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## **Supplementary Explanation for Siting Criteria on Monitoring of Inland Aquatic Environment for EANET**

### **1. Introduction**

National monitoring programs in the participating countries of Acid Deposition Monitoring Network in East Asia (EANET) are being reviewed and revised in 2001 to prepare for the monitoring on a regular basis. There were many monitoring sites for inland aquatic environment during the preparatory phase that might not be very appropriate to monitor impacts of acid deposition on inland aquatic environment. This document is intended to provide supplementary explanation/clear interpretation on siting criteria described in the revised monitoring guidelines and the technical manual for monitoring on inland aquatic environment, so that the participating countries could select their monitoring sites in an appropriate manner.

### **2. Supplementary explanation on the revised technical documents**

#### **(i) Lakes**

##### **Harmonic lakes**

- Fundamentally eutrophic and hypereutrophic lakes should not be selected as a monitoring site. Oligotrophic or extreme oligotrophic lakes are desirable for a monitoring site, but if difficult, mesotrophic lakes could also be selected.
- If there are no such lakes, slight eutrophic lakes may be selected.
- Lakes such as an acidic lakes around a volcano, iron-based eutrophic lakes, alkaline-based eutrophic lakes should not be selected.

##### **Water depth of 10 m or less**

- Average water depth of 10 m or less is a guiding indicator to find a lake with water circulation of once or twice in a year. If this condition is met, deeper water depth could be allowed.
- Average water depth of artificial lakes frequently exceeds 10 m. In such cases, retention time, water area, vertical water mixing, rather than average water depth should be considered in selecting a site.

##### **Retention time of 1 year or less**

- Retention time should be considered as an indicator that must not be strictly

- complied with, because it is very difficult to precisely estimate the retention time.
- Usually alkalinity could be considered as a higher priority factor than retention time.
  - It should be interpreted that retention time could be equal or less than a year, not around a year.
  - It should be noted that retention time is quite important to consider modeling. It should be carefully examined when detailed impact survey is undertaken, even though it may not be so important just for long-term monitoring.

#### **Water area of 1 hecter or more**

- It is a guiding indicator since it is difficult to obtain generic features, if the lake is too small.
- It is not recommended to select complex shape of lakes, or too big lakes, from the viewpoint of representativeness.
- In general, water area could be several dozens of hecters, and not more than 100 hecters.

#### **Low alkalinity (0.05 meq/L) or low electric conductivity (EC)**

- In principle, alkalinity is a better indicator than EC.
- Since it is rather difficult in East Asia to find lakes with alkalinity of less than 0.05 meq/L, it should be considered that lakes with alkalinity of approximately less than 0.2 meq/L should be considered acceptable.
- If there are no data on alkalinity, EC could be used as a supplementary indicator. For the time being, acceptable EC values could be considered as equal or less than 10mS/m.

#### **Minimal anthropogenic water pollution**

- It should be comprehensively judged with various indicators, such as population in the catchment area, effluent from industries, household waste water, agricultural and pasturage activities.
- Water pollution indicators such as chemical oxygen demand (COD) could also factors to be considered. Information on living creatures such as aquatic plants may also be taken into account.
- It is desirable to select as clean lakes as possible. Appropriate judgment should be made, taking into account the situation of the area.

#### **(ii) Springs, headwaters and rivers**

##### **Higher priority on springs than rivers**

- Springs and headwaters (upper reach of a stream/river) should have higher priority on site selection than rivers, to minimize the influence of anthropogenic pollution.

##### **Upper streams of a river or first order streams**

- In the case of rivers, a monitoring site should be selected as upper stream as possible,

and should not be selected at a river with branch stream on upper side.

#### **Monitoring at one point**

- To maintain continuity, it is necessary to always get samples at the same sampling site.

### **3. Additional information on site selection**

#### **Criteria on pH**

- Lakes with extremely high or low pH should be avoided.
- However, such extreme lakes can be avoided by using the criteria for alkalinity. Therefore, criteria for pH values are not established.

#### **Criteria on the scale of catchment area**

- Lakes and rivers with too big catchment areas should be avoided.
- However, catchment area would not be too big if lake water area is not more than 100 h. Therefore, for the time being, criteria for the scale of catchment area were not established.
- In the case of rivers, a monitoring site should be selected at upper stream as much as possible without any branch rivers on its upper side. Especially in the case of rivers, fundamental information on rivers, such as precipitation amount should be well collected and evaluated at selecting a site.

#### **Criteria for natural and artificial lakes**

- There is no need to differentiate natural and artificial lakes from the viewpoint of response to acid deposition.
- In the case of artificial lakes, generally information on artificial change of water levels, inland fishery activities should be well collected and carefully evaluated.

#### **Criteria for seepage and drainage**

- Considering discussions on retention time, it is not necessary for lakes just for long-term monitoring to differentiate the criteria for seepage and drainage.
- Quantitative information on inflow and outflow is required, if modeling be undertaken for the lake.

#### **Criteria for sampling frequency for rivers**

- It is rather difficult to select an appropriate lake, if we would like to minimize influence of artificial pollution. In such cases, springs, headwaters and rivers may need to be selected.
- According to the Program Manual for ICP Waters in Europe, at minimum monthly sampling is required for rivers.
- In the case of rivers, monthly sampling is basically desirable. However, the criteria for sampling frequency was not changed from four times a year, because it seemed actually difficult to do monthly sampling in many countries in East Asia.

- Sampling frequency for rivers would be increased in the future in a step by step manner, for instance, from four times a year to bimonthly, and from bimonthly to monthly.
- Criteria for sampling frequency for rivers will be reviewed and revised as appropriate, in the future when sufficient data be accumulated.

#### **Criteria on soil and geological conditions**

- Information on soil and geological conditions on catchment area is not indispensable but useful to find a lake with low alkalinity, therefore, such information is recommended to be collected as basic information on catchment area, but not deemed as the criteria for site selection.

#### **4. Priority among various siting criteria**

- Through the experience during the preparatory phase, it seems extremely difficult in East Asia to find a monitoring site for inland aquatic environment that satisfies all siting criteria with good traffic access. It is, therefore, necessary to make compromise on some criteria. The priority, for the time being, among various siting criteria is clarified in this section.

- Ideal lakes for monitoring inland aquatic environment are harmonic lakes with low alkalinity that sharply respond to acid deposition, and could present the change of ecosystems in an easy manner.
- It is very difficult to find such a lake in easy traffic access. Therefore, we need to seek as ideal lakes as possible, taking into account the characteristics of lakes and catchment areas.
- Siting criteria include those for finding sites that may be sensitive for acid deposition and those for evaluating the selected sites whether they are actually adequate for long-term acid deposition monitoring.
- Criteria for finding sites that may be sensitive for acid deposition include water depth, retention time, scale of water area (and catchment area), etc.
- Most important criteria for evaluating the selected sites are alkalinity and artificial pollution. Traffic accessibility is another very important factor to be taken into account.
- **Therefore, for the time being, sites are recommended to be selected, by considering the following criteria in this order:**
  - (i) **Lakes, or springs, headwaters or rivers with low alkalinity below certain value;**
  - (ii) **Those with easy traffic access to enable at least sampling of four times a year; and**
  - (iii) **Those with relatively low artificial pollution.**