Nile Basin Initiative
Nile Trans boundary Environmental Action Project

Manual for On-Site Water Tests by Local Communities & Schools for Nile Basin Countries for Transboundary Water Quality Monitoring.

July 2007

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FOREWORD

The Basin wide Water Quality Monitoring Component of the NTEAP has developed four Water Quality Operational Manuals which will assist in the transboundary water quality monitoring of the Nile Basin.
The four Manuals that have been developed are:

- **Simple Procedures for Water & Waste Water Sampling for Nile Basin Countries for Transboundary Water Quality Monitoring.**
- **Selected Common Standard Analytical Methods for Nile Basin Countries for Transboundary Water Quality Monitoring.**
- **Guidelines for Data Reporting Forms for Nile Basin Countries for Transboundary Water Quality Monitoring.**
- **Manual for On-Site Tests by Local Communities & Schools for Nile Basin Countries for Transboundary Water Quality Monitoring.**

The Manuals will also:

- *Promote basin wide networking on Water Quality Management, to ensure transboundary water quality assessment;*
- *Promote continued exchange of information on key transboundary parameters;*
- *Enhance continued awareness on water quality issues;*
- *Assist and enhance capacities for Water Quality Monitoring, and improve the understanding of transboundary Water Quality Management issues.*

The Manuals will promote good comparability of the water quality data produced, and also ensure data reporting consistency on a regional and international level, so that the analytical results produced can be compared on a level platform.

The NBI through NTEAP is proud to produce and launch these simply designed and user-friendly series of Manuals which will compliment the already on-going national water quality monitoring initiatives.

On behalf of the NBI, the NTEAP wishes to acknowledge with gratitude the technical and administrative support by the Regional Water Quality Working Group Members, the Consultant, the PMU Staff, the National Project Coordinators and Water Quality Lead Specialist for contributing to the development of these Manuals.

It is our hope that the users of these Manuals will find them beneficial, as a first step towards harmonizing transboundary water quality monitoring practices in the Nile basin countries.

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In the preparation of these Manuals, other sources of information such the Standard Methods for Water and Waste water Analysis by the American Water Works Association (AWWA) as well as other standard sources were referred to. All these sources are hereby acknowledged.
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Abbreviations

ATC…….Automatic Temperature Compensation
DO ……..Dissolved Oxygen
EC……Electrical Conductivity
FAO…….Food &Agriculture Organisation
NBI ……Nile Basin Initiative
NTEAP ……Nile Trans boundary Environmental Action Project
NTU…….Nephelometric Turbidity Units
OS……On site (analysis)
P……...Phosphorous
TDS……..Total Dissolved Solids
TSS…….Total Suspended Solids
UNOPS……United Nations Office for Project Services
µs/cm……...micro seimans/cm

BACKGROUND

The Nile Trans boundary Environmental Action Project (NTEAP) is one of seven projects under the Nile Basin Initiative Shared Vision Programme and is of five years duration. The main objective of the project is to provide a strategic environmental framework for the management if transboundary waters in the Nile Basin.

The basin wide Water Quality Monitoring Components is one of the five components of the NTEAP. This component's objectives include:

i. Initiate basin-wide dialogue on water quality.
ii. Improve capacities for monitoring and management of water quality.
iii. Provide a platform for the exchange and dissemination on information on key parameters.

This manual is one a series of four manuals which meets these objectives.

The other manuals are:

- Selected Common Standard Analytical Methods for Nile Basin Countries for Transboundary Water Quality Monitoring

- Guidelines for Data Reporting Forms for Nile Basin Countries for Transboundary Water Quality Monitoring

- Simple Procedures for Water & Waste Water Sampling for Nile Basin Countries for Transboundary Water Quality Monitoring

1.0 INTRODUCTION

The objective of this manual is to provide simple instructions and advice on undertaking simple tests to check the quality of river water. The equipment and reagents are all contained in the Water Pollution Monitoring Kit. It is aimed at providing communities and schools a means of simply checking and monitoring the quality of the local rivers and water sources.

