuring parameters	1: SO_2, 2: NO_2, 3: NO, 4: O_3, 5: others (HNO_3, NH_3, HCl)
Period of sample collection	1: an hour, 2: 12 hours, 3: a day, 4: a week, 5: two weeks, 6: a month, 6: other ( )
Measurement interval	1: continuous, 2: hourly, 3: daily, 4: weekly, 5: biweekly, 6: monthly, 7: other ( )

Form 3.2.9 Monitoring method (Gas)

Measuring parameters	1: SO_2, 2: NO_2, 3: NO, 4: O_3, 5: others (HNO_3, NH_3, HCl)
Method	1: automatic monitor (method:) Manufacturer: Model:
	2: manual method 1) filtration [(a) diffusion denuder, (b) filter pack] Sampling flow rate: liters/min

Form 3.2.10 Outline of monitoring (Particulate)

Measuring and analyzing parameters	1: gravimetric method (a: TSP, b: PM-___), 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 8: NO_3^-, 9: Cl^-, 10: others ( )
Period of sample collection	1: an hour, 2: a day, 3: a week, 4: two weeks, 5: a month, 6: other ( )
Measurement interval	1: continuous, 2: hourly, 3: daily, 4: weekly, 5: biweekly, 6: monthly, 7: other ( )

Form 3.2.11 Monitoring method (Particulate)

Method	1: automatic monitor (method:), Manufacturer: Model: 2: gravimetric method (a: Hi-vol sampler, b: Low-vol sampler), 3: other ( )

4) Meteorological observation

The format for preparing this part is shown in Form 3.2.12. This format shall be filled with the meteorological observation around each site.

Form 3.2.12 Meteorological observation

On-site observation of other parameters	1: precipitation amount (a: tipping bucket, b: gravimetric, c: other( )) 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):

3.2.5.3 Soil and vegetation monitoring

1) Outline of monitoring site

The format for preparing this part is shown in Form 3.2.13

Form 3.2.13 Outline of monitoring site (Permanent site for soil monitoring)

Site name (Soil type)	( )	Code	
Location			
Latitude	° ’ ” N S	Longitude	° ’ ” E
Altitude	m		
Data of wet deposition	1: on site measuring data 2: use the nearest wet deposition monitoring site data		
In case of use the nearest wet deposition monitoring site data	Name of the site: distance from the site: km direction from the site (bearings):		
Site classification of the wet deposition monitoring site	1: urban 2: rural 3: remote		

2) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.3.4 – Form 3.3.6.

In these tables, the surrounding conditions for each direction shall be described in the following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of “Outline of monitoring site”. And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

3) Outline of monitoring

The format for preparing this part is shown in Form 3.2.14 and 3.2.15. This format shall be filled with the monitoring information of each site.

Form 3.2.14 Outline of monitoring for soil

Monitoring parameters	1: pH (H_2O), 2: pH (KCl), 3: exchangeable (3: Na^+, 4: K^+, 5: Ca^{2+}, 6:Mg^{2+}, 7: Al^{3+}, 8: H^+), 9: exchangeable acidity, 10: ECEC, 11: Carbonate, 12: T–C, 13: T–N, 14: SO_4^{2-}, 15: available phosphate, 16: others ( )
Monitoring interval	1: annual, 2: every___years, 3: irregular (date of the last survey [dd / mm / yyyy])

Form 3.2.15 Outline of monitoring for vegetation observation

Monitoring parameters	1: observation of tree decline, 2: description of trees, 3: others ( )
Monitoring interval	1: annual, 2: every___years, 3: irregular (date of the last survey [mm / dd / yyyy])

4) Meteorological observation

The format for preparing this part is shown in Form 3.2.16. This format shall be filled with the meteorological observation around each site.

