DRAFT ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR THE UMGUNGUNDLOVU DISTRICT MUNICIPALITY: Water Quality Specialist Report

Institute of Natural Resources

DRAFT ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR THE UMGUNGUNDLOVU DISTRICT MUNICIPALITY

WATER QUALITY SPECIALIST REPORT

Prepared For

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1. INTRODUCTION

The water resources associated with the uMgungundlovu District Municipality are critical resources, not only for the District, but also for the Province of KwaZulu Natal and for the country as a whole. The upper catchments of three important rivers, the Mngeni, Mooi and Mkomazi Rivers are all located partially or wholly within the District's boundary. These critical resources provide water for the provincial capital and the economic heart of the province in the Pietermaritzburg / Ethekwini corridor either directly (Mngeni) or via inter-basin transfer schemes. The quality of the water in these systems is thus of utmost importance, not only for the economic prosperity of the Province, but also for the vast numbers of people who are wholly and directly reliant on these resources for their basic water needs and for the aquatic ecosystems which sustain the resources.

The EMF Water Quality study aims to emphasise the importance of these resources, particularly those that are vital for environmental and economic sustainability, but also those which are currently under pressure with respect to water quality.

2. APPROACH TO THE ASSESSMENT OF WATER QUALITY FOR THE EMF

The EMF Water Quality Specialist study has aimed to identify important areas not only from the perspective of important and vulnerable supply points, but also from an existing quality perspective. Importantly, this has not been limited to water courses, but has assessed catchment areas and their potential impacts on water resources. The quinnary catchment was selected as the base unit of assessment for the Water Quality study. This was in order to gain a finer level of resolution than that afforded by the more-often used quaternary catchments and to ensure continuity with the water production specialist study. The assessment has two principle components:

1. The current water quality situation has been assessed using water quality data supplied by the Department of Water and Sanitation and by Umgeni Water. These data are associated with specific monitoring points located strategically in the catchment. Catchments have been delineated for each of these monitoring points to provide a spatial impression of areas impacting on the water quality at the monitoring point. These catchments extend upstream of the monitoring point either:
    a. up to the next monitoring point upstream, or
    b. if there is no upstream monitoring point, to the top of the watershed

    This data provides measured information providing insight to areas monitored by existing monitoring points. The limitation of this approach is the limited number and distribution of monitoring points. This means that large areas of the District have no data with respect to water quality. For this reason, the ALARM tool has been used to provide a modelled indication of water quality across the district in order to supplement the measured data.

2. Quinnary catchments have been assessed using the ALARM tool for assessing the impact of land based activities on water quality. This tool identifies high risk catchments based on:
    a. point sources of pollution using information captured by the water quality study
    b. diffuse sources of pollution modelled in ALARM using land use data and export co-efficient derived export potentials.

Water quality status quo in uMgungundlovu DM

As it is not feasible to assess every pollutant potentially occurring in the district, catchment monitoring data was assessed to identify problematic pollutant groups in the District. The pollutant groups were based on the groups used in the ALARM tool and are as follows:

1. Nutrients
2. Dissolved Salts
3. Suspended Solids
4. Bacteria / microbiological variables
5. Toxins

Based on this initial screening, the following conclusions could be drawn:

1. Nutrient loading is a significant concern in several of the monitored rivers. Nutrient loading is responsible for significant water quality problems in key resources and can result in significant damage to aquatic ecosystems. This group is thus included in the EMF evaluation and total inorganic nitrogen and soluble reactive phosphate are included as indicators.
2. Electrical conductivity data indicates that dissolved salts are largely at natural concentrations across the district, though they do increase slightly in the lower catchments. This group is thus not considered for further evaluation.
3. The Department of Water and Sanitation does not monitor Suspended Solids or Turbidity routinely and thus data for this group is limited to the Umgeni Water data set. Thresholds for this determinand are difficult to define given that natural ranges are so varied. The group is thus not included in the assessment although it is acknowledged that it is an important parameter in impacting both ecosystems and water supply infrastructure.
4. Elevated E.coli counts are evident in much of the monitoring data and indicate faecal / sewage contamination. Faecal contamination is an important consideration given its links to disease. This group is thus included in the EMF evaluation, with E.coli being the most suitable available indicator.
5. There is insufficient data to assess determinands in the toxic group as these are not routinely monitored by DWS or Umgeni Water. Additionally, there are few sources of contaminants belonging to this group in the catchment. This group is thus not considered for further evaluation.

Water quality sensitivity assessment

Definition of sensitivity

For the purposes of this study, sensitive catchments have been defined as catchments where land use activities have the potential to result in an impact to sensitive receiving environment (such as a water supply dam or a sensitive ecosystem), or catchments where the water quality is already compromised, and thus any further loss of quality poses concomitant increased risks to users.