The kit has the benefits of:

i. Portable.
ii. Easy to operate.
iii. Enabling analysis on site for parameters that might deteriorate if the water sample was transported to the analytical laboratory.
iv. An educational tool for secondary schools.
v. Increasing public awareness of the environment & water quality.
vi. Providing extra monitoring data to the national river basin management authorities.
vii. An early warning system for pollution incidents.

2.0 PARAMETERS

The parameters that have been selected are the following:

2.1) Turbidity or Clarity

The turbidity or clarity is the measure of the transparency or the suspended solids in the water. It is measured in Nephelometric Turbidity Units (NTU's). Clear waters have low Turbidity NTU values and cloudy waters have high values.

The advantages of water of low turbidity are:

1) The clearer the water the less there are suspended solids.
2) Less possibility of chemical and biological contamination.

If the water is cloudy it will have a high turbidity value, the disadvantages of this are:

1) Turbid (Cloudy) water is difficult to totally disinfect, i.e. kill the pathogenic germs with chlorine, as the solid particles shield the pathogens.
2) The particles could contain high doses of pollutants such as heavy metals or biological contaminants.

The method uses a graduated turbidity tube, which is simple to use and does not require any electricity or reagents.

2.2 Electrical Conductivity

Electrical Conductivity (EC) is a simple parameter to measure with a simple EC Meter. It provides a large amount of information about the quality of the water, which includes:

1) A measurement of the water's ability to conduct electricity.
2) Directly related to the amount of dissolved solids in the water.

3) Measured in micro siemens per cm (μs/cm).
4) All waters have a characteristic EC.
5) Drinking waters can range normally from 50 μs/cm to 700 μs/cm.

2.3 Temperature

The Temperature can be simultaneously be measured by the EC Meter. This parameter indicates:

i. Seasonal variations of the water,
ii. Any abnormalities or pollutants up-stream.

2.4 Soluble Phosphates

Phosphates cause problems for the natural environment. In particular, phosphate is associated with eutrophication of water and with rapid unwanted plant growth in rivers and lakes.
This parameter can be measured easily by adding two tablets to the water sample and measuring the developed colour with a dedicated colour comparator.

2.5 Odor

The odour of the water is a very simple test and if carried out in a controlled way, it can provide valuable information on the presence of over ten different types of pollutants.

2.6 pH Analysis

This simple test is measured by a simple meter to check if the water is acid, neutral or alkali. The water is usually fairly constant but if it is polluted it can be indicated by a change in the pH value.

2.7 H2S Bacteriological Test

The H2S Bacteriological Test is a simple screening test to monitor the possible presence of harmful bacteria. However this simple test not does detect every type of waterborne disease and this should be undertaken by qualified bacteriologists using more specialised techniques.

3.0 WATER POLLUTION MONITORING KIT INSTRUCTIONS

3.1 TURBIDITY OR CLARITY

Principle

Turbidity is a measure of the clarity of the water and is measured in Turbidity Units. The lower the value, the clearer the water and the better the quality of the water.

Procedure

1) Connect the tubes together.

2) Gradually pour the water into the tube.

3) Look through the water at the cross at the bottom of the tube.

5) Pour the water into the tube until the cross just disappears.

6) The tube is graduated in Turbidity Units (5 to 500).

7) Read the level of the water where it aligns with the graduation and record the value. If the water level is in between two graduations, estimate the value.

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Nile Trans boundary Environmental Action Project

SIGNIFICANCE OF TURBIDITY VALUES

TURBIDITY RANGE (NTU)	DRINKING		FOOD PREPARATION	BATHING	LAUNDRY
	(Health)	(Aesthetic)			
< 0.1	No effects	Water crystal clear	No effects	No effects	No aesthetic effects
0.1 – 1	Slight risk of potential health effects	Water has good transparency	Slight risk of indirect health effects (e.g., salads)	No effects	No aesthetic effects
1 – 20*	Possibility of secondary health effects	Water slightly cloudy	Slight risk with e.g. salads	Insignificant effects	Insignificant aesthetic effects
20 – 50*	Secondary health effects	Water has a muddy appearance	Secondary health effects	Slight risk of infection if ingested	Possibility of staining of white clothing
> 50*	Serious health effects common in all users	Water has a increasingly muddy appearance	Secondary health effects	Risk of infection if ingested	Staining of clothing

