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# **Environmental Policy and Technology Project**

Contract No. CCN-0003-Q-05-3165-00

## **UKRAINE**

### **Pasichna Water Quality Sampling and Analysis Plan**

**July 1997**

**Delivery Order #05**

**Activity Implementation Plan #24, Amendment 1; Task B**

Prepared for:

**U.S. Agency for International Development**  
Regional USAID Mission to Ukraine, Belarus & Moldova

Bureau for Europe & the New Independent States  
Office of Environment, Energy & Urban Development  
Environment & Natural Resources Division

Prepared by:

Ukraine, Belarus & Moldova Regional Office  
Environmental Policy and Technology Project  
For the New Independent States of the former Soviet Union

A USAID Project Consortium Led by CH2M HILL

## PREFACE

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide various forms of assistance to new independent states (NIS) of the former Soviet Union. Cooperative Agreements were signed between representatives of the U.S. government and each country in which assistance was to be undertaken. The U.S. Agency for International Development (USAID) was given the responsibility to coordinate all U.S. government assistance to the NIS under the Act.

Through competitive bidding, USAID awarded a multi-year contract to a team managed by CH2M HILL International Services, Inc. (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union. Under this contract, termed the Environmental Policy & Technology (EPT) Project, CH2M HILL is to assist USAID's missions in Moscow, Kyiv, and Almaty undertake a program to promote environmental improvements in the NIS. The USAID mission in Kyiv supports environmental, and other, assistance programs to Ukraine, Belarus, and Moldova. CH2M HILL established an office in Kyiv from which to perform services in these countries under the EPT Project.

This report was prepared as a contractually required deliverable under a contract between USAID and CH2M HILL. Although work on this report was conducted in cooperation with the assisted governments and USAID, the findings and recommendations are those of the CH2M HILL team. They do not necessarily represent official positions of the governments of the assisted countries nor of the United States of America.

The CH2M HILL team includes the following organizations:

- Center for International Environmental Law
- Clark Atlanta University/HBCUMI Environmental Consortium
- Consortium for International Development
- Ecojuris
- Environmental Compliance, Inc.
- Harvard Institute for International Development
- Hughes Technical Services Company
- International Programs Consortium
- International Resources Group, Ltd.
- Interfax Newsagency
- K&M Engineering
- Ogden Environmental and Energy Services Company
- Price Waterhouse
- World Wildlife Fund (US).

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## NOTE ON TRANSLITERATION

Ukrainian personal, institutional, and place names used in this report have been transliterated into English from the Ukrainian (not Russian) language, according to the modified U.S. Library of Congress standard for Ukrainian-to-English transliteration that has been adopted by many Western organizations and publications, including the *Encyclopedia of Ukraine*, (University of Toronto Press, 5 vols. 1984-1993) and O. Subtelny's authoritative *Ukraine: A History* (University of Toronto Press, 1994, 2nd Edition), as well as the Ukrainian Commission on Legal Terminology (Resolution No. 9, dated 19 April 1996).

# TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Abbreviations, Acronyms & Glossary .....	iv
<b>1. Introduction .....</b>	<b>1</b>
<b>2. Water Sampling and Analysis .....</b>	<b>2</b>
2.1 Overview .....	2
2.2 Sampling Locations and Frequency .....	2
2.3 Water Quality Parameters .....	3
2.4 Field Sampling and Analysis .....	4
2.5 Schedule .....	4
2.6 Personnel .....	5
<b>3. Estimated Budget .....</b>	<b>6</b>
<b>Table 1: Summary Table of Drinking Water Quality Parameters .....</b>	<b>7</b>
<b>Table 2: Pasichna Water Quality -- Parameters to be Analyzed .....</b>	<b>10</b>

4

## ABBREVIATIONS, ACRONYMS & GLOSSARY

CH2M HILL	CH2M HILL International Services, Inc., which is a U.S.-based international environmental engineering consulting firm under contract to USAID to implement a large component of the EPT Project.
DO	Delivery Order.
EPT	Environmental Policy & Technology (Project). A USAID-funded program to provide environmental assistance to New Independent States of the former Soviet Union.
EU	European Union
LVK	Lviv Vodokanal
MEPNS	(Ukraine) Ministry for Environmental Protection and Nuclear Safety
NIS	New Independent States (of the former Soviet Union)
oblast	A government territorial-administrative unit in the former Soviet Union that is still in use following Ukraine's independence. A U.S. analogue would be something between a state and a county.
USAID	U.S. Agency for International Development
vodokanal	A quasi-government agency responsible for municipal water supply and wastewater collection and treatment. A U.S. analogue would be a water utility.

