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Strategic Action Programme for the Dnieper River Basin

23002

Methodology for Hot Spot Evaluation

Final Report to

United Nations Industrial Development Organization

January 2004

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SNC♦LAVALIN Engineers & Constructors Inc.

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FOREWORD

This document is a final version of the methodology for the selection, evaluation and prioritization of Hot Spots in the Dnieper River Basin. The methodology was developed by SNC-Lavalin Engineers & Constructors Inc. (SLE&C) with substantial input from the National Hot Spot Experts (NHSE) of all three Dnieper River nations and revised according to their comments.

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1.0 INTRODUCTION

1.1 Objective

The Project for the Identification and Analysis of Sources of Pollution (Hot Spots) is a part of the UNDP Regional Project "Preparation of a Strategic Action Programme (SAP) for the Dnieper River Basin and Development of SAP Implementation Mechanisms". The objective of the Strategic Action Plan programme is to facilitate the reduction of pollution in the transboundary Dnieper River Basin and ultimately to contribute to the protection of regional and international waters, namely the Black Sea.

Similar to most river basins in populated areas of the world, there are thousands of pollution sources in the Dnieper River Basin. The objective of this document is to provide a methodology for the identification, asessment and prioritization of the most significant sources of pollution based on their impacts and characteristics. These sources of pollution, known hereafter as "pollution hot spots" (Hot Spots), include point sources such as industrial and municipal effluents and non-point sources such as agricultural and urban run off. Each contributes to human health risk and environmental degradation, including significant impacts to environmentally sensitive areas where biodiversity is threatened.

1.2 Scope of Work

As there are thousands of potential and known Hot Spots in the basin, a multi-stage screening system was proposed to identify priority Hot Spots in an efficient and timely manner. The initial stages of screening are simple, easy to use and broad in their application. As the number of potential Hot Spots is reduced, the level of detail for which they are assessed increases, providing a more detailed, comparative analysis.

The scope of work was to identify and confirm major sources of pollution, examine the environmental effects of contaminant loading and facilitate the implementation of Strategic Action Programmes for all three Dnieper River nations, providing an administrative framework for implementing practical and cost-effective solutions. No sampling program for the river or individual Hot Spots was carried out. The approach is entirely dependent on existing information found in records of the riparian countries made available to the project through the NHSE.

2.0 HOT SPOT DEFINITION

There is no universally accepted concept of a "hot spot" (Hot Spot). The Dnieper Basin Environment Programme Terms of Reference defines Hot Spots as:

- Point sources of pollution/contamination
- Non-point sources of pollution/contamination
- Biodiversity sensitive areas
- Areas with human health risks
- Areas with environmental degradation

In order to develop a systematic and accurate approach addressing the large number of potential Hot Spots to be identified and assessed, a more precise and detailed definition was required. It was proposed by SLE&C, and accepted by the National Experts from all three riparian countries, to impose some limitations on the above definition of Hot Spots.

It was accepted that, for the purpose of this project, a Hot Spot be restricted to sources of contamination only. Sources of contamination (Hot Spots) that could be characterized quantitatively by the NHSE were assessed and prioritized using the proposed Methodology. Those identified sources of contamination that could not be characterized quantitatively by the NHSE were qualitatively described in the National Pollution Reduction Reports/National Reviews. Hence Hot Spots fell under two distinct categories: *Hot Spots subject to scoring*, and *Hot Spots subject to qualitative description.*

The following clarifies what is included under the Hot Spot definition for this project and what is not included.

What is included under Hot Spot definition

Hot Spots subject to scoring

It was accepted that Hot Spots be restricted primarily to sources that introduce pollution directly to the surface waters of the Dnieper River Basin, i.e. 'direct dischargers', through sewer outfalls (sanitary, process and stormwater). Sources of pollution that introduce pollution indirectly, i.e. 'indirect dischargers', by filtration of contaminated groundwater or leachate to surface water bodies (e.g. landfills), or through deposition of contaminated media through other pathways (such as air emissions), were only considered if their impacts were proven to be as significant in scale and effect as direct dischargers, and that the pollution source was quantifiable (e.g. flow, concentration and loading).

Direct dischargers included municipal and industrial wastewater treatment plants, industrial complexes, manufacturing plants, mineral and resource extraction centres, centres of large-scale livestock rearing and areas of high population density (towns and cities). Sources of pollution of this type are typically characterized by availability of data which can be used for their

quantitative description and assessment. These identified sources of pollution (Hot Spots) were assessed and scored using the proposed Methodology.

Hot Spots subject to scoring typically were the point sources of contamination. Non-point (diffuse) sources of contamination such as large farms, contaminated farming and industrial areas, military bases, etc., were also considered as *Hot Spots subject to scoring*, if they could be "equated" to point sources with sufficient available data to pass them through the scoring process.

Hot Spots subject to qualitative description

National Experts also identified, using their professional judgment, particular sources of substantial contamination that, for different reasons, did not have sufficient data to characterize them quantitatively (for scoring). Sources of pollution (Hot Spots) of this type were qualitatively described by the NHSE in the National Pollution Reduction Reports/National Reviews.

Typical examples of these types of pollution sources included 'indirect dischargers', non-point sources that could not be characterized quantitatively as point sources, e.g. landfills, and *areas with environmental degradation* (such as many military bases), large tailing ponds or drained peatlands, that are very extensive and thus difficult to quantitatively characterize. These Hot Spots were not scored, but described qualitatively, in the National Pollution Reduction Reports.

Other examples of *Hot Spots subject to qualitative description* were features with significant risk (potential for significant impacts), that could not be considered as active Hot Spots, for example:

- Petroleum tank farms and pipelines;
- Tailing ponds and reservoirs located on or near of the Dnieper River banks or its tributaries with water levels higher than in the river (unless they have active effluent discharges);
- Non-operational facilities: historical discharges, decommissioned or closed facilities (unless they have active effluent discharges).

These features were also identified by the National Experts of each country, using their professional judgment, and described qualitatively in the National Pollution Reduction Reports.

What is not included under Hot Spots definition

It was fully acknowledged that biodiversity sensitive areas are important features that needed attention in the study, however, they are receptors of pollution, not sources of pollution. As such, biodiversity sensitive areas were not considered as Hot Spots. Instead they were considered useful factors in the prioritization of the Hot Spots. From this perspective, it was proposed that the following areas should be considered "Biodiversity Sensitive Areas" representing potential receptors only. Additional categories of biodiversity sensitive areas could be added to the methodology upon recommendation by the NHSE.

- Wildlife Preserves (areas designated for Environmental Protection);
- Areas with significant habitats (wetlands and terrestrial habitat areas);
- Significant ecosystems, species complexes in need of conservation, e.g., spawning, migration, or staging areas.

Other important receptors included drinking water treatment plants and industrial water intakes (whose source waters are from rivers in the basin), recreational areas and commercial fisheries.

Another proposed restriction on the definition of Hot Spots were activities with significant impacts, whose potential mitigation measures did not meet UNIDO's desired outcome of being bankable projects. These included activities or features whose potential mitigation measures mainly included additional legislation, institutional strengthening, changes in practices, training and education. While these measures may be important for any mitigation, if they comprise the measures exclusively, they will not be perceived as 'bankable'. Examples of these activities included the following:

- Riverbank modifications: habitat loss;
- Farming (crops): soil erosion, run-off contaminated with fertilizers, pesticides;
- Forestry: soil erosion, run-off shock;
- Construction: soil erosion.

Definition of Hot Spot types

It was accepted that, for the purpose of this project, the types of Hot Spots also be defined in relation to their location within the river basin as follows:

Local Hot Spot – is a source of contamination, responsible for exceeding the corresponding local (National) Guidelines / Maximum Permissible Concentration values in surface water within the administrative unit (region, oblast) boundary, and results in an area of elevated human health and biodiversity risk and/or ecological hazard.

National Hot Spot – is a source of contamination, responsible for exceeding the corresponding National Guidelines / Maximum Permissible Concentration values in surface water within the country boundary, and results in an area of elevated human health and biodiversity risk and/or an ecological hazard.

Transboundary Hot Spot – is a source of contamination, responsible for exceeding the corresponding National Guidelines / Maximum Permissible Concentration values in surface water of adjacent countries. This also includes transboundary parts of the Dnieper River Basin where areas of elevated human health and biodiversity risk, as well as ecological hazard zones are formed as a result of industrial, agricultural or municipal activities.

3.0 METHODOLOGY

3.1 Summary of Approach

The methodology provides a formal, systematic approach to addressing the large number of potential Hot Spots in the Dnieper River Basin recognizing the short period of time available to the National Experts to complete their tasks. The approach is also flexible in that rules could be readily modified to ultimately obtain a manageable number of Hot Spots for detailed evaluation.

Five steps were involved:

Step 1 Identification and Preliminary Screening of Hot Spots
Step 2 Detailed Evaluation of Hot Spots (passing Preliminary Screening)
Step 3 Prioritization of Hot Spots
Step 4 Identification of Mitigation Measures and Associated Costs
Step 5 Reporting

Each step is briefly described in the following sections.

3.2 Step 1: Identification and Preliminary Screening of Hot Spots

In Step 1 the NHSE compiled a full list of Hot Spots for each country based on information available and shortened this list to a manageable number of Hot Spots using the screening method. If too few or too many Hot Spots passed through the screening method, the parameters were adjusted until a manageable number of Hot Spots were identified for further assessment (Step 2).

For each country, the NHSE compiled a list of Hot Spots based on the guidance provided by the definition. The Hot Spots were selected from information available in environmental monitoring records of each country and from the knowledge and experience of the NHSE.

Decreasing the number of Hot Spots to a more manageable number for detailed scrutiny was important given the constraints of the project. For the purpose of this report, the following number of Hot Spots were selected for each country:

- Belarus: 50 to 100 Hot Spots
- Russia: 50 to 100 Hot Spots
- Ukraine: 100 to 200 Hot Spots

Ukraine's larger number of Hot Spots reflects their greater portion of the basin in terms of industry, population and land area.

Numerical criteria (such as contaminant loadings released from the Hot Spot), and the knowledge of NHSE, were used to screen the Hot Spots to arrive at a manageable number for in-

depth assessment. Numerical criteria were adjusted to arrive at the appropriate number and were selected to correspond with data used in each country according to format and availability. The parameters used as indicators were selected based on their availability. For example, most municipal sewage treatment plants measure Biochemical Oxygen Demand (BOD) in effluent discharges and therefore BOD was selected for this sector, while one of the heavy metals was selected as the indicator for the industrial sector.

For preliminary screening, the "effective mass of contaminant" methodology, which was developed for the characterization of different discharges (their quantity and toxicity), and is based on the "toxic equivalent" concept, was employed. For details of the "effective mass of contaminant" methodology see Papisov, 1989. The "effective mass of contaminant" derived for a discharge was used for the comparative assessment of different contaminant discharges where multiple contaminants were involved. The Hot Spots yielding the highest "effective mass of contaminant" were promoted to Step 2 for more detailed evaluation.

The method made use of existing contaminant loading estimates available in the State Statistical Database (2TP – "Vodkhoz"), collected for most dischargers in each of the three countries during the period from 2000 to 2002.

Calculation of the effective mass of contaminant for "Hot Spot X"(M_X) was based on two parameters: mass of discharged pollutant "i" (m_i), and relative toxicity of pollutant "i", defined by the coefficient of toxicity, A_i. The coefficient of toxicity, A_i, was calculated on a relative basis to the toxicity of ammonium sulphate which has a Maximum Permissible Concentration (MPC) value of 1 mg/L* :

$$A_i = \frac{\text{MPC ammonium sulphate (mg/L)}}{\text{MPC}_i\,(\text{mg/L})}$$

For example,

for formaldehyde, $A_i = 4$ since $MPC_{formaldehyde} = 0.25$ mg/L*,
for ammonium perchlorate, $A_i = 125$ since $MPC_{ammonium\ perchlorate} = 0.008$ mg/L*.

Note: * State Surface Water Quality Standards (Fishery) for all three countries.

The formula for calculating the "effective mass of contaminant i" for a discharge is given by the following:

$$M_i\ (\text{tonnes/year}) = A_i\ (\text{dimensionless}) \times m_i\ (\text{tonnes/year})$$

Masses of discharged pollutants by individual discharger for a broad range of components (m_i) are stored in the Database "2TP – Vodkhoz". Values of Maximum Permissible Concentrations (MPC_i) for different components were found in the State Surface Water Quality Standards (Fishery).