Ecological sensitivity

The ecological sensitivity of catchments was assessed by consulting the PES-EIS data for the river reaches of the District (Department of Water and Sanitation). This information provides measurements of the Present Ecological State and the Ecological Importance and Sensitivity of each

reach. The Ecological sensitivity data indicates that all of the reaches of the District are either high or very highly sensitive and so this provides little in the way of differentiation between catchments. For the purposes of this study, all catchments are thus considered sensitive and the water quality guidelines developed as part of this EMF take this into account.

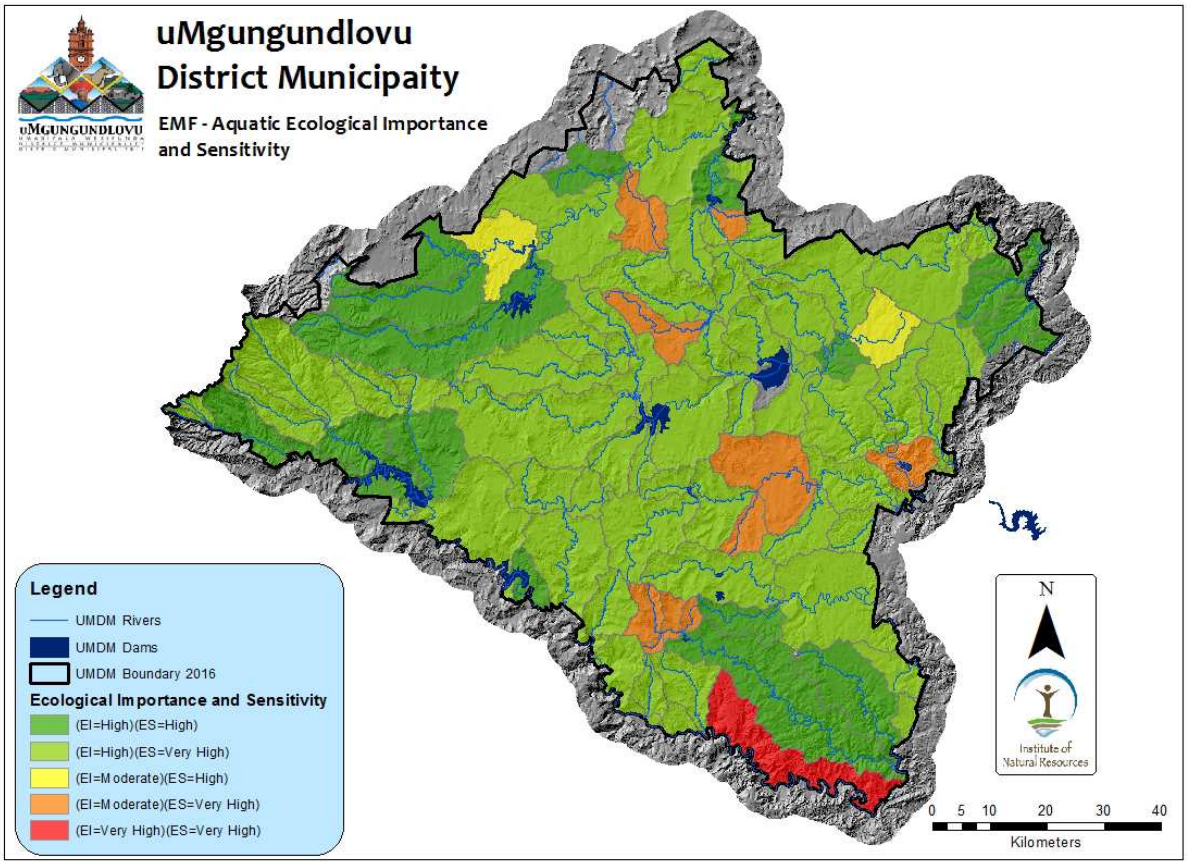

Figure 1: Ecological Importance and Sensitivity of the catchments of uMgungundlovu DM.

Water supply infrastructure

The sensitivity of the District's quinnary catchments has been classified according to their spatial relationship to key water supply infrastructure. Importantly, dams planned as part of the Mkomazi inter-basin transfer scheme have been included in this assessment.

1. Catchments which contain key water supply infrastructure are classified as **critical impact catchments**.
2. Catchments immediately upstream of critical catchments are classified as **proximal impact catchments**.
3. Catchments upstream of proximal catchments are classified as **distal impact catchments.**
4. Remaining catchments are classified as **Non-impacting catchments.**

Existing water quality status

The sensitivity of all catchments is additionally classified according to their existing water quality status. Quinnaries have been scored based on the outcomes of the assessment of the measured monitoring data and on the modelled outputs of the ALARM tool.