## Section 1

### INTRODUCTION

As part of a United States government bilateral assistance program, the U.S. Agency for International Development (USAID) is supporting environmental management in Ukraine. Under direction from USAID, a consortium led by CH2M HILL International Services, Inc. (CH2M HILL), is implementing part of USAID's Environmental Policy & Technology (EPT) Project by undertaking various tasks that have been agreed to by representatives of the governments of both countries.

Under Delivery Order (DO) Nos. 5, 9 and 13, USAID authorized CH2M HILL to provide technical assistance and equipment to the city and vodokanal of Lviv in order to improve the quantity of water delivered to residents in the Pasichna district. The project aims to complete the unfinished Dovha water tanks and pumping station, install new lines that connect the station to the water distribution grid, and repair and improve various water supply and delivery equipment.

Pursuant to chapter 22 of the Code of Federal Regulations, part 216, USAID must conduct a project review and assess potential negative environmental and social impacts as a direct consequence of a USAID activity. In fulfillment of this requirement, CH2M HILL is to assist with data-gathering, that will then be used by USAID in its environmental evaluation. Under DO #5, Activity Implementation Plan (AIP) No. 24 authorized, in part, CH2M HILL to:

*... propose a [water quality] sampling and analysis plan, based on Ukraine's national ... water quality standards and World Health Organization (WHO) standards for drinking water, that contains procedures, sample numbers and locations, and quality assurance and quality control tests. The plan shall contain a statistically based approach that measures drinking water quality in the production, transmission, and distribution system in Pasichna and at least one other district in the city of Lviv, including well fields (before and after chlorination), large pump and transfer stations, the Dovha storage tanks and pump house, taps in apartments, and public taps outside residential buildings.*

*The contractor shall submit the sampling and analysis plan to USAID for review and approval. Upon approval, the contractor shall implement the plan ...*

This report provides USAID with the water sampling and analysis plan.

## Section 2

# WATER SAMPLING AND ANALYSIS

## 2.1 OVERVIEW

Water quality data is collected in the Lviv region by various organizations, including Lviv Vodokanal, the Sanitary Epidemiological Service attached to the Ministry of Health, and various design and research institutes. Very often, drinking water samples are only tested for a limited range of water quality parameters. This is due in part to the administrative and political legacy of the former Soviet Union regarding public access to information, the general lack of modern chemical analytical equipment, and the current economic conditions under which public agencies and institutions operate with severely restricted budgets.

Readily available data on the quality of water consumed by residents in the Pasichna district will be sought from Ukrainian authorities. This data will be solicited for the period January 1996 to July 1997, in order to evaluate conditions over two winters and two summers. To complement this approach, CH2M HILL will try to arrange for an independent comparison of water quality data. This will be accomplished by collecting a series of water samples during summer 1997 and testing them for a range of parameters. The purpose of this field program will be to compare data from samples collected and tested using modern means against data obtained using approaches that have been, and still are, the convention in Ukraine. Further, the field sampling and testing program will seek to include water quality parameters that may not have been including in routine testing by Ukrainian agencies.

The independent sampling and testing program will, to the extent possible, replicate requirements and procedures of the U.S. Environmental Protection Agency (USEPA), using modern analytical equipment located in Ukraine. Over the past two years, USEPA, in cooperation with a taskforce of specialists from the Ministry for Environmental Protection & Nuclear Safety (MEPNS) of Ukraine and various institutes from Ukraine's Academy of Sciences, have been investigating water quality of the Kaniv Reservoir on the Dnipro River. As part of the Kaniv Reservoir water quality project, modern chemical analytical equipment has been procured and delivered to the MEPNS's central laboratory, and Ukrainian staff have been trained in its operation, as well as in water sample collection and handling procedures that follow USEPA guidelines.