The total effective mass of discharged contaminants for "Hot Spot X"(M_X) was calculated as the sum of the effective masses of discharged individual contaminants:

$$M_X = \sum M_i$$

Values of M_X for individual Hot Spots were used as score values for the preliminary screening and preliminary ranking of all the Hot Spots, as a basis for selecting those to go forward to Step 2.

For multi-point sources of contamination, such as those associated with large industrial or municipal complexes, the effective mass of contaminant was assessed using the following formula, which sums multiple point sources:

$$\sum^n M_i = M_1 + M_2 + ... + M_n$$

It was at the discretion of the National Experts whether there was any merit in aggregating multiple discharges in this manner. The decision partly depended on whether mitigation could be applied over several sources and whether a "bankable" project could be identified.

Being a simple system, the numerical screening could leave-out substantial sources of contamination known to the NHSE. In addition to the above methodology, the preliminary screening was augmented with additional criteria designed to ensure Hot Spots associated with most of the major economic sectors were included and that there remained flexibility to promote some Hot Spots based on the professional judgement of the National Experts. This recognized that some significant Hot Spots did not meet the preliminary screening. These additional criteria for promotion to Step 2 are provided below (Table 1).

Table 1 - Hot Spot Promotion Criteria For Preliminary Screening

Sector	Factor	Numerical Criterion*
Municipal Sector	M.1 Total Annual Mass Load [kg/year]. For choice of parameter see notes**	>2% of Total Annual "Watershed" Load
	M.2 Total Annual Hydraulic Loading [km^3/year]	>1% of Total Annual "Watershed" Flow
Industrial Sector	I.1 Total Annual Mass Load [kg/year]. For choice of parameter see notes**	>2% of Total Annual "Watershed" Load
	I.2 Largest establishments in most important industrial sectors for each country	Professional Judgment by National Experts.
Agricultural Sector	A.1 Largest livestock establishments in each country based on animal equivalents (not hectares)***	
Other (Power Sector, etc.)	O.1 Significance to human and environmental health	Professional Judgment by National Experts.

* actual numerical values were adjusted based on data availability, "watershed" defined on a country-specific basis given each country carried out screening independently.

** Municipal Sector promoted on the basis of BOD and Total Phosphorus loading which served as surrogates for other potential contaminants in municipal discharges. Industrial Sector used parameters for which reasonably good watershed loading inventories were available.

*** focused on livestock operations since fertilizer/pesticide issues are more readily addressed through implementation of Best Management Practices.

3.3 Step 2: Detailed Evaluation of Hot Spots

The detailed evaluation of Hot Spots was conducted using the scoring sheets attached. A scoring sheet and a rationale document was developed for each of the categories of Hot Spot issues as follows:

- Water Quality & Human Health
- Pollution Control
- Environment & Biodiversity
- Economics

Work sheets for each category with Rationales and Scoring Sheets are presented in the Attachment. The rationale documents explain why criteria were proposed and their relative importance.

The detailed evaluation was conducted using a numerical scoring methodology. The four areas of interest, identified as Categories in the scoring methodology, were broken into Subcategories of multiple questions (Indicators). The scores were transferred to a Summary Scoring Sheet which calculated the total score of each Hot Spot after accounting for weightings.

The initial activity required for the scoring methodology was the selection of reasonable weightings to determine the relative importance of each indicator. The weighting was undertaken at three levels (categories, subcategories and indicators). Weightings are only relative between indicators in the same subcategories, subcategories in the same categories and between categories. This approach made selecting weighting factors relatively easy to implement and revise as required. It eliminated any bias introduced between categories and/or subcategories with many indicators compared to those categories and/or subcategories with few indicators.

The range of scores was designated as 0 to 5. The range could be altered as desired (i.e., 0 to 100) to provide greater refinement of resolution (more detailed discrimination between criteria). It was considered that a range of 0 to 5 provided an appropriate amount of discrimination for the evaluation.

The scoring sheets with proposed weightings were provided with the guideline. As one of the their first tasks, the NHSE were required to review and revise the proposed weighting values.

The NHSE completed the scoring sheets for each of the short-listed Hot Spots using data available in national and regional centres. During this process, a data quality assessment was conducted by the NHSE for each country and used in a sensitivity analysis of the scoring methodology.

The scores were transferred to a Summary Scoring Sheet which calculated the total score of each Hot Spot after accounting for weightings.

3.4 Step 3: Prioritization of Hot Spots

The prioritization of the Hot Spots was based on the scores determined from the previous step (Step 2) with the highest scores being promoted. Some latitude was allowed for flexibility in developing the final list for immediate implementation of corrective actions, i.e., initial mitigation estimates and funding list. For example, a good range of the major industries in each portion of the basin were represented.

The NHSE prioritized the short-listed Hot Spots using the results of Step 3 and identified the Hot Spots which proceeded to Step 4. The number of Hot Spots, including water treatment plants and industrial enterprises, selected for Step 4 were as follows:

- Belarus: 5 Hot Spots
- Russia: 5 Hot Spots
- Ukraine: 10 Hot Spots

3.5 Step 4: Identification of Mitigation Measures and Associated Costs

For the selected Hot Spots, mitigation measures were proposed and costs for their implementation estimated. This work was primarily conducted by the NHSE for Pollution Control and Economics. Mitigation measures included the installation of treatment technologies, improvements of operating procedures and also adopting new policies, legislation and best management practices. A cost-benefit analysis of the proposed measures was conducted for the 20 selected Hot Spots.

3.6 Step 5: Reporting

The findings of the steps above were summarized in *National Pollution Reduction Reports* for each country. The NHSEs of each participating country produced a National Pollution Reduction Report representing a situational analysis of the country in terms of the identification and analysis of sources of pollution for the Dnieper River Basin. The three National Pollution Reduction Reports/National Reviews will be later combined into the Final Regional Report on Pollution Reduction Measures for the Dnieper River Basin.

3.7 Limitations and Recommendations

This Methodology was developed for the purpose of the implementation of the UNIDO Project for Identification and Analysis of Sources of Pollution (Hot Spots) and was specifically designed for use in the Dnieper River Basin. At the same time, the Methodology uses universal approaches for the analysis of pollution sources and their impact on the environment and diverse receptors within a river basin. The versatility of the Methodology makes it possible to use it for the implementation of similar projects in other river basins.

Initialy, a working version of the Methodology was used, which was open to discussion and changes. As the project progressed , the Methodology was improved and developed to become the Final document. During this process, certain limitations to the Methodology and its implementation became apparent. These limitations and our recommendations to adapt the Methodology for use in other river basins are provided below.

3.7.1 Limitations

Limitation on Accuracy

1. The main source of quantitative data on existing contaminant loadings during the initial stage of the identification and preliminary screening of Hot Spots was the State Statistical Database (2TP – "Vodkhoz"). Consequently, the accuracy of the assessments by this Methodology is determined by accuracy of the original data compiled in the 2TP – "Vodkhoz" Database. These data were collected from different laboratories for a variety of parameters. In addition, the 2TP – "Vodkhoz" Database includes all objective and subjective errors and biases, which is typical in statistical analysis.

2. Some of the Hot Spots, reporting to the 2TP – "Vodkhoz" Database, do not discharge their effluents directly into the river body, but into municipal treatment plants. In these cases, the actual impact and significance of the Hot Spot cannot be properly assessed. This influences the accuracy of the preliminary screening of the Hot Spots, as well as the assessment of real distances between the Hot Spots and receptors, considered under the detailed asessment.

3. In the Methodology, the limitations of the formalized approach are modified by the professional judgement of the National Experts to select some important Hot Spots, eliminated during the preliminary screening; to select weighting coefficients at the stage of the detailed evaluation; and to control the results of the qualitative assessments. In these cases, the accuracy of the screening is determined by the professional judgement of the National Experts.

Limitation on Applicability

1. Non-point (diffuse) sources of contamination that could not be characterized quantitatively as point sources were not primarily the subjects of the Methodology. The impact area of diffuse sources of contamination (e. g. surface run-off within municipal or industrial sites) on the point source Hot Spots' discharge was not considered.
2. The combined effect of pollutants, discharged by individual Hot Spots located within a close distance, was also not assessed.

3.7.2 Recommendations for Adapting the Methodology for Use in Other River Basins

The Methodology can be easily modified and adapted for use in other river basins.

The following general recommendations are proposed.

1. The parameters to be modified must be initially calibrated for specific river basins depending on specific river basin characteristics. These parameters should include, but not be limited to, volumes and concentrations of effluents for the scoring tables, distances from points of discharge to environmentally sensitive areas and, especially, the selection of weighting coefficients.
2. For countries without a centralized statistical database, such as existing contaminant discharges and loadings (similar to the 2TP – "Vodkhoz"), the Hot Spot Promotion Criteria For Preliminary Screening (Table 1) should be employed for the initial selection and screening of Hot Spots.
3. Different countries and river basins should use their own specific criteria for the liminting values of the effective mass of pollutants for the purposes of the prioritization of Hot Spots, which could differ from those used for Dnieper River Basin.

3.8 References

Numerous sources were used to develop the methodology; the most important are shown below:

- 'Transboundary Diagnostic Analysis for the Dnieper River Basin: Synthesis Report', UNDP, UNEP, GEF, 1997
- 'Environmental Situation in the Lower Dnipro River Basin', O.G. Vasenko, Ukrainian Scientific Centre for Protection of Waters, Water Quality Research Journal Canada, 1998, Volume 33, No. 4, 457-487
- Convention on Cooperation for the Protection and Sustainable Use of the Danube River Basin, Danube River Protection Convention
- 'National Reviews 1998', Danube Pollution Reduction Programme
- 'GIWA Methodology: Stage 1: Scaling and Scoping: Guidance to the Methodology and its Use', Global International Waters Assessment, July 2001
- 'Report of the GIWA Methodology Testing Workshop in the Gulf of Thailand System', Southeast Asia Global Change START Regional Centre, July 2000

- 'Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources and Activities'.
- 'Methodology of the integral pollution assessment', from monograph of V. K. Papisov, Nauka Press, Moscow, 1989
- "Regional assessment of the groundwater intake on the river flow", M.M. Cherepanskiy, Prirodnie Resursy, Minsk, 1999, No. 2, 30-39

Many other sources of information, Internet web sites and published reports provided valuable aid and guidance for many issues, but are not listed above.

APPENDIX A

Abbreviations

ABBREVIATIONS

BAT: Best Applicable Treatment

BMP: Best Management Practices

BOD: Biological Oxygen Demand (BOD_5 - value measured after 5-day period at temperature of 20 C)

COD: Chemical Oxygen Demand

IHSE: International Hot Spot Experts (SLE&C)

MDL: Method Detection Limit

MOE: Ontario Ministry of the Environment

NHSE: National Hot Spot Experts (Belarus, Russia, Ukraine)

SIC: Standard Industrial Codes: a system of assigning numerical values to all types of commercial and industrial activities to facilitate database management

SLE&C: SNC-LAVALIN Engineers and Constructors Inc.

TDS: Total Dissolved Solids

TSS: Total Suspended Solids

PAHs: Polyaromatic Hydrocarbons

POPs: Persistent Organic Pollutants

APPENDIX B1

Rationale – Pollution Control Issues

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PREAMBLE

Industries and wastewater treatment plants directly discharging effluents to the Dnieper River watershed are evaluated with respect to their designation as a "Hot Spot" by virtue of two considerations: (1) their characteristics, i.e. flow rate and quality, and (2) treatment, monitoring and type of discharge.

Regarding characteristics, the intent is to promote dischargers of large volumes of effluent and dischargers of large loads of specific, basic parameters which would directly impact on river water quality. These basic or conventional parameters, typically, are also the parameters for which Best Available Treatment (BAT) technologies can be applied, operated and monitored with respect to adequate performance.

The type and degree of wastewater treatment already in place must also be considered in promoting industries to "Hot Spots". By including this consideration, credit can be given to dischargers of large volumes of fully treated wastewater. Thus, large wastewater treatment plants and industries would not necessarily be promoted to Hot Spots based solely on size and conversely preference will be given, for example, to smaller industries having no effluent treatment at all.

Credit is also given to dischargers who (a) already have in place good effluent monitoring (flow measurement, sampling and analytical) programs, and (b) discharge effluents intermittently and / or through well designed and constructed sub-surface river outfalls and diffusers. Data provided by those per (a) above can be considered more reliable and accurate. Those dischargers meeting criterion (b) above will likely be creating smaller zones of adverse (toxic) river water quality and may be allowed to discharge effluent with higher concentrations of certain non-persistent parameters.

Following is a brief description and rationale for the inclusion of each specific criterion on the Hot Spot Evaluation sheets.