1. **Measured data -** The water quality information gathered from the monitoring points in the catchment has been classified by comparing it to recognised screening values to identify areas under pressure from a water quality perspective (Figure 3). The following screening values have been used:

2.

Table 1: Screening values used to identify sensitive catchments

Variable	Screening value	Source of screening value
Soluble Reactive Phosphate	Average >0.025mg P/l (Eutrophic threshold)	South African Water Quality Guidelines for Aquatic Ecosystems (DWAF 1996)
Total Inorganic Nitrogen	Average >2.5mg N/l (Eutrophic threshold)	South African Water Quality Guidelines for Aquatic Ecosystems (DWAF 1996)
E.coli	600 cfu/100ml	South African Water Quality Guidelines for Domestic Use (DWAF 1996)

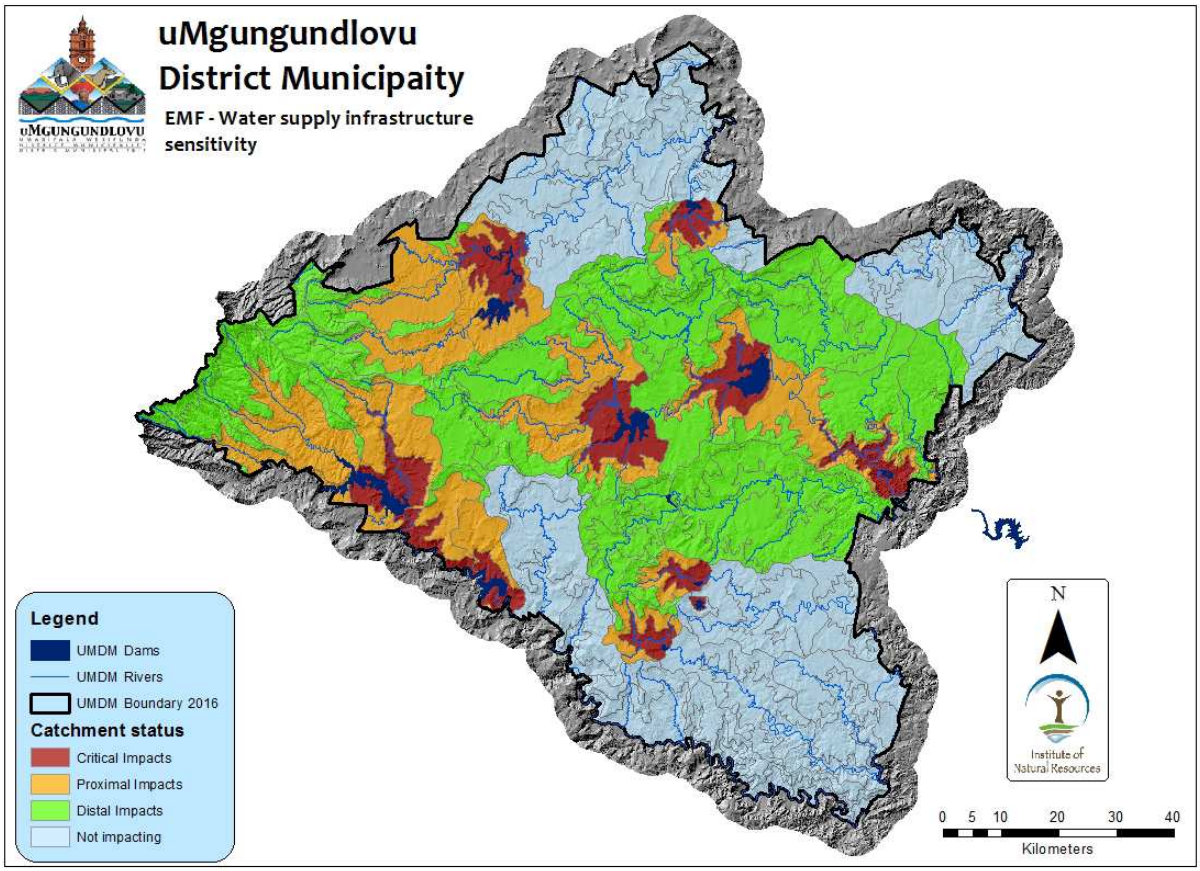

Figure 2: Classification of quinnary catchments with respect to their impacts on water supply infrastructure