## 2.2 SAMPLING LOCATIONS AND FREQUENCY

In accordance with the AIP requirements, as outlined in Section 1 (above), water quality data will be collected for the following ten locations:

- Water Supply:** 1. Pluhiv well field. Sample before chlorination.
- Water Transmission:** 2. Vynnyky pump station. Sample after chlorination.
- Water Distribution:**

**Pacishna District:**

3. Dovha pump station. From the storage tank.
4. Inside apartment building, middle distance from Dovha pump station. From tap in an apartment.
5. Inside apartment building, far distance from Dovha pump station. From tap in an apartment.
6. Outside apartment building. From public tap.

**One other location (Kryvchytsi District):**

7. Kryvchytsi pump station. From the storage tank.
8. Inside apartment building, middle distance from Kryvchytsi pump station. From tap in an apartment.
9. Inside apartment building, far distance from Kryvchytsi pump station. From tap in an apartment.
10. Outside apartment building. From public tap.

Existing water quality data will be solicited, to the extent possible, for points that best approximate the above locations. The independent field program will collect samples from the locations listed above, providing access is approved by local authorities.

Readily available data on water quality will be sought, on at least a quarterly basis, for the period January 1996 to July 1997, covering a period of two winter and two summer seasons. The field program will collect three sets of samples, every two weeks, on or near the following dates in 1997:

- 8 August
- 22 August
- 5 September.

## **2.3 WATER QUALITY PARAMETERS**

Drinking water quality standards and guidelines adopted by the World Health Organization (WHO), European Union (EU), and Ukraine, are presented in Table 1 at the end of this

document. As evidenced from this table, there are differing requirements regarding parameters, and acceptable limits, set by each entity concerning drinking water quality. Based upon the standards and guidelines presented in Table 1, together with discussions with staff of the MEPNS central laboratory regarding their *actual* analytical capabilities, a series of water quality parameters was identified for which samples would be tested. This list is presented in Table 2 at the end of this report.

Lviv's drinking water supply is extracted from a series of well fields at some distance from the city perimeter. Many substances specified in the drinking water standards and guidelines listed in Table 1 are therefore not expected to be present in notable amounts, and these are indicated by shading in Table 2. Therefore, only the first set of samples (8 August 1997) will be tested for the full range of parameters listed in Table 2. For those parameters that are shaded in Table 2, testing will only be undertaken of subsequent samples if initial testing indicates elevated levels.

## 2.4 FIELD SAMPLING AND ANALYSIS

To the extent possible, the methods of water sampling and analysis conventionally used in Ukraine will be documented, in order to provide a basis against which to assess the reliability of readily available data obtained from existing sources.

It is intended that USEPA procedures will be following for collection and analysis of field samples. This field sampling and analysis program will be supervised by Ms. H. Babich of the MEPNS's central laboratory. Ms. Babich has received training by USEPA specialists in the agency's Region 4 water quality laboratory near Atlanta, as part of the joint Ukraine-U.S. Kaniv Water Quality project. She subsequently participated in the collection and analysis of Kaniv water samples, under supervision of chemists from USEPA's Region 4 laboratory. The USEPA Region 4's manual *Environmental Investigations: Standard Operating Procedures and Quality Assurance* was translated into Russian language, and used during the Kaniv water quality project. As part of Kaniv study, the following major analytical equipment was provided, and will be used, as necessary, for analysis of the Pasichna water samples in accordance with the *Standard Methods for the Examination of Water and Wastewater*:

- portable equipment -- Hach Potable Water Quality Laboratory, DREL/2000
- gas chromatograph -- Hewlett Packard, HP 5890E
- spectrophotometer -- Hewlett Packard, HP 8453 General Purpose UV-Vis system
- water quality analyzer -- TRAACS 2000, 2CH, XYZ
- pH meter -- pH/ISE Meter, model 920A
- laboratory turbidimeter.