The scoring methodology allows alternative questions to be answered for the same criteria when appropriate. For example, flow rates from municipal wastewater treatment plants tend to be much larger than from industrial complexes, therefore, there are two sets of evaluation data for Criterion No. 1.1: one pertaining to municipal waste water treatment plants and one pertaining to industrial complexes. With respect to Hot Spots that do not fall into either of the two categories above, select data are evaluated based on the characteristics of the effluent (i.e. stormwater discharges and agricultural run-off would both most likely fit with the evaluation data for municipal wastewater treatment plants).

Additionally, for wastewater characteristics, it is acknowledged that it is unlikely that all Hot Spots will have laboratory analyses characterizing the wastewater for every parameter proposed. Thus, for every evaluation question pertaining to specific contaminants, an alternate question is

proposed that relies on professional judgement. Similarly for loadings, there is an alternate question to those relying on data, which relies on professional judgement. Criteria scoring based on professional judgement has a maximum score of 3 as opposed to 5 for measured results, in order to compensate for uncertainty.

1.0 WASTEWATER TREATMENT AND DISCHARGE

1.1 Normal Total Effluent Flow Rate

Industrial: For a given industrial sector, this criterion will allow separation of industrial facilities based on size. Wastewater generation rates are typically proportional to production rates. Industries with effluent flow rates greater than 2500 m^3/day are considered very large, 1000 m^3/day medium and less than 50 m^3/day small.

With this scoring criterion, credit is given for large industries, which have implemented or achieved water conservation measures (i.e. lower effluent rate per unit of production).

Municipal: As municipal wastewater treatment plant effluents tend to be larger than their industrial counterparts, the rates have been increased based on professional judgement. The rate ranges have been modified to increments of 1000 m^3/day. The National Experts utilized official information contained in the 2TP reports for effluent rate data.

1.2 Proportion of Effluent Treated

Both continuous and intermittent effluent discharges are scored in this criterion, so that while all continuous process effluent streams may be treated, spills and clean out wastewater may not be, and may have significant impacts. This would be the case, for example, for base metal mining where processing effluents were being treated but discharges from tailings dams were not.

1.3 Dilution/Mixing

To account for the assimilative capacity of the river, the hydraulic flow rate of the discharge (m^3/d), is included in the evaluation. This is accomplished by ranking the dilution factor (river flow to effluent discharge). The minimum average 7-day river flow with a recurrence interval of 10 years ($7Q_{10}$) was proposed as a standard river flow criterion. This criterion is also used by industry in New York State as a guideline for monitoring industrial waste discharges.

For point source discharges to rivers and streams, the Ontario Ministry of the Environment (MOE) uses the $7Q_{20}$ low flow statistic (the minimum 7-day average low flow with a recurrence period of 20 years) - i.e. a 5% chance of there being inadequate stream flow to meet the minimum acceptable dilution in any given year.

For discharges to lakes (reservoirs) and interconnecting channels, discharges directly to a shoreline are not acceptable (MOE). A shoreline discharge of storm water and/or cooling water may be considered on a case-by-case basis.

In the Great Lakes, initial mixing for discharge diffusers in lakes must have a minimum near field (initial mixing) ratio of 20:1. Specification of additional site-specific conditions (e.g. spawning shoals, beaches, drinking water intakes, minimum depth of submergence and distance offshore, etc.) are based on the professional judgment of the reviewer (MOE staff).

For the Dnieper River Basin, the low flow criterion was discussed with the National Experts. The $7Q_{10}$ flow rate is not used and it was suggested to base the discharge dilution on 95% of the inter-season river water flow rate.

1.4 Secondary Contributors

For both municipal wastewater treatment plants and industrial dischargers, contribution to the effluent by secondary sources can have an important impact on effluent quality. For industry, secondary contributors are less under control than their own operations and therefore add uncertainty to effluent quality and thus greater concern for adverse impacts. For municipal wastewater treatment plants, the greater the portion of the effluent whose source is industrial, the more likely that contaminants such as heavy metals and petroleum products will be present in the effluent.

1.5 Method of Discharge

The method of discharge of treated or untreated effluent will impact on the location and size of the mixing zone where toxic conditions could exist.

Full credit is given for situations where there is no discharge by virtue of complete containment, recycling, re-use, etc.

Uncontrolled discharges are those with no distinct point of discharge which can readily sampled. Such would be the case if no collection sewers or pipes were evident and discharge was by overland routes.

Discharge into the sub-surface, either controlled or not, is considered less desirable based on the potential for the contamination of groundwater, which is used as a supply of potable water for a large number of communities.

1.6 Frequency of Discharge

Generally, intermittent discharges are considered to have less impact than continuous discharges because there are times when local impairment of water quality does not occur. However,

intermittent discharges can be more detrimental to fish and other aquatic life if they are present at the point of discharge and possibly subject to rapid changes in water quality. Mobile aquatic life will often stay away from continuous discharge mixing zones.

1.7 Frequency of Flow Monitoring

High frequency of flow monitoring implies better actual or potential environmental management and control.

Continuous flow monitoring would generally be preferred to intermittent flow monitoring, so that possible uncontrolled discharges are known and, hopefully, controlled. However, where effluent flow remains constant, intermittent flow monitoring is acceptable.

1.8 Frequency of Sampling and Analysis

High frequency of effluent sampling and analysis implies better actual or potential environmental management and control.

Continuous effluent sampling and analysis is generally preferred to intermittent sampling and analysis, so that possible uncontrolled discharges are known and hopefully controlled. However, where effluent quality remains constant, intermittent or grab sampling and analysis is acceptable. Continuous sampling would have to be done initially, and periodically thereafter, to confirm the invariability of effluent quality.

1.9 Type of Sampling

Continuous, composite sampling is preferred to grab sampling so that intermittent quality spikes are captured. However, as for the frequency of flow monitoring, sampling and analysis, grab sampling of effluents with constant quality (as determined by initial, and confirmed by periodic, continuous sampling) is equivalent.

2.0 WASTEWATER CHARACTERISTICS

The ranking of the severity of the impact of wastewater on the environment is based on 6 categories as follows:

0 no effect
1 slight effect
2 moderate effect
3 major effect
4 severe effect
5 extreme effect

2.1 Oxygen Demanding or Depleting Materials

This criterion is rather subjective in that under certain circumstances, BOD or COD discharge loads or concentrations can fluctuate as a result of intermittent, highly polluting operations.

Also for certain industries, such as agri-food, and especially where there is no effluent treatment, BOD / COD concentrations will be very high.

If BOD or COD data is unavailable, total organic carbon (TOC) or dissolved organic carbon (DOC) data can be used.

2.2 Nitrogen

Nitrogen in the form of nitrites, nitrates and organic nitrogen contributes to river water eutrophication.

2.3 Ammonia

Ammonia is included because of its acute toxicity to aquatic life particularly at higher pH.

2.4 Phosphorus

Phosphorus in the form of ortho-phosphates and condensed phosphates contribute to water eutrophication.

2.5 Total Suspended Solids

This quality parameter impacts water clarity and build up of sediment at the point of discharge and possible movement downstream. The secondary characteristics of the solids are not specified e.g. biodegradability, specific gravity, particle size, hazardous constituents, etc.

Suspended solids containing toxic organics, heavy metals and the like are scored under their specific criteria.

2.6 Phenols

The non-specific phenol parameter is useful for the initial evaluation of wastewaters particularly from petroleum and petrochemical plants. Phenols are also good indicators of water contamination from organic chemical facilities and the presence of other organic compounds. At low concentrations, phenols impart objectionable taste and odour to drinking water.

2.7 Persistent Organic Pollutants

Persistent organic pollutants (POPs) are those organic compounds that do not readily (bio)degrade in the natural environment and therefore tend to accumulate in sediment and aquatic life. These compounds include specific pesticides and herbicides, PCB, polyaromatic hydrocarbons (PAH), halogenated organic chemicals and others.

The type and load or concentration of persistent organic compounds discharged will depend on the industry. While many of these compounds can be detected at low (trace) concentrations in many if not all industrial discharges, the intent is to identify those discharges containing relatively high loads or concentrations which would be associated with their use as raw materials and generation as un-recovered or un-treated by-products or products.

While all detected POPs are grouped in this criterion, information available which identifies specific compounds and their discharge concentration or load is also useful to assist in the subjective evaluation of hot spots. For example, more acutely toxic POPs could receive a higher weighting.

2.8 Oil and Grease

There are usually two discharge limits for oil and grease – one for animal or vegetable oil and grease and the other for mineral or synthetic oil and grease. Discharge limits are usually an order of magnitude more stringent for the latter type, as animal and vegetable oil and grease is typically more biodegradable. However, both are aesthetic quality criteria. The concentrations of animal / vegetable fats and oils in the scoring matrix have been reduced to reflect more likely actual concentrations encountered in certain industrial discharges

2.9 Heavy Metals

The eight heavy metals of concern are iron, copper, zinc, nickel, chromium, cadmium, lead and mercury. Metals concentrations and loads are determined as total (dissolved + solid). The impact of heavy metals on the environment relates to water and sediment quality. Dissolved metals impact primarily on toxicity to aquatic life and drinking water toxicity and aesthetics i.e. taste. Evaluation of each of these heavy metals, is made individually, rather than collectively.

2.10 Radioisotopes

The main radioisotopes of concern are Ce^{137} and Sr^{90} which arise from the nuclear power industry.

3.0 POLLUTION LOADINGS

While the concentration of contaminants in a discharge have immediate effect on receiving waters, contaminant loadings are also important to the overall ecological health and beneficial use of a river system. Thus, a similar scoring methodology has been created for loadings following the same contaminant-by-contaminant approach as the previous section.

The loads are represented by the percentage of total load at the nearest downstream national boundary (e.g. Ukraine's would be a percentage of the loading that reaches the Black Sea minus the national loads from Belarus and the Russian Federation). Professional judgement is based on high, medium, low and none.

The National Experts indicated that loading information for all but 6 of the parameters may not be available. The six parameters for which data is routinely recorded are BOD, COD, ammonium nitrogen , iron, copper and oil. Where loading data is unavailable for specific other parameters, the professional judgement of the National Experts is used to estimate qualitatively whether loadings would be expected to be high, moderate, low or non-existent.