Form 3.2.16 Meteorological observation

On site measurement of precipitation amount	Usage of rain gauge: 1: yes, 2: no if yes, Manufacturer: Model: Height from the ground level: m Measurement mode: 1: tipping bucket, 2: gravimetric, 3: other ( )
On-site observation of other parameters	1: wind direction, 2: wind velocity, 3: temperature, 4: humidity, 5: solar radiation, 6: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):
	Possible obtaining data: 1: precipitation amount, 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )

3.2.5.4 Inland aquatic environment monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.17.

Form 3.2.17. Standard format for the site properties (research year)

Country			
Location			
Kind	1. Lake 2. River (stream) 3. Other ( )		
Site name			
Altitude	m above sea-level		
Site Classification	1. Urban 2. Rural 3. Remote		
Latitude	° ' " N S	Longitude	° ' " E
Origin (for lakes/ponds)			
Nearest Wet deposition monitoring site	(km)		
Living organisms			
Catchment Area	km^2 (based on the sampling site)		
Catchment elevation and topography	m~ m		
Surface geology			
Soil types			
Vegetation			
Land use			
Population			
Lake area	m^2	Lake shape	
Shore line length	m		
Lake trophic type			
Water depth(mean)	m	(maximum)	m
Water volume	m^3		
Annual water level fluctuation	m ~ m (mean m)		
Residence time of water			
Lake utilization			
Number of inflow river		Number of outflow river	
River length			
River water depth (mean)	m	Minimum & maximum	m
Flow discharge (m^3 sec^{-1})	Mean Minimum Maximum		
Drought or freeze	1. Nothing 2. Existence(~)		
Lake or river (flows into)			
Precipitation (mm)	Annual and monthly data		
Evaporation (mm)	At least annual		
Solar radiation			
Wind speed	mean		
Prevailing Wind direction			
Annual air temperature			
Relative humidity			
Nearest meteorological station			
Soil chemical properties in the catchment area			
Bottom sediment			

2) Criteria for site selection of lakes and/or rivers (streams)

Lakes will be selected as monitoring sites. If appropriate lakes are not available, rivers (streams) that

are potentially susceptible to acidification and have little artificial influence should be selected.

Because the sampling point should be representative in the water bodies, it should be confirmed within half a year from the start of sampling, that the sampling site represents the water quality of the water body, by analyzing relevant items of surface water in several points (more than five sites including the center of the water body). In the case that there are islands at the center of site, the detailed survey is needed to decide a representative point in the site. It is desirable that the monthly and ten-days period variations be investigated to evaluate the representativeness of a sampling site (more than 4 times, in each season). For the time being, on-site measurement of water temperature, electric conductivity and pH values can be deemed as a substitute method for these investigations.

a) Criteria of lakes

It is recommended that harmonic lakes which are considered to be potentially susceptible to acidification should be selected. Natural lakes have higher priority for selection of sites than artificial lakes. If the management such as dredge is carried out, effects of the management should carefully be investigated. Oligotrophic or Mesotrophic of harmonic lake is recommended. If there is no harmonic lake, dystrophic lakes could be selected for monitoring. However, in this case, appropriate monitoring methods should further be investigated.

It is desirable to choose monitoring lakes which are harmonic type with low BOD, COD, or TOC (inorganic acidic lakes, organic acidic lakes or alkaline-based eutrophic lakes is not good for the monitoring), preferably having a maximum depth of approximately 10 m or less, a water retention time of 1 year or less, water area from 1 hectare to 100 hectares, low alkalinity (less than 200 μeq L^{-1}) or electric conductivity (less than 10 mS m^{-1}), minimal anthropogenic water pollution and no coverage of the surface with aquatic plants.

The lakes' catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation. The access from the site to the laboratory is desirable to be short for preventing change of the sample qualities.

b) Criteria of rivers (streams)

Rivers or streams that are potentially susceptible to acidification may be selected, where the impacts of human activities such as deforestation, slash-and-burn farming, stock-farming or cultivation is not being conducted or planned in the future in the upper stream area of the water sampling site. The river/stream's catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation.