## 2.5 SCHEDULE

Water quality data will be tabulated and compared against WHO, EU, and Ukrainian standards. The sources of data will be identified, either existing or EPT Project. It is anticipated that analysis of field samples will be completed by mid September 1997, and a report submitted to USAID by the end of September, 1997. 9

## 2.6 PERSONNEL

The following persons will be involved with the water quality study:

- Task manager: Ulian Bilotkach -- Manager, CH2M HILL EPT Project Water Programs in Ukraine. Prior to joining the EPT Project, Mr. Bilotkach was head of the Department for Radiological and Hydrochemical Water Monitoring at the State Committee for Water Resources of Ukraine. As part of the Kaniv Reservoir water quality study, he was task leader responsible for managing local activities.
- Chief chemist: H. Babich -- Head of Water Quality Division, MEPNS central environmental laboratory. She has been trained in USEPA methods for water quality sampling and analyses, both in the U.S. and Ukraine, as part of the Kaniv Reservoir water quality study.
- Assistant: Larysa Denysiuk -- water quality specialist at the CH2M HILL EPT Project in Kyiv. She has a masters degree in water and wastewater engineering and chemistry.

In addition, cooperation will be sought from several organizations in Lviv, including:

- Lviv Vodokanal
- MEPNS, Lviv oblast office
- Lviv Institute for Design of Communal Facilities
- Western Ukraine Geological Survey

### Section 3

## ESTIMATED BUDGET

#### Labor:

Collect & review existing data: 20 days @ \$100/day	=	\$2,000
Collect samples: 6 days @ \$100/day	=	\$600
Conduct chemical analysis: 60 days @ \$100/day	=	\$6,000
Report preparation: 5 days @ \$100/day	=	\$500
<b>Subtotal:</b>	=	<b>\$8,100</b>

#### Other costs:

Laboratory reagents: assume	=	\$2,000
Air travel: 6 trips @ \$200 each	=	\$1,200
Ground transportation in Kyiv and Lviv: assume	=	\$1,000
Lodging & meals in Lviv: 10 days @ \$170/day	=	\$1,700
Purchase of existing data: assume	=	\$500
Reproduction: assume	=	\$500
Telecommunications & freight: assume	=	\$500
Incidentals: assume	=	\$500
<b>Subtotal:</b>	=	<b>\$6,900</b>

**Contingency:** Assume 10% of labor and other costs = \$1,500

**Total estimated cost:** = \$16,500

11

Table 1

SUMMARY TABLE OF DRINKING WATER QUALITY STANDARDS<sup>1</sup>

Note: “-” = No standard  
 “\*” = Guideline (not mandatory) values  
 “\*\*” = Depending on method of analysis

Parameters	Units	EU	WHO	Ukraine	Comments
<b>Organoleptic parameters/Aesthetic quality</b>					
Taste & Odor	DN	2/2	Not offensive	2/5	Dilution number
Turbidity	JU	4	5	4	Jackson units
Color	TCU	20	15	20	Total color units
pH		6.5-8.5	6.5-8.5	6.0-9.0	
TDS	mg/l	400*	1000	1000	
Chlorides	mg/l	25*	250	350	
Sulfates	mg/l	250	400	500	
Calcium	mg/l	100*	-	-	
Magnesium	mg/l	50	-	-	
Sodium	mg/l	175	200	-	
Potassium	mg/l	12	-	-	
Aluminum	mg/l	0.2	0.2	0.5	
Hardness	mg/l	60(Ca)	500	7 mgEq/l	
Boron	mg/l	1*	-	0.3	
Copper	mg/l	0.1/3**	1	2	
Iron	mg/l	0.2	0.3	0.3	
Manganese	mg/l	0.05	0.1	0.1	
Molybdenum	mg/l	-	-	0.07	
Phosphate	mg/l	-	-	3.5	
Strontium	mg/l	-	-	7	
Surfactants	mg/l	0.2	-	0.5	
Zinc	mg/l	5	5	5	

<sup>1</sup> Categorization of water quality parameters by EU, WHO, and Ukrainian agencies differs, so the categorization in this table is approximate.