APPENDIX B2

Work Sheet – Pollution Control Issues

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.0	**General**			
1.1a	If the Hot Spot is a municipal waste water treatment plant, what is the total average daily flow discharged to the river? 5 – > 100,000 m^3/d 4 – > 50,000 but < 100,000 m^3/d 3 – > 10,000 but < 50,000 m^3/d 2 – > 5,000 but < 10,000 m^3/d 1 – > 1,000 but < 5,000 m^3/d 0 – equal to or < 1,000 m^3/d			
1.1b	If the Hot Spot is an industry, what is the normal total effluent flow rate ? 5 – more than 2,500 m^3/day 4 – 2000 to 2,500 m^3/day 3 – 1000 to 1,999 m^3/day 2 – 500 to 999 m^3/day 1 – 50 to 499 m^3/day 0 – less than 50 m^3/day			
1.2	What percentage of the total daily effluent discharged receives treatment? 5 – < 20% 4 – < 40 to 20% 3 – < 60 to 40% 2 – < 80 to 60% 1 – < 100 to 80% 0 – 100%			
1.3	What is the dilution ratio, low river flow:total daily wastewater discharge rate? 5 – < 5:1 4 – > 5:1 but < 10:1 3 – > 10:1 but < 20:1 2 – > 20:1 but < 40:1 1 – > 40:1 but < 80:1 0 – > 80:1			
1.4a	If the Hot Spot is a municipal wastewater treatment plant, what is the daily flow contribution from industries (not municipal sanitary sewage)? 5 – > 40% 4 – > 30% but < 40% 3 – > 20% but < 30% 2 – > 10% but < 20% 1 – > 0 but < 10% 0 – 0%, no flow contribution			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.4b	If the Hot Spot is an industry, what is the daily flow contribution from secondary industries (dischargers not under the control of the point source industry)? 5 – > 40% 4 – > 30% but < 40% 3 – > 20% but < 30% 2 – > 10% but < 20% 1 – > 0 but < 10% 0 – 0%, no flow contribution			
1.5	What is the method of discharge of treated or untreated effluent? 5 – single surface outfall 4 – multiple surface outfall 3 – submerged, low river flow 2 – submerged, high river flow 1 – submerged outfall / diffuser			
1.6	What is the frequency of discharge? 5 – continuous 4 – nearly continuous (more than 5 days per week) 3 – intermittent (once per week) 2 – intermittent (once per month) 1 – intermittent (once per quarter) 0 – intermittent (once per year or less)			
1.7	What is the frequency of flow monitoring? 5 – never 4 – intermittent (few points of discharge) 3 – intermittent (most points of discharge) 2 – continuous (few points of discharge) 1 – continuous (some points of discharge) 0 – continuous (all points of discharge)			
1.8	Which discharges are sampled? 5 – none 4 – few points of discharge 3 – most points of discharge 2 – few points of discharge 1 – some points of discharge 0 – all points of discharge			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.9	What is the type/frequency of sampling and analysis? 5 – none/never 4 – monthly (or less frequent) grab samples and analyses 3 – weekly grab samples and analyses 2 – daily grab samples and analyses 1 – continuous sampling, laboratory analyses 0 – continuous sampling, on–line analyses			
1.10	Is the effluent from all discharge points subject to flow controls. 5 – no controls on any discharge points 3 – some controls on some discharge points 1 – some controls on all discharge points 0 – all discharge points controlled			
2.0	**Wastewater Characteristics**			
2.1a	What is the BOD_5 concentration of the discharge? 5 – > 240 mg/l 4 – 120 mg/l to < 240 mg/l 3 – 60 mg/l to < 120 mg/l 2 – 30 mg/l to < 60 mg/l 1 – 15 mg/l to < 30 mg/l 0 – < 15 mg/l			
2.1b	If BOD_5 is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high BOD_5 2 – effluent has moderate BOD_5 1 – effluent has low BOD_5 0 – no BOD_5			
2.2a	What is the COD concentration of the discharge? 5 – > 400 mg/l 4 – 200 mg/l to < 400 mg/l 3 – 100 mg/l to < 200 mg/l 2 – 50 mg/l to < 100 mg/l 1 – 20 mg/l to < 50 mg/l 0 – < 20 mg/l			
2.2b	If COD is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high COD 2 – effluent has moderate COD 1 – effluent has low COD 0 – no COD			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.3a	What is the total suspended solids (TSS) concentration of the discharge? 5 – > 240 mg/l 4 – 120 mg/l to < 240 mg/l 3 – 60 mg/l to < 120 mg/l 2 – 30 mg/l to < 60 mg/l 1 – 15 mg/l to < 30 mg/l 0 – < 15 mg/l			
2.3b	If TSS is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high TSS 2 – effluent has moderate TSS 1 – effluent has low TSS 0 – no TSS			
2.4a	What is the total dissolved solids (TDS) concentration of the discharge? 5 – > 1000 mg/l 4 – 800 mg/l to < 1000 mg/l 3 – 700 mg/l to < 800 mg/l 2 – 600 mg/l to < 700 mg/l 1 – 500 mg/l to < 600 mg/l 0 – < 500 mg/l			
2.4b	If TDS is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high TDS 2 – effluent has moderate TDS 0 – effluent has low TDS			
2.5a	What is the Total Phosphorus concentration of the discharge? 5 – > 5.0 mg/l 4 – 4.0 mg/l to < 5.0 mg/l 3 – 3.0 mg/l to < 4.0 mg/l 2 – 2.0 mg/l to < 3.0 mg/l 1 – 1.0 mg/l to < 2.0 mg/l 0 – < 1.0 mg/l			
2.5b	If Total Phosphorus is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high phosphorus 2 – effluent has moderate phosphorus 1 – effluent has low phosphorus 0 – no phosphorus			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.6a	What is the Ammonium Nitrogen (NH_4–N) concentration of the discharge? 5 – > 16.0 mg/l 4 – 12.0 mg/l to < 16.0 mg/l 3 – 8.0 mg/l to < 12.0 mg/l 2 – 4.0 mg/l to < 8.0 mg/l 1 – 2.0 mg/l to < 4.0 mg/l 0 – < 2.0 mg/l			
2.6b	If NH_4–N is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high NH_4–N 2 – effluent has moderate NH_4–N 1 – effluent has low NH_4–N 0 – no NH_4–N			
2.7a	What is the Nitrate Nitrogen (NO_3–N) concentration of the discharge? 5 – > 30.0 mg/l 4 – 25.0 mg/l to < 30.0 mg/l 3 – 20.0 mg/l to < 25.0 mg/l 2 – 15.0 mg/l to < 20.0 mg/l 1 – 10.0 mg/l to < 15.0 mg/l 0 – < 10.0 mg/l			
2.7b	If NO_3–N is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high NO_3–N 2 – effluent has moderate NO_3–N 1 – effluent has low NO_3–N 0 – no NO_3–N			
2.8a	What is the Nitrite Nitrogen (NO_2–N) concentration of the discharge? 5 – > 0.5 mg/l 4 – 0.4 mg/l to < 0.5 mg/l 3 – 0.3 mg/l to < 0.4 mg/l 2 – 0.2 mg/l to < 0.3 mg/l 1 – 0.1 mg/l to < 0.2 mg/l 0 – < 0.1 mg/l			
2.8b	If NO_2–N is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high NO_2–N 2 – effluent has moderate NO_2–N 1 – effluent has low NO_2–N 0 – no NO_2–N			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.9a	What is the concentration of Oil Products (mineral or synthetic) in the discharge? 5 – > 16.0 mg/l 4 – 8.0 mg/l to < 16.0 mg/l 3 – 4.0 mg/l to < 8.0 mg/l 2 – 2.0 mg/l to < 4.0 mg/l 1 – 1.0 mg/l to < 2.0 mg/l 0 – < 1.0 mg/l			
2.9b	If oil products are not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high oil product concentrations 2 – effluent has moderate oil product concentrations 1 – effluent has low oil product concentrations 0 – no oil product concentrations			
2.10a	What is the concentration of Persistent Organic Pollutants (POPs) in the discharge? (Dibutylphthalate, Diethylhexylphthalate, Other Phthalates, Dechlorane (mirex), Polychlorinated Biphenyl (PCB), Polybrominated Biphenyl (PBB), Dichlorodiphenyltrichloroethane (DDT) and Metabolites) 5 – MDLs exceeded by 160% and higher 4 – MDLs exceeded by 80% 3 – MDLs exceeded by 40% 2 – MDLs exceeded by 20% 1 – above MDLs 0 – less than method detection limits (MDLs)			
2.10b	If POPs are not measured, is it likely that: 3 – POPs are present in the effluent in high concentrations 2 – POPs are present in the effluent in moderate concentrations 1 – POPs are present in the effluent in low concentrations 0 – POPs are not present			
2.11a	What is the concentration of Phenols in the discharge? 5 – > 0.16 mg/l 4 – 0.08 mg/l to < 0.16 mg/l 3 – 0.04 mg/l to < 0.08 mg/l 2 – 0.02 mg/l to < 0.04 mg/l 1 – 0.01 mg/l to < 0.02 mg/l 0 – < 0.01 mg/l			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.11b	If Total Phenols are not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high phenols 2 – effluent has moderate phenols 1 – effluent has low phenols 0 – no phenols			
2.12a	What is the concentration of Polyaromatic Hydrocarbons (PAH) in the discharge? (Naphthalenes, Phenanthrenes, Pyrenes, Chrysene or Triphenylene or Benzanthracene, Benzopyrenes or Perylene or Benzofluoranthenes) 5 – > 0.16 mg/l 4 – 0.08 mg/l to < 0.16 mg/l 3 – 0.04 mg/l to < 0.08 mg/l 2 – 0.02 mg/l to < 0.04 mg/l 1 – 0.01 mg/l to < 0.02 mg/l 0 – < 0.01 mg/l			
2.12b	If PAHs are not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high PAHs 2 – effluent has moderate PAHs 1 – effluent has low PAHs 0 – no PAHs present			
2.13a	What is the concentration of Fats & Oils (animal or vegetable) in the discharge? 5 – > 150 mg/l 4 – 75.0 mg/l to < 150.0 mg/l 3 – 25.0 mg/l to < 75.0 mg/l 2 – 5.0 mg/l to < 25.0 mg/l 1 – 1.0 mg/l to < 5.0 mg/l 0 – < 1.0 mg/l			
2.13b	If not measured, is it likely that: 3 – effluent has high levels of fats & oils 2 – effluent has moderate levels of fats & oils 1 – effluent has low levels of fats & oils 0 – no fats & oils present			
2.14a	What is the concentration of Iron (Fe) in the discharge? 5 – > 1.5 mg/l 4 – 1.2 mg/l to < 1.5 mg/l 3 – 0.9 mg/l to < 1.2 mg/l 2 – 0.6 mg/l to < 0.9 mg/l 1 – 0.3 mg/l to < 0.6 mg/l 0 – < 0.3 mg/l			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.14b	If Iron is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Iron 2 – effluent has moderate Iron 1 – effluent has low Iron 0 – no Iron present			
2.15a	What is the concentration of Copper (Cu) in the discharge? 5 – > 0.13 mg/l 4 – 0.11 mg/l to < 0.13 mg/l 3 – 0.09 mg/l to < 0.11 mg/l 2 – 0.07 mg/l to < 0.09 mg/l 1 – 0.05 mg/l to < 0.07 mg/l 0 – < 0.05 mg/l			
2.15b	If Copper is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Copper 2 – effluent has moderate Copper 1 – effluent has low Copper 0 – no Copper present			
2.16a	What is the concentration of Zinc (Zn) in the discharge? 5 – > 0.11 mg/l 4 – 0.09 mg/l to < 0.11 mg/l 3 – 0.07 mg/l to < 0.09 mg/l 2 – 0.05 mg/l to < 0.07 mg/l 1 – 0.03 mg/l to < 0.05 mg/l 0 – < 0.03 mg/l			
2.16b	If Zinc is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Zinc 2 – effluent has moderate Zinc 1 – effluent has low Zinc 0 – no Zinc present			
2.17a	What is the concentration of Nickel (Ni) in the discharge? 5 – > 0.11 mg/l 4 – 0.09 mg/l to < 0.11 mg/l 3 – 0.07 mg/l to < 0.09 mg/l 2 – 0.05 mg/l to < 0.07 mg/l 1 – 0.03 mg/l to < 0.05 mg/l 0 – < 0.03 mg/l			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.17b	If Nickel is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Nickel 2 – effluent has moderate Nickel 1 – effluent has low Nickel 0 – no Nickel present			
2.18a	What is the concentration of Chromium (Cr) in the discharge? 5 – > 0.16 mg/l 4 – 0.14 mg/l to < 0.16 mg/l 3 – 0.12 mg/l to < 0.14 mg/l 2 – 0.10 mg/l to < 0.12 mg/l 1 – 0.08 mg/l to < 0.10 mg/l 0 – < 0.08 mg/l			
2.18b	If Chromium is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Chromium 2 – effluent has moderate Chromium 1 – effluent has low Chromium 0 – no Chromium present			
2.19a	What is the concentration of Cadmium (Cd) in the discharge? 5 – > 0.010 mg/l 4 – 0.008 mg/l to < 0.010 mg/l 3 – 0.006 mg/l to < 0.008 mg/l 2 – 0.004 mg/l to < 0.006 mg/l 1 – 0.002 mg/l to < 0.004 mg/l 0 – < 0.002 mg/l			
2.19b	If Cadmium is not measured, is it likely, based on effluent characteristics, that: 3 – effluent has high Cadmium 2 – effluent has moderate Cadmium 1 – effluent has low Cadmium 0 – no Cadmium present			
2.20a	What is the concentration of Mercury (Hg) in the discharge? 5 – > 0.010 mg/l 4 – 0.008 mg/l to < 0.010 mg/l 3 – 0.006 mg/l to < 0.008 mg/l 2 – 0.004 mg/l to < 0.006 mg/l 1 – 0.002 mg/l to < 0.004 mg/l 0 – < 0.002 mg/l			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.20b	If Mercury is not measured, is it likely, based on effluent characteristics, that: 5 – effluent has very high Mercury 4 – effluent has high Mercury 3 – effluent has moderate Mercury 2 – effluent has low Mercury 1 – effluent has very low Mercury 0 – no Mercury present			
2.21a	What is the concentration of Lead (Pb) in the discharge? 5 – > 0.22 mg/l 4 – 0.19 mg/l to < 0.22 mg/l 3 – 0.16 mg/l to < 0.19 mg/l 2 – 0.13 mg/l to < 0.16 mg/l 1 – 0.10 mg/l to < 0.13 mg/l 0 – < 0.10 mg/l			
2.21b	If Lead is not measured, is it likely, based on effluent characteristics, that: 5 – effluent has very high Lead 4 – effluent has high Lead 3 – effluent has moderate Lead 2 – effluent has low Lead 1 – effluent has very low Lead 0 – no Lead present			
2.22	Is there a potential, confirmed or suspected, that radioisotopes (Ce^{137}, Sr^{90}) are present in the effluent above background levels? 3 –very likely 2 – likely 1 – possible but unlikely 0 – not possible			
3.0	**Wastewater Loadings**			
3.1a	Estimate BOD_5 as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.1b	If BOD_5 is not measured, is it likely that: 3 – effluent has high BOD_5 loading 2 – effluent has moderate BOD_5 loading 1 – effluent has low BOD_5 loading 0 – no BOD_5 loading			
3.2a	Estimate COD as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.2b	If COD is not measured, is it likely that: 3 – effluent has high COD loading 2 – effluent has moderate COD loading 1 – effluent has low COD loading 0 – no COD loading			
3.3a	Estimate Total Suspended Solids (TSS) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.3b	If TSS is not measured, is it likely that: 3 – effluent has high TSS loading 2 – effluent has moderate TSS loading 1 – effluent has low TSS loading 0 – no TSS loading			
3.4a	Estimate Total Dissolved Solids (TDS) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.4b	If TDS is not measured, is it likely that: 3 – effluent has high TDS loading 2 – effluent has moderate TDS loading 1 – effluent has low TDS loading 0 – no TDS loading			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.5a	Estimate Total Phosphorus as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.5b	If phosphorus is not measured, is it likely that: 3 – effluent has high phosphorus loading 2 – effluent has moderate phosphorus loading 1 – effluent has low phosphorus loading 0 – no phosphorus loading			
3.6a	Estimate Ammonium Nitrogen (NH_4–N) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.6b	If NH_4–N is not measured, is it likely that: 3 – effluent has high NH_4–N loading 2 – effluent has moderate NH_4–N loading 1 – effluent has low NH_4–N loading 0 – no NH_4–N loading			
3.7a	Estimate Nitrate Nitrogen (NO_3–N) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.7b	If NO_3–N is not measured, is it likely that: 3 – effluent has high NO_3–N loading 2 – effluent has moderate NO_3–N loading 1 – effluent has low NO_3–N loading 0 – no NO_3–N loading			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.8a	Estimate Nitrite Nitrogen (NO_2–N) concentration as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.8b	If NO_2–N is not measured, is it likely that: 3 – effluent has high NO_2–N loading 2 – effluent has moderate NO_2–N loading 1 – effluent has low NO_2–N loading 0 – no NO_2–N loading			
3.9a	Estimate the loading of Oil Products (mineral or synthetic) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.9b	If oil products are not measured, is it likely that: 3 – effluent has high oil product loading 2 – effluent has moderate oil product loading 1 – effluent has low oil product loading 0 – no oil product loading			
3.10a	What is the loading of Persistent Organic Pollutants as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.10b	If POPs are not measured, is it likely that: 3 – POPs are present in the effluent with high loadings 2 – POPs are present in the effluent with moderate loadings 1 – POPs are present in the effluent with low loadings 0 – POPs are not present			
3.11a	Estimate Phenols as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.11b	If Total Phenols are not measured, is it likely that: 3 – effluent has high phenol loadings 2 – effluent has moderate phenol loadings 1 – effluent has low phenol loadings 0 – no phenol loadings			
3.12a	Estimate Polyaromatic Hydrocarbons (PAH) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.12b	If PAHs are not measured, is it likely that: 3 – effluent has high PAH loadings 2 – effluent has moderate PAH loadings 1 – effluent has low PAH loadings 0 – no PAH loadings present			
3.13a	Estimate Fats & Oils (animal or vegetable) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.13b	If Fats & Oils are not measured, is it likely that: 3 – effluent has high loadings of fats & oils 2 – effluent has moderate loadings of fats & oils 1 – effluent has low loadings of fats & oils 0 – no fats & oils present			
3.14a	Estimate Iron (Fe) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.14b	If Iron is not measured, is it likely that: 3 – effluent has high Iron loading 2 – effluent has moderate Iron loading 1 – effluent has low Iron loading 0 – no Iron present			
3.15a	Estimate Copper (Cu) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.15b	If Copper is not measured, is it likely that: 3 – effluent has high Copper loading 2 – effluent has moderate Copper loading 1 – effluent has low Copper loading 0 – no Copper present			
3.16a	Estimate Zinc (Zn) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.16b	If Zinc is not measured, is it likely that: 3 – effluent has high Zinc loading 2 – effluent has moderate Zinc loading 1 – effluent has low Zinc loading 0 – no Zinc present			
3.17a	Estimate Nickel (Ni) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.17b	If Nickel is not measured, is it likely that: 3 – effluent has high Nickel loading 2 – effluent has moderate Nickel loading 1 – effluent has low Nickel loading 0 – no Nickel present			
3.18a	Estimate Chromium (Cr) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.18b	If Chromium is not measured, is it likely that: 3 – effluent has high Chromium loading 2 – effluent has moderate Chromium loading 1 – effluent has low Chromium loading 0 – no Chromium present			
3.19a	Estimate Cadmium (Cd) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			