Especially, to prevent the influence of other pollutions and storm runoff, streams have higher priority than rivers in the site selection. In the case of selecting rivers, the upper streams of a river or first-order streams (as stream order) is desirable for the areas with storm events. At upper reach of the stream area, monitoring should be done at one point, and measurement of the flow is desirable.

It is desirable to choose monitoring rivers (streams) which are natural rivers (streams), having low alkalinity (less than 200 μeq L^{-1}) or electric conductivity (less than 10 mS m^{-1}) with low BOD, COD, or TOC. The recommendations for catchment properties and accessibility are the same as the lakes.

In the case of river (streams), flow volume and ion concentrations change dramatically with intense rainfall. Therefore, sampling should be carried out when there is no or small rainfall (below 10 mm per day) within 2 days before monitoring for average samples. Samples should also be collected during flood and after intensive rainfalls or snow melting, if possible. This will allow us to get more reliable information already on the stage of a plot selection. On this stage, the most important parameters to be measured are the temperature, electric conductivity, and pH values.

3) Outline of monitoring

The format for preparing this part is shown in Form 3.2.18 and 3.2.21. This format shall be filled with the monitoring information of each site.

Form 3.2.18 Outline of monitoring (on-site)

Monitoring parameters (Ever sampling event)	1: Water temperature, 2: pH, 3: EC, 4: Dissolved oxygen, 5: Water color, 6: other ( )

Form 3.2.19 Outline of monitoring for lakes

Monitoring parameters (mandatory) (4 times a year)	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon or total organic carbon, 11: NO_2^-, 12: PO_4^{3-}, 13: Chlorophyll a, 14: Total phosphorus, 15: Total nitrogen, 16: other ( )
Monitoring parameters (Optional) (4 times a year)	1: Total dissolved Al, 2: Reactive Al, 3: Chemical oxygen demand, 4: Phytoplankton, 5: other ( )
Monitoring parameters (Optional) (every 3 – 5 years)	1: Living organisms other than phytoplankton, 2: Pb, ^{210}Pb and stable isotope S in sediment 3: other ( )

Form 3.2.20 Outline of monitoring for rivers (streams)

Monitoring parameters (mandatory) (every 1 or 2 month(s))	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon (DOC) or total organic carbon (TOC), 11: NO_2^-, 12: PO_4^{3-}, 13: Total phosphorus, 14: Total nitrogen, 15: Suspended solids, 16: other ( )
Monitoring parameters (Optional) (every 1 or 2 month(s))	1: Hydrological flow (at sampling time), 2: Total dissolved Al, 3: Reactive Al, 4: Chemical oxygen demand, 5: other ( )
Monitoring parameters (Optional) (4 times a year)	1: Epilithic algae, 2: other ( )
Monitoring parameters (Optional) (every 3 or52 years)	1: Living organisms other than epilithic algae 2: other ( )

3.2.5.5 Catchment-scale monitoring

1) Outline of the site

The format for preparing this part is shown in Form 3.2.21.

Form 3.2.21 Outline of the monitoring site

Site name			code	
Location				(attach a map)
Latitude (at the outlet of the catchment)	(north, south) ° ‘	Longitude (at the outlet of the catchment)	(east) ° ‘	
Altitude	m -		m	
Catchment area			km^2	
Surface geology				
Soil type				
Vegetation (dominant species)				
Land use (coverage %)				
Population within the catchment area				

Note. Map of the catchment area specifying the sampling point of the stream water will be attached.

2) Criteria for selection of site for catchment-scale monitoring

Sites for the catchment-scale monitoring should be selected taking the following recommendations into account:

- A forest catchment with a stream should be selected, while the size of the catchment may depend on each situation.
- The catchment, where the water budget has been estimated, is preferable.
- Sensitivity of soil or bedrock geology to atmospheric deposition should be considered for site selection.
- If possible, the site should be in vicinity of the EANET acid deposition site to estimate atmospheric deposition amounts precisely.
- Other ecological information from nearby sites is valuable.

