WATER RESEARCH COMMISSION

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA:	**Water Resources and Ecosystems**
THRUST:	**6**
PROGRAMME:	**1**
Title:	**Flood, Drought, and Pollution Disaster Early Warning System for South Africa**

***General* Objective:**
Develop an integrated early warning system (EWS) to improve disaster preparedness across different administrative jurisdictions and water management areas.

Specific:
1. Develop the base layers for the whole country.
2. Develop the EWS background models and algorithms using available products and data.
3. Ensure interoperability/data sharing between different platforms.
4. Develop and test data sharing mechanisms, arrangements and agreements.
5. Test and calibrate for different catchment boundary scales (Water Management Area to District Municipality).
6. Develop user and training manuals.
7. Provide training on the use of the system.
8. Provide 12-month post project closure support.

Rationale:
Being able to predict the onset of disasters like floods (fast onset), droughts (slow onset) and pollution (fast and slow onset) is a prerequisite to save lives and protect infrastructure. As our climate continues to change, these extreme events are increasing and become less predictable. Coupled with poor land-use planning and management practices which threaten the quality of our source waters and environment. There is a need for system(s) that assist decision-making that is data driven and contextualised.

The Inkomati-Usuthu Catchment Management Agency (IUCMA) developed an early warning system tool called “Disaster Early Warning System for the Inkomati-Usuthu Catchment Management Agency”. The tool supports the implementation of flood, drought, and pollution disaster protocols. It is based on a disaster incident classification scheme for floods and droughts according to interpretations (by an operator/operators) and scoring of a wide range of indicators (weather forecasts, stream flow, dam levels, river water

levels, formation of cyclones, vegetation condition, etc.) (IUCMA, 2022a)[1]. The system depends on data and operator skill to develop early warning classes for flood events, droughts, and pollution. It uses a colour classification of blue, red, amber, and green to show severity (IUCMA, 2022a). The system was developed and accompanied by an Operator Manual (IUCMA, 2022b)[2]. The credibility and quality of the predictions can be improved over time by revising indicator weights and incident status thresholds after the comparisons of predictions with the situation on the ground. The EWS protocol that is embedded provides for a series of checks and balances in the form of supervisor approvals at various stages of the assessments. The system is being implemented in the Inkomati-Usuthu Water Management Area and was initially developed through the Programme for Progressive Realisation of the IncoMaputo Agreement (PRIMA)[3] for the Incomati and Maputo Basins to contain and manage water disasters using mainly open-source software and tools. The model and associated codes are open source. The existing platform details are in Annexure 1. There is scope to include other early warning systems, tools and models into the model to develop a multi-hazard model for different applications and sectors, like agriculture. Access to a variety of application layers will enable users to select additional tools to suite their contexts and needs. Examples of existing open source tools include, but not limited to, (1) Integrated Water Resources Decision Support System (INWARDs), (2) Strategic Source Water Areas, etc.

It is proposed to improve, adapt, and extend the developed system to cover all Water Management Areas and to downscale it to different administrative and hydrological units for contextual decision-making. This will entail building into the system other components such as available open source climate weather, hydrological forecasts and water quality risk indicators available from WRC projects and relevant institutions. The system development will also be accompanied by operator training and decision-making awareness building. The aims of the system will:

1. Improve data collection and curation.
2. Provide early warning and near real-time advisories on potential droughts, floods, and pollution to decision-makers.
3. Provide data gaps and identify needs and investments required.

The system should be set up at a national scale, using localised data and information, to provide risk indicators at various scales—localised, catchment or WMA. It can build on initiatives by various institutions like WRC, DWS, DFFE, SANSA, among others, to build a powerful decision-making tool. Further development, as an example, can include aspects of machine learning and citizen science tools and initiatives.

Deliverables:

Below reports are available on request – gerdak@wrc.org.za

[1] IUCMA (2022a). Disaster Early Warning System for the Inkomati-Usuthu Catchment Management Agency: Volume 1: System Report. IUCMA, Mpumalanga.

[2] IUCMA (2022b). Disaster Early Warning System for the Inkomati-Usuthu Catchment Management Agency: Volume 2: Operator's Manual. IUCMA, Mpumalanga.

[3]Information Management System Handbook (2011): Consultancy Services for the project on Disaster Management in the Incomati and Maputo Watercourses Progressive Realization of the Inco-Maputo Agreement (PRIMA), IAAP5

1. Inception and conceptualisation report
2. System setup and report
3. User manual
4. Training manual(s) and Training of users
5. Print-ready final report and system handover

Time Frame:
24 months

Total Funds Available:
R 2 000 000
Year 1: R1000 000

Annexure 1

Component		Technology	Comment
1.	Web API backend	Django REST Framework (Python)	Open source, all source code made available.
2.	Browser frontend	Quasar / Vue JS	Open source, all source code made available.
3.	DARE desktop engine (Risk assessment)	Delphi XE7	All source codes developed will be made available. Source code of commercial third-party components is not available. The entire system will be moved to open source.
4.	Hydrological and hydrodynamic models	HEC suite	Open source. All software, model configurations and data will be made available.
5	Server Requirements	N/A	Ideal specifications for the cloud server are: • 8 core CPU • 16 GB RAM • 400 GB HDD • Ubuntu Linux 18.04 LTS Operating system