Hot Spot Evaluation: Pollution Control Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.19b	If Cadmium is not measured, is it likely that: 3 – effluent has high Cadmium loading 2 – effluent has moderate Cadmium loading 1 – effluent has low Cadmium loading 0 – no Cadmium present			
3.20a	Estimate Mercury (Hg) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.20b	If Mercury is not measured, is it likely that: 3 – effluent has high Mercury loading 2 – effluent has moderate Mercury loading 1 – effluent has low Mercury loading 0 – no Mercury present			
3.21a	Estimate Lead (Pb) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.21b	If Lead is not measured, is it likely that: 3– effluent has high Lead loading 2 – effluent has moderate Lead loading 1 – effluent has low Lead loading 0 – no Lead present			
3.22a	Estimate radioisotope (Ce^{137}, Sr^{90}) as a percentage of the loading at the national boundary? 5 – > 5% 4 – 1% to 5% 3 – 0.1% to 1% 2 – 0.01% to 0.1% 1 – 0.01% to 0.001% 0 – 0%			
3.22b	If radioisotopes are not measured, is it likely that: 3– effluent has high radioisotope loading 2 – effluent has moderate radioisotope loading 1 – effluent has low radioisotope loading 0 – no radioisotopes present			

APPENDIX C1

Rationale – Water Quality and Human Health Issues

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PREAMBLE

The water quality scoring focuses primarily on the beneficial uses of the river which have a significant impact on human health. It was not considered prudent to place too much emphasis on measured instream water quality data as it would likely not be adequate to separate the contribution of individual Hot Spot discharges to the measured impact on river quality. Therefore, it was assumed that the preliminary "short-listing" criteria and the municipal and industrial pollutant source scoring would identify the most significant Hot Spots from a loading perspective and hence potential impact basis, including contribution to transboundary pollution.

1.0 DRINKING WATER SUPPLY

1.1 Location of Nearest Municipal Drinking Water Withdrawal

This criteria establishes the proximity to the nearest drinking water withdrawal downgradient of the Hot Spot. Municipal systems have been specified to differentiate from individual water takings. The criterion is based on the assumption that pollutant assimilation and drinking water supply are incompatible uses in close proximity. For scoring purposes it has been assumed that all existing drinking water treatment plants are not adequately designed to treat the river water supply, or if adequately designed, not maintained or operated to appropriate standards. If there are exceptions to this assumption, these treatment plants can be excluded from consideration in this criterion.

1.2 Municipal Drinking Water Withdrawals Under the Direct Influence of River Quality

This criteria examines whether the nearest downgradient drinking water withdrawal is influenced by river quality, recognizing that in numerous instances well water supplies (and not direct river withdrawals) are used as the source of municipal water supplies. The criterion is based on an evaluation factor, α, which establishes for a given well supply its connectivity to the river (surface water). The evaluation system was based on an assessment methodology (Cherepanskiy 1999) which takes into account the hydrodynamic relationship between the well and the river, the distance between the well and the river, or time for contaminant migration between the well and the river. For scoring purposes, it has been assumed that water supplies under the direct influence of the river (surface) water would obtain the highest scores.

1.3 Population Being Supplied By River Water Within 25 Km Downgradient of Hot Spot

A pollutant discharge can pose a threat to drinking water supply with the overall risk greater where higher populations are dependent on the river supply. The specified 25 km limit was

arbitrarily selected for comparison purposes and does not represent a real measure of the potential impact zone.

2.0 RECREATION

While local residents may place a high value on recreational pursuits in and on the river, the *Recreation* scoring criteria should be assigned a lower weight relative to *Drinking Water Supply,* given the greater health risks associated with the latter. For contact recreation (e.g. swimming) typically bacteriological quality is the primary focus, however, aesthetics (as governed by nutrient and suspended solids loadings, odour and colour) are also clearly relevant. The downstream cut-off distance of 10 km used in the scoring criterion versus the 25 km distance used in the drinking water supply criteria, was selected to account in part for the reduced weight to be applied for recreation relative to drinking water supply.

2.1 Recreational Bathing Areas Located Near The Hot Spot

The presence of a recreational bathing (swimming) area in close proximity to a Hot Spot discharge is a potential source of concern. As reflected in the scoring methodology, greater distance downstream assumes greater assimilative potential of the river and hence reduced concern (and score).

2.2 Other Aquatic Recreational Activities Near The Hot Spot

Rowing, sailing and other aquatic recreational activities may result in direct contact and exposure to the river water. Poor aesthetics (eg., eutrophication, colour, odour) plus bacteriological contamination will diminish enjoyment of these activities. Again, the greater the downstream separation between these activities and the Hot Spot, the lower the assigned score.

2.3 Any Illnesses Attributed To The Recreational Areas

This criterion was developed to provide higher scores to Hot Spots which have the potential to be directly implicated with causing illness in people engaged in recreational activities regardless of whether the Hot Spot is the confirmed cause of the reported illness. The scoring is based on the level of medical intervention required to deal with any reported eye, ear or throat infections, skin rashes or gastro-intestinal problems or more serious illnesses.

2.4 Hot Spot Identified as Source of Illnesses

This criterion was developed to provide higher scores to Hot Spots which have been directly implicated with causing illness in people engaged in recreational activities. The criterion provides a zero score to a Hot Spot which is not characterized by bacteriological releases and hence cannot be identified as a source of illness.

3.0 FISHING – RECREATIONAL

For recreational fishing (Criterion 3.1) the potential impact on fishing opportunities is determined by using proximity of established licensed fishing areas to the Hot Spot discharge. Commercial fishing is addressed in Criterion 4.1. The overall health of the fisheries is considered under ***Environment & Biodiversity Issues.***

3.1 Proximity of Recreational Fishing Areas and Sustainability

This criterion focuses on the potential impact on recreational fishing opportunities by using proximity of fishing areas to the Hot Spot discharge. While it is recognized that recreational fishing is conducted throughout the watershed, the scoring system has been based on proximity of designated, licensed recreational fishing areas to differentiate Hot Spots. The highest score is assigned to Hot Spots which have already been identified as having adversely impacted these recreational fishing areas. So as not to bias the scoring, the scoring criteria take into account the possibility that recreational fishing is no longer carried out at some locations because river conditions are so degraded. In these cases, it is assumed that further degradation is unacceptable and a high score is warranted.

4.0 FISHING – COMMERCIAL

For commercial fishing (Criterion 4.1) the original intent was to base the scoring on human exposure (health risks) to trace organics and heavy metals, which may bioaccumulate in fish flesh. While testing of commercial fish for potential contamination prior to their reaching the market is routinely carried out, no overall databases of contaminant levels in fish are maintained in the three countries. Several scientific studies on bioaccumulation are available or underway, however these are very site-specific, research-oriented studies (often focused on specific fish organs) which cannot be applied basin-wide. For this reason the commercial fishing criterion was modeled after that developed for recreational fishing.

The overall health of the fisheries is considered under ***Environment & Biodiversity Issues.***

4.1 Proximity of Commercial Fishing Areas and Sustainability

This criterion focuses on the potential impact on commercial fishing opportunities by using proximity of designated, licensed commercial fishing areas to the Hot Spot discharge. The closer the licensed commercial fishing areas are to the Hot Spot, the greater the overall risk to human consumers. The highest score is assigned to Hot Spots which have already been identified as having adversely impacted these commercial fishing areas. So as not to bias the scoring, the scoring criteria take into account the possibility that commercial fishing is no longer carried out at some designated locations because river conditions are so degraded. In these cases it is assumed that further degradation is unacceptable and a high score is warranted.