3.2 ELECTRICAL CONDUCTIVITY (EC)

Principle

Electrical Conductivity (EC) is measured using the EC meter it provides the following information:

1) A measurement of the water's ability to conduct electricity.
2) Directly related to the amount of dissolved solids in the water.
3) Measured in micro siemens per cm (µs/cm).
4) All waters have a characteristic EC.
5) Drinking waters can range normally from 50 µs/cm to 700 µs/cm.

Procedure

1) Press the meter on/off button and the reading should be 0 µs.

2) Rinse the water sample in the probe cup and pour away twice.
3) Pour the water the third time into the probe leaving the water in place.
4) When the reading on the display is steady, press the hold button, and record the reading in µs/cm.
5) Press the hold button again, then press the mode button and note the new reading, which is the temperature in ºC.
6) The meter can be calibrated and the procedure is shown in appendix 1. This procedure should only be undertaken by a qualified analytical chemist. It is recommended that the Government Water Management Department undertakes this calibration on a regular basis.

SIGNIFICANCE OF ELECTRICAL CONDUCTIVITY

ELECTRICAL CONDUCTIVITY RANGE **EC: µS/cm** **TDS: mg/l**	**DRINKING**		FOOD PREPARATION	**BATHING**	**LAUNDRY**
	(Health)	**(Aesthetic)**			
EC: < 700 µS/cm **(TDS: < 450 mg/l)**	No effects	Water tastes fresh	No effects	No effects	No effects
EC: 700 – 1 500 **(TDS: 450 – 1 000)**	Insignificant effect on sensitive groups	Water tastes good	Insignificant effect on sensitive groups	No effects	No effects
EC: 1 500 – 3 700 **(TDS: 1 000 – 2 400)**	Slight possibility of salt overload in sensitive groups	Water has a distinctly salty taste	Slight possibility of slat overload in sensitive groups	No effects	Insignificant corrosion
EC: 3 700 – 5 200) **(TDS: 2 400 – 3 400)**	Possible health risk to all individuals	Water tastes extremely salty	Possible health risk to all individuals	Impaired soap lathering	Slightly corrosive
EC: > 5 200 **(TDS > 3 400)**	Increasing risk of dehydration	Tastes extremely salty and bitter	Increasing risk of dehydration	Impaired soap lathering	Corrosive

3.3 SOLUBLE PHOSPHATE ANALYSIS BY COLOUR MATCH COMPARATOR METHOD 0 - 4.0 mg/1

Principle

Phosphates are extensively used in detergent formulations and washing powders. Phosphates also find widespread application in the food processing industry and in industrial water treatment processes. Agricultural fertilisers normally contain phosphate minerals and phosphates also arise from the breakdown of plant materials and in animal wastes.
Phosphates can enter watercourses through a variety of routes - particularly domestic and industrial effluents and run-off from agricultural land. Phosphate is an important control test for the pollution of river waters.

Whilst phosphates are not generally considered harmful for human, they do cause problems for the natural environment. In particular, phosphate is associated with eutrophication of water and with rapid unwanted plant growth in rivers and lakes.

The Colour Match Comparator Method provides the simple method for measuring phosphate levels over the range 0 - 4 mg/1 P04.

Method

The test is simply carried out by adding one of each tablet to a sample of the water and waiting 10 minutes.The intensity of the colour produced in the test is proportional to the phosphate concentration, and is measured by comparison against colour standards using the Comparator and the Phosphate LR Disc.

Test Procedure

1) Fill the square test tube with sample to the 10 ml mark and insert into the left hand opening of the comparator.

2) Add one Phosphate No 1 LR tablet, crush, and mix to dissolve.

3) Add one Phosphate No 2 LR tablet, crush, and mix to dissolve.

4) Stand for 10 minutes to allow full colour development.
5) Place the test tube in the other opening of the Comparator (Right Hand Side). Ensure there are no bubbles in the tubes or condensation on the sides of the tubes.