3) Outline of the monitoring

Outline of the monitoring will be summarized in the Forms 3.2.22, 3.2.23, 3.2.24, and 3.2.25. When existing data will be used for input (total deposition, wet + dry), soil, and/or forest vegetation, the names of monitoring sites/plots should be spcifiy.

Form 3.2.22 Input (total deposition)

Items	Outline of the sampling method	Note
Precipitation amount	Rain gauge	If the deposition data at the nearest EANET station will be used as the input data, specify the name of the station.
Wet deposition	wet only sampling or bulk sampling in forest area	
Dry deposition (Air concentration measurement for Inferential method)	Filter pack method ( ) Automatic monitor ( ) Passive sampler ( )	
Total deposition	calculation as wet+dry or throughfall-stemflow method	

Form 3.2.23 Output

Items	Outline of the method	Note
Water discharge	Weir or H-Q curve method	
Stream water chemistry	Collection to a plastic bottle at the outlet of the catchment	
Chemical discharge	Calculation based on water discharge and stream water concentration	

Form 3.2.24 Biogeochemical processes

Items		Outline of the sampling method	Note
Soil	1. Soil chemical properties	1. Number of plot and subplots	If the data on regular soil and vegetation monitoring is used, specify the plot name.
	2. Soil solution	2. Suction cup method, Pan lysimeter method, Resin capsule method, *or* Others ( )	
	3. Soil moisture	3. TDR, ADR, or others ( )	
	4. Soil physical properties	4. Fine earth bulk density: Metal sampling cylinder method Penetration resistance: Pocket penetrometer method	
	5. Soil gas emission	5. Chamber method or others ( )	
Vegetation	1. Plant growth (field measurement)	1. Number of plots (with three coacxial sub-plots)	If the data on regular soil and vegetation monitoring is used, specify the plot name.
	2. Species composition (field measurement)	2. Number of plots	
	3. Elemental contents (litter trap, leaf element	3. Litter trap: size of the trap (m^2), height of the trap (m),	

	analysis)	number of the trap ( ) Collection of living leaf: height of branches (m), number of samples ( )	
Water balance	1. Evapotanspiration	1. Heat balance method, others ( )	

Form 3.2.25 Meteorological observation

Parameters of Observation	1.precipitation amount (a.tipping bucket, b.gravimetric**,** other( )), 2.wind direction, 3.wind velocity, 4.temperature, 5.humidity, 6.solar radiation, 7.other( )
In case of using the Nearest meteorological station data	name of the station: distance from the site: km direction from the site (bearings):

The sampling sites for the related media, i.e., wet deposition, air concentration, soil and vegetation, and inland aquatic environment, should be selected in accordance with each site selection requirements.

The information above may be updated according to modification/improvement of technical manuals for the respective monitoring items.

3.3 Methodology and instrumentation for the EANET monitoring

3.3.1 Analytical methodologies for the monitoring

According to the requirement in the technical manual, overview of the analytical method for each monitoring item were shown in Table 3.3.1. The responsible laboratories should select the proper method to use and described the selected method on the National Monitoring Plan.

3.3.2 Adopted analytical method

3.3.2.1 Wet deposition monitoring

The adopted analytical methods for mandatory and optional items of wet deposition monitoring should be described in the Form 3.3.1a and 3.3.1b. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.1.