5.0 SEDIMENT QUALITY

5.1 Sediment Contamination

For the purposes of this criterion, an area of sediment contamination is defined as an area where the sediment quality concentration for at least one parameter is over five times the respective sediment background concentration for that parameter. The criterion assumes that, likely, there will likely not be enough data available to attribute sediment contamination to a specific Hot Spot discharge. However, where the Hot Spot is the confirmed source of the contamination, the highest score is assigned. A score of zero is assigned if the Hot Spot discharge does not contain significant quantities of the subject contaminant parameter, by which the impact was defined.

6.0 AGRICULTURAL WATER TAKING

6.1 Agricultural Water Utilization in Proximity to Hot Spot

Agricultural water taking for crop irrigation and livestock watering are important uses of the river particularly in its lower reaches. Proximity to a Hot Spot is used as a potential indicator of increased risk to livestock and crops. Scoring assigns higher risk to areas where this beneficial use is carried out more extensively. The degree of use is a relative scale which must be determined and applied by each national expert independently.

Data sources to be used to determine utilization include: presence of large pumping stations (investment), crop water consumption normals in conjunction with areas (hectares) under cultivation for specific crops, calculated water deficits by basin area and licensed water taking volumes.

[Note: In the Russian/Ukrainian language, the term irrigation encompasses land drainage activities and hence should be used with caution.}

7 .0 TRANSBOUNDARY ISSUES

7.1 Proximity to National Boundaries

This criterion reflects one of the stated objectives of this UNIDO project to reduce transboundary transport of pollutants and loadings to the Black Sea. Hot Spots located in close proximity to national boundaries (or the Black Sea) warrant higher scores than those more distant as they will have a greater impact on their downstream "neighbours".

APPENDIX C2

Work Sheet – Water Quality and Human Health Issues

Hot Spot Evaluation: Water Quality and Human Health Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.0	**Drinking Water Supply**			
1.1	Are municipal drinking water withdrawals located downgradient of the Hot Spot? 5 – within 1 km 4 – within 3 km 3 – within 10 km 2 – within 25 km 1 – greater than 25 km			
1.2	Are municipal well supplies located downgradient of the Hot Spot under the direct influence of river (surface) water quality? 5 – α*=100% or high connectivity to the river source (i.e. under direct influence of surface water or a direct river water withdrawal) 4 – α=75 % or moderate 3 – α=50 % or average 2 – α=25 % or low 0 – α= 0 % or absent or no connectivity between well supply and river * α is an estimate of the connectivity of a well supply to the river based on subsurface stratigraphy, physical relationships and distance to the river, and contaminant migration time.			
1.3	What is the population being supplied with drinking water within 25 km downstream/downgradient of Hot Spot? 5 – greater than 500,000 4 – 100,000 to 500,000 3 – 50,000 to 100,000 2 – 10,000 to 50,000 1 – less than 10,000			

Hot Spot Evaluation: Water Quality and Human Health Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.0	**Recreation** (for recreational fishing see 3.0)			
2.1	Are recreational areas frequented by swimmers (i.e. formally established or locally–recognized beach facilities) located near the Hot Spot? 5 – within 1 km downstream or immediately adjacent upstream 4 – within 3 km downstream 3 – within 5 km downstream 2 – within 10 km downstream 1 – greater than 10 km downstream			
2.2	Are there areas located near the Hot Spot where other aquatic recreational activities take place (i.e. rowing, sailing, etc.)? 5 – within 1 km downstream or 1 km upstream 4 – within 3 km downstream 3 – within 5 km downstream 2 – within 10 km downstream 1 – greater than 10 km downstream			
2.3	Have there been any commonly acknowledged or formally documented illnesses that have been attributed to bathing or other water–based recreational activities downstream of the Hot Spot? 5 – illnesses requiring hospitalization 2 – illnesses requiring moderate medical intervention (eye, ear and throat infections; rashes; gastro–intestinal problems) 1 – as above without medical intervention required 0 – none reported or no bacteriological releases associated with Hot Spot discharge			
2.4	With respect to any illnesses reported in 2.3, was the Hot Spot confirmed as the source? 5 – confirmed source 4 – strongly suspected source 1 – potential source (illnesses not attributed to a specific upstream source) 0 – no illnesses reported or no bacteriological releases associated with Hot Spot discharge			

Hot Spot Evaluation: Water Quality and Human Health Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.0	**Fishing – Recreational**			
3.1	Are there any designated recreational areas located near the Hot Spot which are licensed for recreational fishing or have water quality conditions deteriorated to a point where this activity is no longer sustainable? 5 – no licensed recreational fishing areas established downstream as a direct consequence of the Hot Spot discharge 4 – no licensed recreational fishing areas established downstream due to poor water quality conditions not attributed to a specific Hot Spot 3 – licensed recreational fishing areas located within 5 km downstream or 5 km upstream of Hot Spot 2 – licensed recreational fishing areas located within 25 km downstream 1 – licensed recreational fishing areas located greater than 25 km downstream			
4.0	**Fishing – Commercial**			
4.1	Are there any designated areas located near the Hot Spot which are licensed for commercial fishing or have water quality conditions deteriorated to a point where this activity is no longer sustainable? 5 – no licensed commercial fishing areas established downstream as a direct consequence of the Hot Spot discharge 4 – no licensed commercial fishing areas established downstream due to poor water quality conditions not attributed to a specific Hot Spot 3 – licensed commercial fishing areas located within 5 km downstream or 5 km upstream of Hot Spot 2 – licensed commercial fishing areas located within 25 km downstream 1 – licensed commercial fishing areas located greater than 25 km downstream			

Hot Spot Evaluation: Water Quality and Human Health Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
5.0	**Sediment Quality**			
5.1	Is there an area of sediment contamination* downstream of the Hot Spot? 5 – where the Hot Spot is the confirmed source 4 – where the Hot Spot is the suspected source 1 – where the source of contamination is not known however the Hot Spot is potentially a contributing source 0 – no sediment contamination* noted * "contamination" is defined as sediment pollutant concentrations at least five (5) times the respective sediment background concentration			
6.0	**Agricultural Water Taking**			
6.1	Are there areas downstream of the Hot Spot where water takings for agricultural purposes are frequently being carried out? 5 – high* utilization within 5 km downstream or moderate* utilization within 2 km downstream of Hot Spot 4 – high* utilization within 10 km downstream or moderate* utilization within 5 km downstream of Hot Spot 3 – moderate* utilization within 10 km downstream of Hot Spot 2 – low* utilization within 10 km downstream of Hot Spot 0 – no appreciable utilization within 10 km downstream of Hot Spot * definition of high, moderate and low utilization to be determined on a relative scale for each country.			
7.0	**Transboundary Issues**			
7.1	Is the national boundary located near the Hot Spot? 5 – within 10 km downstream 4 – within 15 km downstream 3 – within 20 km downstream 2 – within 30 km downstream 1 – greater than 30 km downstream			

APPENDIX D1

Rationale – Environment and Biodiversity Issues

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PREAMBLE

The environment and biodiversity category is divided into the following subcategories of multiple indicators: General, Aquatic Species (Fish, Benthic and Waterfowl) and Plant Species. The following is a brief description of the scoring methodology for these indicators and a rationale for the inclusion of each specific criterion in the Hot Spot Evaluation Sheets.

1.0 GENERAL

In this subcategory, sections 1.1 to 1.5 describe the indicator criteria which establish the proximity of environmental receptors to sources of pollution. Proximity is assessed by mapping. The various types of receptors have been separated only to allow the opportunity for different weightings denoting relative importance. Receptors are identified by published sources such as the "Red Book" for each of the riparian countries, as well as by the knowledge of each individual expert for biodiversity. The first three indicator criteria relate to areas officially protected by government decree. The final two indicator criteria relate to areas that are not officially protected, but have been identified by scientific authorities as significant. The environmental receptors do not have to be located downstream of the Hot Spot. The National Experts may use their judgement to apply a modifier to the score based on the likelihood of impact. This likelihood is assessed by considering the relative position of the Hot Spot and the receptor (upstream/downstream, side of bank, water flow, breadth of river, mixing, intervening islands, sand banks, etc.) as well as the mobility of the receptors (fish or waterfowl). The modifier is as follows:

1 to 5 - potential for direct or indirect impact
0 - insufficient evidence for assessment

The maximum score is always 5, and the minimum score always 0. The selection of the modifier is made by the National Expert of each riparian country and must be fully justified in the comment section of the work.

In the final section (1.6), the indicator criteria relate to a more substantial linkage between the Hot Spot and the receptor than described above. The determination is made based on the results of scientific studies, observed impacts on receptors or experience from similar situations. This indicator criteria is given the highest weighting and addresses both proven impacts and suspected impacts.

1.1 Location Near Wildlife Sanctuaries

This criteria establishes the proximity to the nearest of these potential receptors but does not necessarily assume there is an impact on officially designated wildlife sanctuaries (officially protected). The criteria was selected because it is easily measurable when the wildlife sanctuaries

are defined and the Hot Spot is an identified point source. If the Hot Spot is a non-point (diffuse) source (i.e. storm sewers from a large area such as a city or a town), the judgement of the National Expert must be employed to define the effective proximity. It is anticipated that the effects of individual Hot Spots on individual wildlife sanctuaries have not been defined in many cases. Whether the Hot Spot is having an impact on these areas is not accounted for in this criteria (other than the modifier scheme identified above).

1.2 Location Near National Parks

This criteria has the same objective as 1.1 but with respect to National Parks as opposed to Wildlife Sanctuaries. National Parks are officially designated protected areas.

1.3 Location Near Areas Frequented by Rare and Endangered Species

This criteria has the same objective as 1.1 but with respect to areas frequented by rare and endangered species as opposed to Wildlife Sanctuaries. These areas would be those that are officially designated protected areas. Such determinations would be made by referring to the "Red Book" or other published sources.

1.4 Location Near Unprotected Areas of Ecological Significance

This criteria has the same objective as 1.1 but with respect to areas of ecological significance as opposed to Wildlife Sanctuaries. These areas would be those that are **not** officially designated protected areas. These areas may include areas identified through scientific studies as being important spawning grounds, habitat, nesting, or stopover spots for both migratory and non-migratory species.

1.5 Location Near Environmentally Sensitive Areas

This criteria has the same objective as 1.1 but with respect to areas defined as "Environmentally Sensitive Areas" (ESA) as opposed to Wildlife Sanctuaries. These areas would be those that are **not** officially designated protected areas. For the purpose of this methodology, an ESA has been defined as an area with a high biodiversity determined by the professional judgement of the NHSE based on the number of species present, various biotic indices which may be available and other applicable sources of information.

Biotic indices are used if they are available. Such indices may include the Trent Biotic Index (Woodiwiss) and oligochaetal index (Goodnight-Whitely) for zoobenthos, as well as the Saprobe Index for phyto- and zooplankton.

1.6 Identified Adverse Impacts

It is assumed that in some cases, although not comprehensively, that adverse impacts on environmental features (Wildlife Sanctuaries, National Parks, etc.) may have been studied. When such information is available, this criteria allows it to be entered in the rating system.

2.0 AQUATIC SPECIES (FISH)

2.1 Adverse Impacts To Fish Habitat

In the event the impacts to the habitat of fish from the Hot Spot have been suspected, identified or studied, this criteria allows for the situation to be scored accordingly. It is not anticipated that such studies are widely available for individual Hot Spots.

2.2 Fish Kills

This criteria accounts for any fish kills in the area of specific Hot Spots. The fish kill may be attributable to a specific Hot Spot, potentially attributable or not attributable, each category decreasing in scoring weight.

2.3 Reproductive Impacts On Fish Species

In the event the impacts to fish species in the form of reproductive effects, as evidenced by abundance, diversity or community structure, have been identified through studies, this criteria allows for the situation to be scored accordingly. It is not anticipated that such studies are widely available for individual Hot Spots. The effects may be attributable to a specific Hot Spot, potentially attributable or not attributable, each category decreasing in scoring weight.

3.0 AQUATIC SPECIES (BENTHIC)

3.1 Impacts On Benthic Species

In the event the impacts to benthic species in the form of reproductive effects, as evidenced by abundance, diversity or community structure, have been identified through studies, this criteria allows for the situation to be scored accordingly. It is not anticipated that such studies are widely available for individual Hot Spots. The effects may be attributable to a specific Hot Spot, potentially attributable or not attributable, each category decreasing in scoring weight.