*12*

Parameters	Units	EU	WHO	Ukraine	Comments
<b>Undesirable substances/Inorganics</b>					
Nitrates	mg/l	50	10	45	
Nitrites	mg/l	0.1	-	3	
Ammonium	mg/l	0.5	-	-	
Oxidizability	mg/l	5	-	-	
Total organic carbon	mg/l	-	-	-	
Phenols	mg/l	0.0005	-	0.001	EU standard excluding natural phenols
Residual chlorine	mg/l	-	0.2-0.5	0.3-0.5	EU ambient standard
<b>Toxic substances/organics</b>					
Arsenic	mg/l	0.05	0.05	0.01	
Barium	mg/l	-	-	0.7	
Beryllium	mg/l	-	-	0.0002	
Cadmium	mg/l	0.005	0.005	0.003	
Cyanides	mg/l	0.05	0.1	0.07	
Chromium	mg/l	0.05	0.05	0.05	
Mercury	mg/l	0.001	0.001	0.001	
Nickel	mg/l	0.05	-	0.02	
Lead	mg/l	0.05	0.05	0.01	
Antimony	mg/l	0.01	0.05	0.01	
Selenium	mg/l	0.01	0.01	0.01	
Parameters	Units	EU	WHO	Ukraine	Comments
Pesticides: -separately -total	mg/l	0.0001 0.0005	-	-	
Polycyclic aromatic hydrocarbons	mg/l	0.0002	-	-	
Benzene	mg/l	-	0.01	0.01	
Carbon Tetrachloride	mg/l	-	0.003	0.002	
Chloroform	mg/l	-	0.03	0.02	
2,4-D	mg/l	-	0.1	0.03	
DDT	mg/l	-	0.001	0.002	
1,2-Dichloroethane	mg/l	-	0.01	0.03	

13

Parameters	Units	EU	WHO	Ukraine	Comments
1,1-Dichloroethylene	mg/l	-	0.0003	0.03	
Hexachlorobenzene	mg/l	-	1E-5	0.001	
Lindane	mg/l	-	0.003	0.002	
Tetrachloroethylene	mg/l	-	0.01	0.04	
Trichloroethylene	mg/l	-	0.03	0.07	
Pentachlorophenol	mg/l	-	0.01	0.01	
2,4,6-Trichlorophenol	mg/l	-	0.01	0.004	
<b>Microbiological parameters</b>					
Total coliforms	per 100 ml	0/1**	0	3	
Fecal coliforms	per 100 ml	0/1**	0	0	
Fecal streptococci	per 100 ml	0/1**	-	-	
Free-living organisms	per 100 ml	-	-	< 100	

14

Table 2

## PASICHNA WATER QUALITY -- PARAMETERS TO BE ANALYZED

No	Parameter	Comments
1	Color	Photometric method
2	Conductivity	Electrometry
3	Taste and Odor	To be analyzed <i>in situ</i> , successive dilutions or similar methods
4	Residual Chlorine	To be analyzed <i>in situ</i> , titrimetry or spectrophotometry
5	pH	Electrometry
6	Turbidity	Silica method or Formazine test
7	Chlorides	Titrimetry or Mohr's method
8	Sulfates	Gravimetry or complexometry or spectrophotometry
9	Total hardness	Complexometry
10	Iron	Spectrophotometry or atomic adsorption
11	Nitrate	Spectrophotometry or atomic adsorption
12	Total coliforms	Fermentation or membrane filtration
13	Fecal coliforms	Fermentation or membrane filtration
14	Copper	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
15	Zinc	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
16	Manganese	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
17	Arsenic	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
18	Cadmium	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
19	Cyanides	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
20	Chromium	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
21	Mercury	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
22	Lead	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
23	Antimony	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption

No	Parameter	Comments
24	Selenium	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
25	DDT (Pesticide)	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption
26	Lindane (Pesticide)	Single test at the beginning; further analyses if present in notable amount, spectrophotometry or atomic absorption

16