Table 3.3.1 Analytical techniques used for the analysis of ions

Method	Measuring item(s)	Media			
		Wet	Dry	Soil	IAE*
conductivity cell method	electric conductivity	✓			✓
glass electrode method	pH	✓			✓
ion chromatograph	chloride, nitrate, sulphate, ammonium, sodium, potassium, calcium, magnesium, hydrogen carbonate, nitrite, fluoride, phosphate, organic acids	✓			✓
spectrometry	chloride, nitrate, sulphate, ammonium, nitrite, fluoride, phosphate	✓			✓
ultraviolet fluorometry	sulphur dioxide (automatic monitor)				
electric conductivity method					
chemical emission spectrometry	Nitrogen oxides (automatic monitor)				
spectrometry (Salzmann)					
ultraviolet spectrometry	ozone (automatic monitor)				
spectrometry (KI method)					
gravimetry	particulate matter (automatic monitor)				
beta-ray absorption					
tapered element oscillating microbalance					
light dispersion					
atomic absorption	sodium, potassium, calcium, magnesium, total aluminum	✓			✓
emission spectrometry	sodium, potassium, calcium, magnesium	✓			✓
ICP/AES** or ICP/MS***	total aluminum, lead				✓
HPLC****	hydrogen carbonate	✓			
Titration of H_2SO_4	Alkalinity				✓

* IAE: Inland aquatic environment
** ICP/ES: Inductively coupled plasma / Atomic emission spectrometry
*** ICP/MS: Inductively coupled plasma / mass spectrometry
**** HPLC: High performance liquid chromatography

Form 3.3.1a Adopted analytical method for wet deposition monitoring

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Mandatory		
pH	1: Glass electrode, 2: other ( )	
EC	1: Conductivity cell, 2: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury (II) thiocyanate, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	

Form 3.3.1b Adopted analytical method for wet deposition monitoring

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Optional		
F^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HCO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
$R\text{-}COO^-$	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamin, b: other), 3: other ( )	
PO_4^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other), 3: other ( )	

3.3.2.2 Air concentration (dry deposition) monitoring

The adopted analytical methods for mandatory and optional items of air concentration monitoring should be described in the Form 3.3.2a and 3.3.2b. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.2.

Form 3.3.2a Adopted analytical method of automatic system for air concentration monitoring

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
SO_2	1: Ultraviolet fluorometry, 2: H_2O_2 oxidation/Electric conductivity 3: other ( )	
NO_2	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
NO	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
O_3	1: Ultraviolet absorption spectrometry, 2: Spectrometry with neutral potassium iodide, 3: other ( )	

Form 3.3.2b Adopted analytical method for air concentration monitoring with filter pack method

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and typeUpper: manufacturer, Lower: type
Gases substances		
SO_2	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HNO_3	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HCl	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
NH_3	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Nessler's reagent, b: Indophenol blue, 3: other ( )), 3: other ( )	
Particulate matter components		
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	

3.3.2.3 Soil monitoring for basic survey site

The adopted analytical methods of soil monitoring for basic survey site should be described in the Form 3.3.3. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.3.

Form 3.3.3 Adopted analytical method for soil monitoring

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
pH (H_2O)	1: Glass electrode (extracted with water)	
pH (KCl)	1: Grass electrode (extracted with KCl aq.)	
Exchangeable Na^+	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable K^+	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Ca^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Mg^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Al^{3+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: Titration, 4: other ( )	
Exchangeable H^+	1: Subtract Al^{3+} data from Ex-acidity, 2: other ( )	
Exchangeable acidity	1: Titration, 2: other ( )	
ECEC		
HCO_3^-	1: Volumetric calcimeter, 2: other ( )	
T–C	1: Titration (Walkeley0Black), 2: Carbon-nitrogen analyser, 3: other ( )	
T–N	1: Titration (Kjeldahrl), 2: Carbon-nitrogen analyser 3: other ( )	
SO_4^{2-}	1: Turbidimetry 2: Ion chromatograph 3: Emission spectrometry 4: other ( )	
Available phosphate	1: Spectrometry (Bray-1), 2: other ( )	

3.3.2.4 Inland aquatic environment monitoring

The adopted analytical methods for inland aquatic environment monitoring site should be described in the Form 3.3.4. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.4.