3.2 Biotic Index

In areas within the proximity of the Hot Spot for which a biotic index has been determined, this information is used to assess the relative significance of the Hot Spot. For this criteria, proximity is determined by the NHSE using professional judgement and based on the likelihood of significant impact. It is assumed that the areas subject to monitoring by biotic indices will be downstream from the Hot Spot and within a reasonable distance (i.e. 5 km) so that an impact is possible. The Trent Biotic Index for zoobenthos as defined by Woodiwisss (1964) is used. This is a measure of structure for zoobenthos. The higher the index the more diverse is the zoobenthos community and, therefore, the more important the area is with respect to biodiversity. Thus, this criteria is not a measure of impact from the Hot Spot but a measure of proximity to an area of significant biodiversity.

4.0 AQUATIC SPECIES (WATERFOWL)

4.1 Adverse Impacts To Waterfowl Habitat/Nesting Areas

Similar to that for fish (2.1), this criteria allows for scoring in the event the impacts to waterfowl habitat or nesting areas from the Hot Spot have been suspected, identified or studied. It is not anticipated that such studies are widely available for individual Hot Spots.

4.2 Adverse Impact To Migratory Species

Similar to impacts to local waterfowl (4.1), this criteria allows for the scoring of impacts to migratory bird species. The congregation of migratory birds would have to be significant for the assessment. Such impacts may have been identified in studies.

5.0 PLANT SPECIES

5.1 Adverse Impacts To Plant Species

This criteria allows for scoring in the event the impacts to plant species from the Hot Spot have been suspected, identified or studied. It is not anticipated that such studies are widely available for individual Hot Spots.

APPENDIX D2

Work Sheet – Environment and Biodiversity Issues

Hot Spot Evaluation: Environment & Biodiversity Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.0 General				
1.1	Is the Hot Spot located near an important wildlife sanctuary? 5 – within 1 km 4 – within 3 km 3 – within 5 km 2 – within 10 km 1 – within 15 km 0 – greater than 15 km distant from an important wildlife sanctuary			
1.2	Is the Hot Spot located near a national park? 5 – within 1 km 4 – within 3 km 3 – within 5 km 2 – within 10 km 1 – within 15 km 0 – greater than 15 km distant from a national park			
1.3	Is the Hot Spot located near an area frequented by rare or endangered aquatic species? 5 – within 1 km 4 – within 3 km 3 – within 5 km 2 – within 10 km 1 – within 15 km 0 – greater than 15 km distant from an area frequented by rare or endangered aquatic species			
1.4	Is the Hot Spot located near an unprotected area of ecological significance (areas of spawning, nesting, etc.) 5 – within 1 km 4 – within 3 km 3 – within 5 km 2 – within 10 km 1 – within 15 km 0 – greater than 15 km distant from an unprotected area of ecological significance			

Hot Spot Evaluation: Environment & Biodiversity Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
1.5	Is the Hot Spot located near an unprotected Environmentally Sensitive Area (ESA-areas of high biodiversity based on the number of species, biotic indices, professional judgement, etc.) 5 – within 1 km 4 – within 3 km 3 – within 5 km 2 – within 10 km 1 – within 15 km 0 – greater than 15 km distant of an ESA			
1.6	Is the Hot Spot the source of adverse impacts on the nearest environmental features (i.e., Environmentally Sensitive Area, Wildlife Sanctuary or National Park)? 5 – proven impacts with adverse effects 4 – proven impacts with suspected adverse effects 3 – proven impacts with unknown effects, or suspected impacts with suspected adverse effects 2 – suspected impacts with unknown effects 1 – unknown impacts 0 – no impacts			
2.0 Aquatic Species (Fish)				
2.1	Is the Hot Spot the source of adverse impacts on the habitat of any fish species? 5 – proven impacts with adverse effects 4 – proven impacts with suspected adverse effects 3 – proven impacts with unknown effects, or suspected impacts with suspected adverse effects 2 – suspected impacts with unknown effects 1 – unknown impacts 0 – no impacts			

Hot Spot Evaluation: Environment & Biodiversity Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
2.2	Have any fish kills been attributed to the hotspot (i.e. numerous fish deaths occurring at a given time)? 5 – officially confirmed periodic fish kills for which the Hot Spot is the confirmed source 4 – officially confirmed periodic fish kills with unknown causes, or one or two events of officially confirmed fish kills for which the Hot Spot is the confirmed source 3 – one or two events of officially confirmed fish kills with unknown causes 2 – periodic unconfirmed fish kills with unknown causes 1 – one or two evens of unconfirmed fish kills with unknown causes 0 – no fish kills			
2.3	Is the Hot Spot the source of adverse impacts on the reproduction of any fish species (reproductive impacts)? 5 – proven impacts with adverse effects 4 – proven impacts with suspected adverse effects 3 – proven impacts with unknown effects, or suspected impacts with suspected adverse effects 2 – suspected impacts with unknown effects 1 – unknown impacts 0 – no impacts			

Hot Spot Evaluation: Environment & Biodiversity Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
3.0 Aquatic Species (Benthic)				
3.1	Have benthic studies been conducted in the area of the Hot Spot to identify impacts on abundance, diversity and /or community structure? 5 – confirmed adverse impact where the Hot Spot is the confirmed source of impacts 4 – confirmed adverse impacts where the Hot Spot is the suspected source of impacts 3 – confirmed adverse impacts where no cause is known 2 – no benthic studies conducted but adverse impacts suspected and Hot Spot is a potential source of impacts 1 – no benthic studies conducted 0 – no adverse impacts observed			
3.2	Is the Hot Spot located within 1 km of an area with a high Biotic Index (by Woodiwiss)? 5 – with a Biotic Index of 10 (very clear) 4 – with a Biotic Index between 7 and 9 (clear) 3 – with a Biotic Index between 5 and 6 (moderately polluted) 2 – with a Biotic Index of 4 (polluted) 1 – with a Biotic Index between 2 and 3 (dirty) 0 – with a Biotic Index between 0 and 1 (very dirty)			
4.0 Aquatic Species (Waterfowl)				
4.1	Is the Hot Spot the source of adverse impacts on the nesting area or other habitat type of any waterfowl? 5 – proven impacts with adverse effects 4 – proven impacts with suspected adverse effects 3 – proven impacts with unknown effects, or suspected impacts with suspected adverse effects 2 – suspected impacts with unknown effects 1 – unknown impacts 0 – no impacts			

Hot Spot Evaluation: Environment & Biodiversity Issues				
	Hot Spot:	**Country:**	**Region:**	**Id #**
No.	**Issue**	**Raw Score**	**Supporting Comments or Explanations**	
4.2	Is the Hot Spot located within an area frequented by migratory species? 5 – confirmed multiple migratory species, more than 3 4 – confirmed migratory species, 1–3 3 – unconfirmed multiple migratory species, more than 3 2 – unconfirmed migratory species 1–3 1 – potential for migratory species 0 – no migratory species			
5.0 Plant Species				
5.1	Is the Hot Spot the source of adverse impacts on any plant species? 5 – proven impacts with adverse effects 4 – proven impacts with suspected adverse effects 3 – proven impacts with unknown effects, or suspected impacts with suspected adverse effects 2 – suspected impacts with unknown effects 1 – unknown impacts 0 – no impacts			

APPENDIX E1

Rationale – Economic Issues

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PREAMBLE

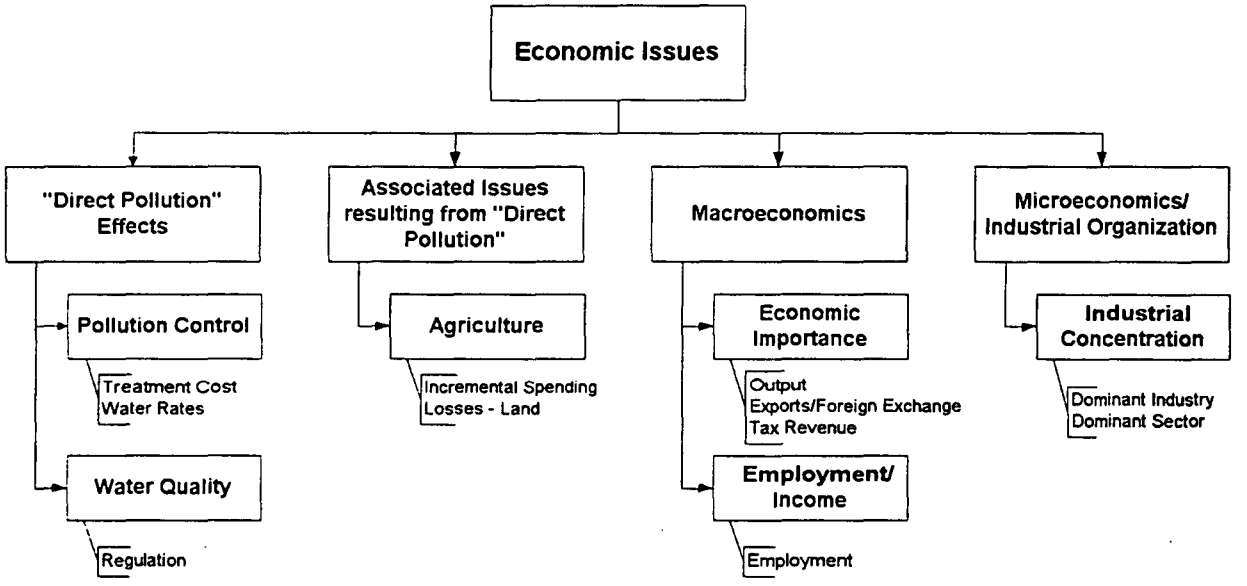
Assumptions and Approaches for Establishment of Economic Evaluation Criteria

1. Hot Spots subject to scoring typically are the point sources of contamination. Thus, wherever possible, only "direct-effect" criteria are used.
2. The range of scores follows the "0 to 100" scheme. This scoring scheme is adapted to accommodate the existing "0 to 5" scheme, as well as other schemes that will be used in subsequent analysis.
3. Any costs directly related to pollution and water quality are evaluated based on criteria identified in the preceding sections on "Water Quality Issues" and "Pollution Control Issues". At this point economic issues directly related to "Environmental & Biodiversity Issues" are considered difficult and problematic to quantify, and thus, are not considered.
4. For key economic criteria where no absolute measures are widely available, relative measures are used.
5. As a more detailed economic analysis will be undertaken in a subsequent phase of the project, evaluation criteria developed provide directional data for subsequent analysis.
6. It is the goal of the three countries to reach the EU standards outlined in the Water Framework Directive.
7. It is assumed that Ramsey (i.e. differential) pricing is in effect for water services (industrial and potable), and that any increases in treatment costs will be transferred to the consumer (household and industry).
8. It is assumed that direct health impacts cannot be measured (i.e. direct causality may be difficult to establish).
9. It is assumed that direct impacts to fishery and tourism cannot be measured (i.e. direct causality may be difficult to establish).
10. Flat rate/normalized cost is assumed for agricultural inputs.
11. No major public expenditures in investment and tourism marketing are considered.
12. Current mitigative actions are not considered in each country's respective GNP.
13. It is assumed that direct demographic (i.e. life expectancy, migration and fertility rates) impacts cannot be measured (i.e. direct causality may be difficult to establish).
14. At this point, no compensation costs have been paid.
15. No resettlement initiative resulting from water pollution has been undertaken anywhere in the river basin.
16. Incremental communication costs, such as public education and industrial pollution control, are not considered.

Framework for Evaluation

The following framework was developed to identify the key criteria for analysis. "Direct Pollution" and "Associated Issues resulting from 'Direct Pollution'" are considered economic issues resulting from *direct effects* of a Hot Spot. "Macroeconomics" and "Microeconomics/Industrial Organization" have been developed to assess the *economic significance* of the Hot Spot. The role of each criterion is explained in the rationale (Section 4) below.

Economic Assessment Criteria for Dnieper River Basin Hot Spot Evaluation



RATIONALE FOR CRITERIA

1.0 "DIRECT POLLUTION" EFFECTS

Criteria developed under this area seek to assess the effect pollution on has on the water supply, as well as incremental costs associated with water treatment.

1.1 Potable Water – Incremental Treatment Cost

Additional operating costs, for activities/items such as labour, energy and chemicals (and in some cases alternative sources), are required to treat and purify raw water to potable level. The costs considered are only those extra costs that are due to pollution from the hot spots.

1.2 Potable Water – Relative Treatment Costs

Depending on levels of pollution, there are different levels of treatment required to meet potable standards. As pollution varies from one area to another, it is anticipated that treatment costs will vary accordingly. This measure evaluates the per unit treatment cost for potable water in Hot Spot areas relative to the average per unit treatment costs for the country as whole. It is assumed that relatively higher treatment costs will be transferred to residential users at higher water tariffs.

