TOPIC: WATER QUALITY ASSESSMENT

SUB-TOPIC: PART A: ASSESSMENT, MONITORING AND ANALYSIS

Supporting Transcript

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Hello, my name is Sam Addison and welcome to this lesson on water quality assessment, monitoring and analysis.

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In this lesson we will start with an introduction and objectives. The main part of the lesson we will look at why water quality is monitored, the approaches to water quality monitoring and finally, representativeness within monitoring. The lesson will be finished with a learning exercise and references and resources for further information.

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This lesson will provide an overview of selected aspects of water quality assessment, monitoring and analysis and will develop on knowledge learnt in the Water Quality - Importance and Regulatory Settings" and "Contamination of water" lessons.

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The objectives of this lesson are to be able to identify why the monitoring of water quality is important. To be able to compere and contrast the relative advantages and disadvantages of field based and laboratory-based analysis. And to be able to discuss some of the considerations involved in the design of a monitoring programme.

Slide 5 – Section break

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First of all, it is important to establish key definitions that are important for this lesson.

Firstly, water quality assessment is the overall process of evaluation of the physical, chemical, and biological nature of water. Whilst water quality monitoring is the collection of the relevant information for water quality assessments.

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Whilst monitoring is the process of sampling, measurement and recording of various water characteristics, it can be split into three types of monitoring activities. These are based on long-term, short-term, and continuous monitoring programmes.

For monitoring this relates to the long term, standardised measurement, and observation to define status and trends.

Surveys are instead short duration, intensive programmes to measure the quality of water for a specific purpose.

Surveillance is continuous specific measurement and observation for the purpose of water quality management.

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So, why do we monitor water? There are many reasons why water quality is monitored. In this lesson we have categorised the reasons into 5 main reasons.

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Reason number 1 is that by monitoring water, it allows for water to be characterised, and allows for changes and trends over time in water quality to be identified.

The second reason for monitoring is that it allows for water quality problems to be identified. These could be existing problems or emerging and new problems.

The third is that when setting up pollution prevention and management strategies, data collected from monitoring allows for help in the design, knowing where best to focus efforts and what needs to be done.

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As discussed within the lesson focused on water quality guidelines and standards - governments, businesses, and other organisations need to comply with relevant environmental and/or public health legislation. Monitoring allows for the tracking of water quality to check if guidelines are being followed.

The final reason is that monitoring is crucial for developing emergency strategies in the case of emergencies such as oil spills, mass erosion or chemical spills.

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Overall, the purpose of monitoring us to make sure water systems are protected and if problems emerge, the problem would be spotted and the identification of the problem would be the start of corrective measures.

Water quality monitoring could be considered as the foundation on which water quality management is based.

Importantly, monitoring programmes are not intended to simply be data collection exercises. Effective monitoring is well designed and with a clearly identified purpose.

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Before the planning of water sampling and analysis can be started, it is necessary to define key points. This would include what information is needed, what information is already available and also what are the aims and objectives of the intended programme. Depending on the answers to these questions, it will change how the monitoring programme will be set.

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The objectives of the monitoring inform the approach required. This may change the length of the programme to either short term or long term, or it may change what is being measured such as multiple parameters or just a single parameter.

Different monitoring programmes include rapid assessments, routine monitoring programmes and community-based programmes. Each of these changing the overall approach that would be used.

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If we take a closer look at one of the key types of monitoring: rapid assessments. There are two types of rapid assessments which are multi-parameter and single parameter.

Multi-parameter is a more comprehensive survey which would be used to establish a water quality baseline, help predict quality patterns and trends, help establish or improve routine monitoring systems and help with the development of policies and legislation.

The choice of which water quality parameters to include in a multi-parameter assessment could depend on the relative priorities or seriousness of a parameter in terms of health impact, whether or not a parameter is known or suspected, to be present and the existence of human activities that are known to potentially cause pollution of water supplies.

A single-parameter assessment is usually carried out in response to an existing public health problem caused by a specific contaminant. These surveys are used to quickly assess the extent of the contamination and the types or characteristics of the water sources affected. The information is used to help design mitigation programmes and to inform people about which specific sources, or type of sources, should be avoided.

In some countries or localities robust and representative water quality data is not available. A rapid assessment can often provide the very first set of usable information on water quality. In most cases, the assessment is a one-off event.