Form 3.3.4a Adopted analytical method for inland aquatic environment monitoring (on-site)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
Water temperature	1: Thermometer, 2: pH meter, 3: EC meter, 4: other ( )	
pH	1: Glass electrode, 2: other ( )	
EC	1: Conductivity cell, 2: other ( )	
Dissolved oxygen	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Available phosphate	1: Spectrometry (Bray-1), 2: other ( )	

Form 3.3.4b Adopted analytical method for inland aquatic environment monitoring (mandatory)

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
Alkalinity	1: Titration using burette, 2: Titration using digital burette 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamin, b: other), 3: other ( )	
PO_4^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other), 3: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Ca^{2+}	1: Ion chromatography, 2: Atomic absorption spectrometry, 3: other ( )	
Mg^{2+}	1: Ion chromatography, 2: Atomic absorption spectrometry, 3: other ( )	
Na^+	1: Ion chromatography 2: Atomic absorption spectrometry, 3: Flame emission spectrometry, 4: other ( )	
K^+	1: Ion chromatography 2: Atomic absorption spectrometry, 3: Flame emission spectrometry, 4: other ( )	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other), 3: other ( )	

Form 3.3.4c Adopted analytical method for inland aquatic environment monitoring (mandatory)
(continued)

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
DOC or TOC	1: Total organic carbon analyzer, 2: Wet-oxidation method, 3: other ( )	
Chlorophyll a	1: SCOR/UNESCO method, 2: other ( )	
Total P	1: Potassium peroxodisulfate decomposition, 2: other ( )	
Total N	1: Ultraviolet absorption spectrometry, 2: Hydrazinium sulfate reduction, 3: other ( )	
SS	1: Gravimetry (1 mm glass fiber filter filtration) 2: other ( )	
Total dissolved Al	1: Atomic absorption spectrometry with graphite furnace, 2: ICP/AES or ICP/MS 3: other ( )	
Reactive Al	1: Lumogallion method, 2: Spectrometry, 3: other ( )	
COD	1: Potassium bichromate method, 2: Acidic potassium permanganate method, 3: other ( )	
DO	1: DO meter, 2: Winkler-modified sodium azide method, 3: other ( )	

Form 3.3.4d Adopted analytical method suggested for lake sediment and their pore water

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
^{210}Pb	1: Isotope ratio mass spectrometry, 2: other ( )	
Pb	1: Atomic absorption spectrometry with graphite furnace, 2: ICP/AES or ICP/MS 3: other ( )	

Appendix 2

Check list of site audit
for wet deposition monitoring site

organization	
position in charge of management	
person who was audited	
date of audit	
person who carried out audit	

（1） Site classification

site classification	remote／rural／urban

（2） Local condition of monitoring site

Note: Although descriptions below are not applied for urban sites, results should be recorded to describe the state of monitoring sites.

1）The collector should be in an open, flat, grassy area far enough from trees, hills, and other obstructions to avoid adverse effects on sampling.

2）No obstructions should be within a few meters of the collector, and no object should shade the collector.

3）The horizontal distance between a large obstruction and the collector should be at least twice the obstruction's height, or the top of an obstruction as viewed at least twice the obstruction's height, or the top of an obstruction as viewed

4）The collector should be a minimum off 100 m from local emission and contamination sources such as waste disposal sites, incinerators, parking lots, open storage of agricultural products, and domestic heating.

5）The collector and rain gauge (and dry deposition collector) should be in the same immediate area but no closer than 2 meters. A line drawn between the rain gauge and the wet deposition collector should be perpendicular to the prevailing wind direct (specifically during seasons where precipitation events are common).

Appendix 2

（３） Site management

１）Position and person in charge of site maintenance and/or sample collection

２）Are manuals and standard operation procedures (SOPs) are properly used? Are they stored at or carried to the monitoring station?

３）Are on site operations recorded precisely on a field sheet? Are past field sheets carried to the site to refer?

４）Are there any measures to keep the site out of lightning?

５）Is abnormal value by unnatural factors recorded on a field book and treated as a missing value?