6) Rotate the disc until the same colour is seen in both windows- colour match.

7) Record the result in the reading window.
8) The disc reading represents the Phosphate concentration present in the sample as milligrams per litre P04

Note

Phosphate concentrations can be expressed in a number of different ways. The following factors may be used for the conversion of readings. To convert from P04 to P205 - multiply by 0.75
To convert from P04 to P - multiply by 0.33

3.4 ODOUR TEST

Caution: Only use this test for samples that are known to be safe, such as normal river samples. Not to be used for effluent samples or samples that are known to be grossly polluted or hazardous.

1) Pour 100ml of water into the conical flask.
2) Place the stopper on the flask.
3) Shake the flask.
4) Remove the stopper.
5) Smell the odour liberated at the top of the bottle.
6) Record the intensity and characteristic of the odour using the below.
7) Ideally, the odour should be zero, or maybe earthy or musty.

Odour/Intensity Table	
Characteristic Odour	**Intensity**
Earthy	No Smell (0)
Musty	Very Slight
Oily	Slight
Petrol	Medium
Diesel	Strong
Sewage	Very Strong
Woody	
Soapy	
Milky	
Sweet	
Phenol	
Organic Solvent	
Ammonia	
Chlorine	
Hydrogen Sulphide	
Other (Specify	

3.5 pH ANALYSIS

Principle

The pH is an assessment of the Hydrogen ion concentration (H^+) and depending on this value, it is assessed as Acid (0-6.9) Alkali(7.1-14) or Neutral (7). The pH of the water can be checked using a pH Meter

Procedure

Calibration

1) Press the meter ON/OFF button and immerse the probe into the pH 7 Buffer Solution and Wait for displayed for the value to stabilize.
2) Press the CAL button.
3) When the display flashes continuously, press HOLD/INC button to confirm. The instrument is now calibrated.

Measurement

1) Press the ON/OFF button on the keypad to turn on the meter.
2) Rinse the end of the probe in the water sample two times.
3) Immerse the probe in about 2 cm into the water sample.
4) Stir once and let the display stabilize.
5) Record the pH value.
6) Press HOLD/CON button if you wish to hold the reading.
7) Press again to release •
8) Press the ON/OFF button to switch off •
9) Place a small piece of clean cloth or sponge in the cap, moisten with tap water. (Note it is important for the end of the probe to be kept moist.)

3.6 Bacteriological Analysis by the H2S Test Method

The Bacteriological Quality of the water can be simply tested by the H2S test Method. This consists of a sterile bottle with a strip of paper, which has been coated with a special chemical (pre soaked in a modified media).

1) Fill up the bottle up to the arrow.
2) Close the bottle.
3) The water will soak into the paper.
4) Shake the bottle gently.
5) Keep at room temperature (30ºC) or preferably at body temperature keeping it in a pocket next to the human body.
6) Observe the contents after 16 to 48 hours.
7) If the water turns black, then it could contain harmful bacteria.
8) If the water looks cloudy, then add about 1ml of a chemical called Kovacs reagent, and gently shake the bottle.
9) If a red colour appears on the upper layer, then this also indicates that the water could contain harmful bacteria.

This is a simple screen test, if the result is positive, indicating there are some bacteria, then further in depth bacteriological tests can be undertaken.

However even if there are no indications from the test that there are any harmful bacteria, this may not necessarily is the case. To be absolutely sure, further in-depth analysis should be undertaken by trained bacteriologists

Disposal

Add a few drops on disinfectant (Dettol) and discard the sealed bottle responsibly. Preferably, it is best to return the bottle to the Ministry of Water or Environment, who can dispose of it properly by sterilisation.

4.0 SAMPLING AND RECORDING

It is recommended that the water sample is taken in a clean glass bottle. The bottle should be dipped in the water, suspended by string away from the bank. The bottle should be rinsed out three times with the sample, and analysed as soon as possible for all the parameters.

The results can be recorded on copies of the record forms, as shown in Table 2 in appendix 2.