1.3 Industrial Water – Incremental Treatment Costs

Additional operating costs, for activities/items such as labour, energy and chemicals (and in some cases alternative sources), are required to treat and purify raw water to an acceptable level for industrial use. The costs considered are only those extra costs that are due to pollution from the hot spots.

1.4 Industrial Water – Relative Treatment Costs

Depending on levels of pollution, there are different levels of treatment required to meet industrial usage standards. As pollution varies from one area to another, it is anticipated that treatment costs will vary accordingly. This measure evaluates the per unit treatment cost for industrial water in Hot Spot areas relative to the average per unit treatment costs for the country as whole. It is assumed that relatively higher treatment costs will be transferred to industrial users at higher tariffs.

1.5 Meeting EU Water Standards

A willingness-to-pay measure. It is assumed that it is the goal of all countries to meet the EU standards outlined, for example, in the Water Framework and Pollution Control Directives.

However, to meet the all the identified standards, substantial investment will be needed to reduce the release of all pollutants into waterways to acceptable levels. Where high-levels of discharges are observed, it is expected compliance costs will be high (and likely expensive).

2.0 AGRICULTURE

Agriculture within the basin is dependent on the River's resources. Additional costs are incurred to mitigate negative effects of pollution and in some cases, there is a substantial decline in the productivity.

2.1 Agricultural Production - Increased Operating & Investment Cost

Incremental operating costs could be incurred through the application of more fertilizers, the use of more chemicals spray on trees and crops to kill insects and parasites, and additional water use for leaching purposes due to extra soil salinity caused by pollution. Also, there may be increased investment required to treat raw water to make it safe for irrigation, as well as resolve damages due to pollution. A trend in incremental cost needs to be firmly established.

2.2 Loss of Arable Land

The effects of pollution may be irreversible in the short term. Losing arable land means losing the economic potential of that resource. While, it may not be feasible to assess the total value of such a loss, the mere loss of access to land for agricultural purposes can serve as an evaluation criterion. In this case, a relative measure of loss is assessed within a fixed area within the vicinity of a Hot Spot.

3.0 NATIONAL ECONOMY

Criteria in this category provide a macro-measure of economic significance. Criteria developed assess the significance of the hot spot to the economy and government, and if the area is a strong employer.

3.1 Contribution to GNP

This criterion allows for a general appraisal of a Hot Spot's importance to the national economy in terms of output.

3.2 Exports & Foreign Exchange

This criterion allows for a general appraisal of a Hot Spot's importance to the national economy in terms of exports and foreign exchange earning ability.

3.3 Tax Revenue

This criterion allows for a general appraisal of a Hot Spot's importance to the national government in terms of a source of tax revenue.

3.4 Employment

This criterion establishes the economic significance of the number of people employed within the Hot Spot. Ranges were developed based on a total population of 33 million residing within the River Basin.

4.0 REGIONAL AND SECTORIAL IMPORTANCE

Industries are noted to be key point sources for pollution. These criteria assess industries within Hot Spot areas that have a dominant share of regional employment, but also play a dominant role in the national sector.

4.1 Dominance of Regional Industrial Employment

Within each region, a small number of Hot Spots may account for a large share of the total industrial employment. This may further be concentrated within a single sector within the Hot Spot. This criterion assesses if there is one industry/sector that dominates industrial employment within a hot spot. This data is a key input into the IPPS model and should be carefully evaluated for subsequent prioritization.

4.2 Dominance of National Industrial Sector Employment

Within each industrial sector, a small number of Hot Spots may account for a large share of the total sector's employment. Such information is valuable if that sector is noted as a relatively higher polluter compared to other sectors. This criterion assesses if there is one industry within a Hot Spot that dominates industrial employment in a specific national sector. This data is a key input into the IPPS model and should be carefully evaluated for subsequent prioritization.

APPENDIX E2

Work Sheet – Economic Issues

Hot Spot Evaluation: Economic Issues

	Issue	Importance (1-100)	Weight under subcategory (1-100)	Weight of subcategory
1.0 "Direct Pollution" Effects – Water Supply				
1.1	Has the Hot Spot had a negative impact on downstream water supply requiring additional treatment to meet **potable (drinking) water** quality standards? (Assume: Increased annual treatment cost include labour, energy, chemicals and/or alternative sources, most recent comparable year across all countries)		**50**	**70**
1.2	Is the average cost of treatment for **potable (drinking) water** significantly higher than the national average cost for treatment? (Assume treatment benchmark: treatment costs per 1,000 m^3 of potable water, most recent comparable year across all countries)		**5**	
1.3	Has the Hot Spot had a negative impact on downstream water supply requiring additional treatment to meet **industrial** quality needs/standards? (Assume: Increased annual treatment cost include labour, energy, chemicals and/or alternative sources, most recent comparable year across all countries		**20**	
1.4	Is the average cost of treatment for **industrial** water significantly higher than the national average cost for treatment? (Assume treatment benchmark: treatment costs per 1,000 m^3 of industrial water, most recent comparable year across all countries)		**5**	
1.5	What level of investment will be required in the Hot Spot to meet EU standards outlined in the Water Framework Directive? (Assume 2001 dollars)		**20**	
2.0 Agricultural Development				
2.1	Are there increased average operating and investment costs in fertilizers and chemicals, on a per unit basis in grain/fruit/vegetable production? (Assume, costs tracked on $ yield per hectare over last 10 years, real dollars)		**50**	**10**
2.2	Has there been a substantial loss in arable land, directly related to the effects of pollution, within the vicinity of the hot spot? (Assume a 5 km radius)		**50**	
3.0 National Economy				
3.1	Hot Spot industries' operation and output makes a substantial contribution to GNP. (Annual, assume most recent comparable years across all countries)		**25**	**10**
3.2	Hot Spot industries are significant exporters and (net) foreign exchange earners. (Annual, assume most recent comparable years across all countries)		**25**	

	Issue	Importance (1-100)	Weight under subcategory (1-100)	Weight of subcategory
3.3	Hot Spot generates substantial tax revenues (business and personal) for the government. (Annual, assume most recent comparable years across all countries)		25	
3.4	Hot Spot is a major employer of citizens. (Assume most recent comparable employment surveys across all countries)		25	
	4.0 Regional and Sectorial Importance			
4.1	An industrial sector within the Hot Spot has a dominant share of **regional** industrial employment. (Assume most recent comparable employment surveys across all countries)		50	10
4.2	Hot Spot has significant employment share of a specific **industrial sector** in the country. (Assume most recent comparable employment surveys across all countries)		50	

APPENDIX F

Scoring Summary Sheet

Scoring Summary Sheet

(Final January 2004 with Updated Economic Indicators and Weights and Cell I82 formula)

Hot Spot		Enter Raw Score Below	
Hot Spot ID No.			
Country			
Region			

Category	Category Weight	Subcategory	Subcatergory Weight	Indicator	Indicator Weight	Raw Score	Weighted Score	Worksheet Input Relative Weighting
Water Quality & Human Health Issues	3	Drinking Water Supply	10	1.1	8	5		0.14286
				1.2	6	5		0.10714
				1.3	10	5		0.17857
				Indicator Total	24		5.000	
		Recreation	5	2.1	10	5		0.10204
				2.2	4	5		0.04082
				2.3	2	5		0.02041
				2.4	5	5		0.05102
				Indicator Total	21		5.000	
		Fishing: Recreational	2	3.1	1	5	5.000	0.08571
		Fishing: Commercial	3	4.1	1	5	5.000	0.12857
		Sediment Quality	3	5.1	1	5	5.000	0.12857
		Agriculture	5	6.1	1	5	5.000	0.21429
		Transboundary	7	7.1	1	5	5.000	0.30000
		SubCategory Total	35	Category Weighted Score			5.000	
Pollution Control Issues	3	General	2	1.1	5	5		0.03348
				1.2	3	5		0.02009
				1.3	5	5		0.03348
				1.4	4	5		0.02679
				1.5	5	5		0.03348
				1.6	2	5		0.01339
				1.7	1	5		0.00670
				1.8	1	5		0.00670
				1.9	1	5		0.00670
				1.10	1	5		0.00670
				Indicator Total	28		5.000	
		Characteristics	5	2.1	1	5		0.00884
				2.2	1	5		0.00884
				2.3	1	5		0.00884
				2.4	1	5		0.00884
				2.5	3	5		0.02653
				2.6	3	5		0.02653
				2.7	1	5		0.00884
				2.8	1	5		0.00884
				2.9	3	5		0.02653
				2.10	1	5		0.00884
				2.11	3	5		0.02653
				2.12	5	5		0.04422
				2.13	1	5		0.00884
				2.14	1	5		0.00884
				2.15	1	5		0.00884
				2.16	1	5		0.00884
				2.17	4	5		0.03538
				2.18	4	5		0.03538
				2.19	4	5		0.03538
				2.20	4	5		0.03538
				2.21	4	5		0.03538
				2.22	5	5		0.04422
				Indicator Total	53		5.000	

Scoring Summary Sheet

(Final January 2004 with Updated Economic Indicators and Weights and Cell I82 formula)

Hot Spot		Enter Raw Score Below	
Hot Spot ID No.			
Country			
Region			

Category	Category Weight	Subcategory	Subcatergory Weight	Indicator #	Indicator Weight	Raw Score	Weighted Score	Work... Importance Weight
		Loadings	9	3.1	1	5		0.02411
				3.2	1	5		0.02411
				3.3	1	5		0.02411
				3.4	1	5		0.02411
				3.5	2	5		0.04821
				3.6	2	5		0.04821
				3.7	1	5		0.02411
				3.8	1	5		0.02411
				3.9	2	5		0.04821
				3.10	1	5		0.02411
				3.11	2	5		0.04821
				3.12	3	5		0.07232
				3.13	1	5		0.02411
				3.14	1	5		0.02411
				3.15	1	5		0.02411
				3.16	1	5		0.02411
				3.17	2	5		0.04821
				318	2	5		0.04821
				3.19	2	5		0.04821
				3.20	2	5		0.04821
				3.21	2	5		0.04821
				3.22	3	5		0.07232
				Indicator Total	*35*		*5.000*	
		Subcategory Total	**16**	**Category Weighted Score**			*5.000*	
Environment & Biodiversity Issues	3	General	10	1.1	5	5		0.09259
				1.2	4	5		0.07407
				1.3	5	5		0.09259
				1.4	3	5		0.05556
				1.5	3	5		0.05556
				1.6	10	5		0.18519
				Indicator Total	*30*		*5.000*	
		Aquatic Species (Fish)	6	2.1	8	5		0.10667
				2.2	10	5		0.13333
				2.3	7	5		0.09333
				Indicator Total	*25*		*5.000*	
		Aquatic Species (Benthic	6	3.1	10	5		0.22222
				3.2	5	5		0.11111
				Criteria Total	*15*		*5.000*	
		Aquatic Species (Waterfc	3	4.1	10	5		0.11111
				4.2	5	5		0.05556
				Indicator Total	*15*		*5.000*	
		Plant Species	2	5.1	1	5		0.11111
				Indicator Total	*1*		*5.000*	
		Subcategory Total	**27**	**Category Weighted Score**			*5.000*	

Scoring Summary Sheet

(Final January 2004 with Updated Economic Indicators and Weights and Cell I82 formula)

Hot Spot		**Enter Raw Score Below**	
Hot Spot ID No.			
Country			
Region			

Category	Category Weight	Subcategory	Subcategory Weight	Indicator #	Indicator Weight	Raw Score	Weighted Score	Weighted Income Adjusted Score
Economic Issues	1	Water Supply	70	1.1	50	*100*		0.17500
				1.2	5	*100*		0.01750
				1.3	20	*100*		0.07000
				1.4	5	*100*		0.01750
				1.5	20	*100*		0.07000
				Indicator Total	*100*		*5.000*	
		Agricultural Development	10	2.1	50	*100*		0.02500
				2.2	50	*100*		0.02500
				Indicator Total	*100*		*5.000*	
		National Economy	10	3.1	25	*100*		0.01250
				3.2	25	*100*		0.01250
				3.3	25	*100*		0.01250
				3.4	25	*100*		0.01250
				Indicator Total	*100*		*5.000*	
		Regional and Sectoral Importance	10	4.1	50	*100*		0.02500
				4.2	50	*100*		0.02500
				Indicator Total	*100*		*5.000*	
		Subcategory Total	*100*	**Category Weighted Score**			*5.000*	

TOTAL SCORE (Max. = 5)	*5.00000*	*5.00000*
Normalized (Max. = 100%)	*100.0%*	

Legend

5 Weight factor
5 Entered value
5 Calculated value