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Chemical analysis can be conducted in the field or also known as in-situ, or can be conducted in the laboratory and depends on analytical, project and technical requirements. Some analytes, particularly unstable parameters, are recommended to be measured in-situ. Adequate sample storage and preservation must be considered for samples intended for laboratory analysis; this can be parameter dependent. Regardless of the approach data quality and assurance measures should be considered for ALL analysis undertaken.

The next two slides will look at the advantages and disadvantages of both field analysis and laboratory analysis.

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For field analysis, the main advantages are that firstly, for some samples they need to be tested in the field as they are unstable and may change before they reach the laboratory. The most obvious example would be sample temperature which would change to the room temperature. Another key advantage is that field analysis can provide Immediate results for spot checks and/or to inform decision making.

However, there are disadvantages. Firstly, whilst in the field it is a less controlled environment where some methods might be sensitive to ambient temperature, humidity, and other environmental conditions. Additionally, some methods may have lower precision or accuracy as compared to lab-based methods.

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In lab-based analysis the key advantages are that it typically has higher accuracy and lower detection limits and the controlled environment reduces some analytical uncertainties.

However, the disadvantages are that the approach is not as quick as field based analysis and there are added complications such as preserving, transporting, and storing samples. The added complications can make the logistics of the programme more difficult and involved. Laboratory analysis is typically more resource intensive both financially and in terms of time.

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An important consideration within monitoring is that when a particular water sample is taken, natural changes in time and space mean that the sample taken might not properly represent the water that the sample was taken from. Therefore, temporal and spatial changes must be understood if necessary for the project.

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Within any one water body water quality can differ with time and with place. Differences due to time are of five types:

1. Minute-to-minute and day-to-day differences resulting from water mixing and fluctuations in inputs, usually as a result of meteorological conditions. These differences are most evident in small water bodies.

2. Diurnal (24-hour) variations resulting from biological cycles and daylight/darkness cycles which cause changes in, for example, dissolved oxygen and pH. Diurnal patterns also result from the cyclic nature of waste discharges from domestic and industrial sources.

3. Seasonal biological and hydrological cycles.

4. Year-to-year trends, usually as a result of increased human activities in the watershed

5. Irregular patterns. Irregular sources of pollution include fertilisers, pesticides and herbicides, present in the run-off from agricultural land, and wastes discharged from food processing plants.

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Within any one water body water quality can differ with place.

An example would be to think of a lake and how different areas of the lake may have different water quality. Where feeder streams enter lakes there may be local areas where the incoming water is concentrated, because it has not yet mixed with the main water body. Also isolated bays and narrow inlets of lakes are frequently poorly mixed and may contain water of a different quality from that of the rest of the lake. Wind action and the shape of a lake may lead to a lack of homogeneity; for example when wind along a long, narrow lake causes a concentration of algae at one end. Finally vertical stratification results in differences in water quality at different depths.

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Given temporal and spatial changes, representativeness needs to be considered in a sampling or monitoring campaign if necessary for the project.

If we were to take one sample in the middle of a river it is possible that the sample may be different than a sample collected from the river bank. The water composition is likely to change depending on location within the river. So, to be more representative an example may be that a sample could be taken on cross sectional surveys or during a monthly basis to account for changes in pollution levels. Also, when sampling each month, more than one sample may be taken at a time, instead multiple samples may be taken across the width of a river channel to evaluate any mixing impacts.

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Monitoring has a range of purposes but most importantly is used to make sure water systems are protected and, if problems emerge, to be the start of corrective measures

There are a range of ways that water quality monitoring can be approached – in the laboratory and in the field or both.

Planning is necessary to ensure monitoring is representative and so takes in to account the spatial and temporal changes that impact water quality

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In this learning exercise think of developing your own water quality monitoring programme. What would you test for, what approach would you take and how would you make sure that your monitoring strategy was representative.

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The information provided in this lesson was developed from these references and can be used for further information.

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For further learning, these resources expand on the material covered in this lesson. The first link is a chapter which provides an overview of many of considerations in water quality sampling with a particular focus on the importance of representativeness. The second resource provided is a chapter which shows how this thinking is applied to a real case study.

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Thank you for watching this lesson.