（４） Meteorological monitoring

１）Are Meteorological instruments checked periodically?

２）Is standard rain gauge work properly? Are two metal nets set on the receiving funnel to avoid dusts coming into? In the cold area, is a heater or other measures to prevent the instruments being frozen are equipped?

（５） Wet deposition sampling and monitoring

１）Information of the sampler: type, manufacturer and date of manufactured and installed

２）Does a lid of sampler open within 1 minute after the precipitation starts? Does it close immediately after the precipitation stops? In cold area, is a heater appropriately used?

３）Are precipitation samples are protected from the contamination by dry deposition? Are parts of instruments which contact with the samples chemically inert?

４）Sample collection frequency and its start/finish time

Appendix 2

5）Is a field blank program carried out?

6）State of contamination and exchange frequency of the tube between collection funnel and sample bottle

7）Are plastic gloves used for on-site sample collection?

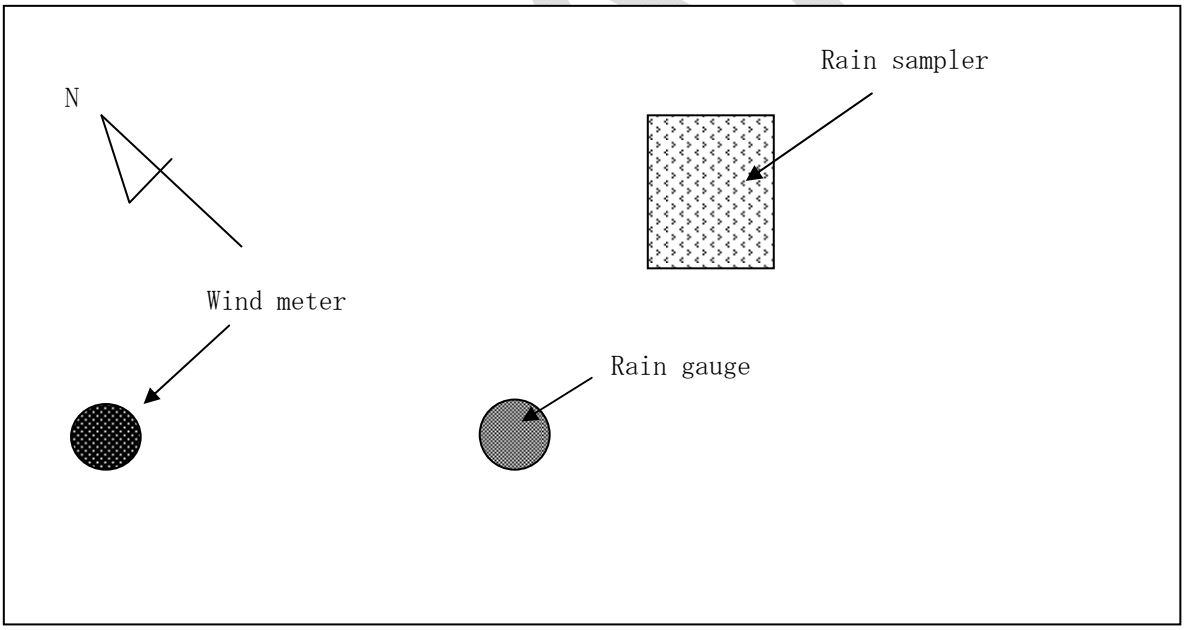
8）State of on-site sample preservation (usage of refrigerator or usage of biocide)

9）State of sample transportation (e.g. time needed for transportation to laboratory)

（6） Overall review, notes

（7） Outline of monitoring site

1）Instruments arrangement on site



Appendix 2

2）Pictures

- Overview: should be taken from an enough distance to describe surrounding state of the sampler
- Eight direction: should be taken from the funnel of rain sampler
- Sample collection: funnel of rain sampler
- Instruments: outside view, inside
- Sample transportation: container, usage of coolant
- Others