APPENDIX 1

CALIBRATION OF ELECTRICAL CONDUCTIVITY METER

CALIBRATION OF ELECTRICAL CONDUCTIVITY METER

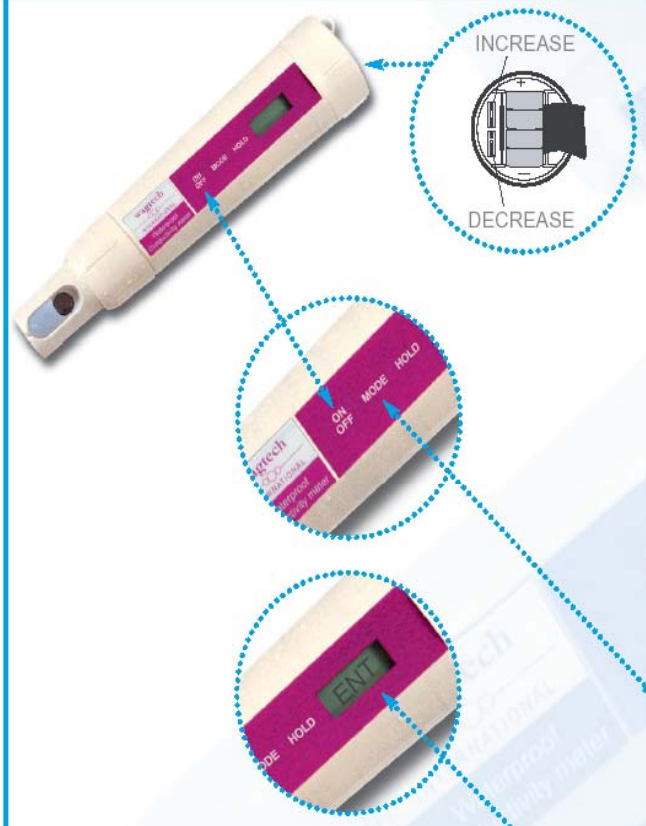
ELECTRICAL CONDUCTIVITY

drinking water quality...

Principle

The Electrical Conductivity (EC) is a measure of the water to carry an electrical current and is directly related to the concentration of the dissolved solids. The measurements are expressed in microsiemens/cm (µS/cm). All drinking waters have a characteristic EC and can range normally from 50 µS/cm to 800µS/cm.

method...



1. Remove the battery cover to reveal the batteries and the Increase and Decrease buttons.
2. Switch the unit on (ON/OFF key) and wait for the display to stabilise.
3. Rinse the probe with calibration standard.
4. Dip the probe in the calibration standard or fill the electrode cup with the solution.
5. Press the MODE button to obtain the temperature.
6. Press the MODE button to obtain the electrical conductivity
7. Press the Increase or Decrease buttons to adjust the reading to the calibration value of as defined in table 1. (Temperature / Conductivity)
8. After 3 seconds the display flashes 3 times then displays "ENT".
9. Dip the probe in the water or fill the electrode cup as a rinse, then repeat to take a measurement.
10. Wait for the reading to stabilise and note the reading.

Table 1: Conductivity Standard

Temperature °C	Conductivity µS/cm
5	894
10	1007
15	1139
16	1167
17	1194
18	1221
19	1249
20	1278
21	1304
22	1331
23	1358
24	1386
25	1413
30	1550

APPENDIX 2

RESULTS RECORD SHEET

APPENDIX 2: RESULTS RECORD SHEET

Table 2 Record Results Form

Parameter	Result	Date	Time	Sampler	Location	Comments
Turbidity T.U						
Electrical Conductivity µs/cm						
Temperature ºC						
Phosphate PO4 mg/l						
Odour						
Intensity						
Turbidity T.U						
Electrical Conductivity µs/cm						
Temperature ºC						
Phosphate PO4 mg/l						
Odour Intensity						
Turbidity T.U						
Electrical Conductivity µs/cm						
Temperature ºC						
Phosphate PO4 mg/l						
Odour Intensity						
Turbidity T.U						
Electrical Conductivity µs/cm						
Temperature ºC						
Phosphate PO4 mg/l						
Odour Intensity						