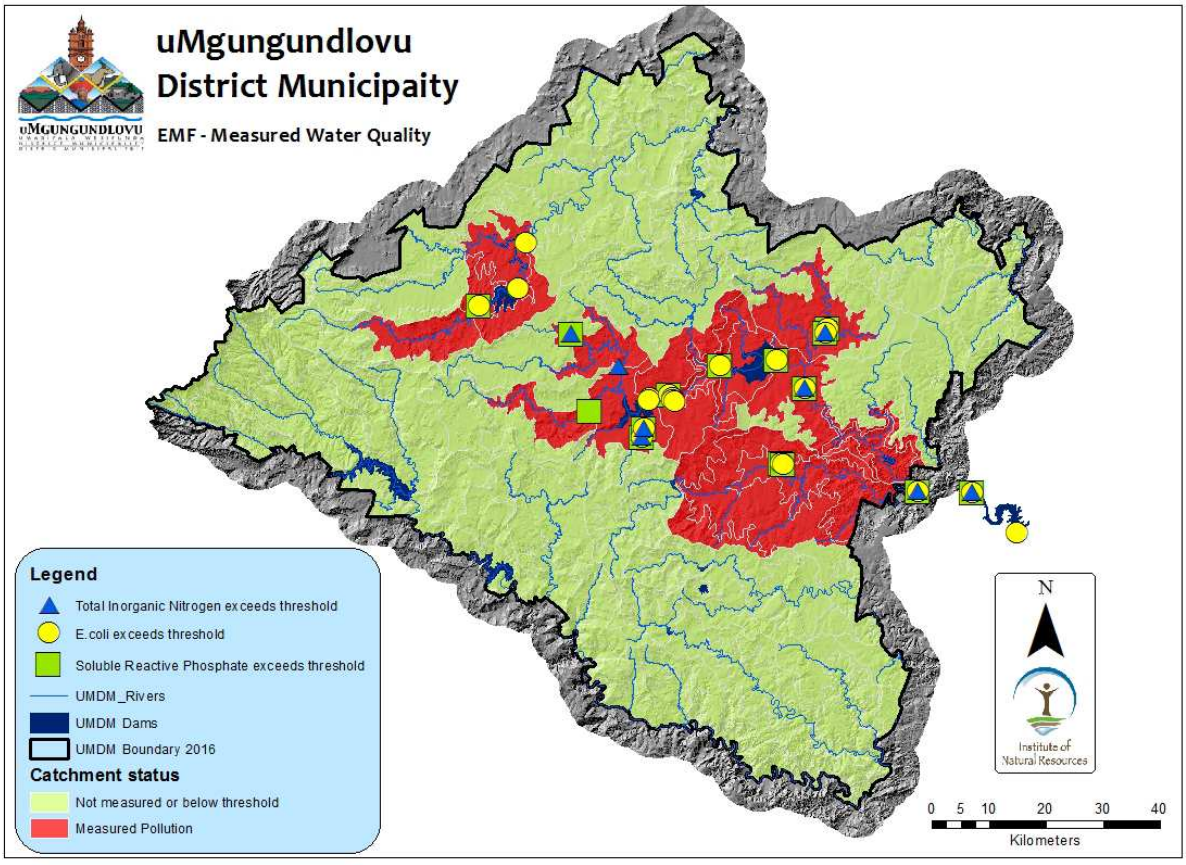

Figure 3: Catchment status based on monitoring data results

3. **Modelled Data –** The outputs of an ALARM assessment have been used to provide a classification of catchments in the absence of monitoring data. Land cover/use is used to identify areas where there is a high potential for diffuse pollution impacts. Point source data captured during this project are used to identify catchments where point source discharges have a high potential to negatively impact water quality.

The ALARM scores for diffuse pollution potential for each of the catchments were classified using the a threshold of the mean value plus one standard deviation to identify areas where diffuse pollution potentially contributes significantly to nutrient loading.

Activities with the potential to generate point sources of pollution were scored according to their potential to impact a catchment from a nutrient and bacteria perspective relative to a waste water treatment works, which is assumed to have the highest potential for such pollution. The following scores were used:

Table 2: Relative potential of point source types to impact nutrient and bacteria loading

Horse Stud	Dairy	Piggery	WWTW	Poultry	Crocodiles	Greenhouse	Feedlot	Industry
0.1	0.7	0.7	1.0	0.3	0.4	0.1	0.9	0.8

The product of the number of occurrences of a point source type and its score was calculated for each catchment and the scores for each point source type summed to get a total for each catchment. Catchments scoring higher than 5.4 were selected as being sensitive from a point source perspective. The outcomes of this assessment are illustrated in Figure 4.

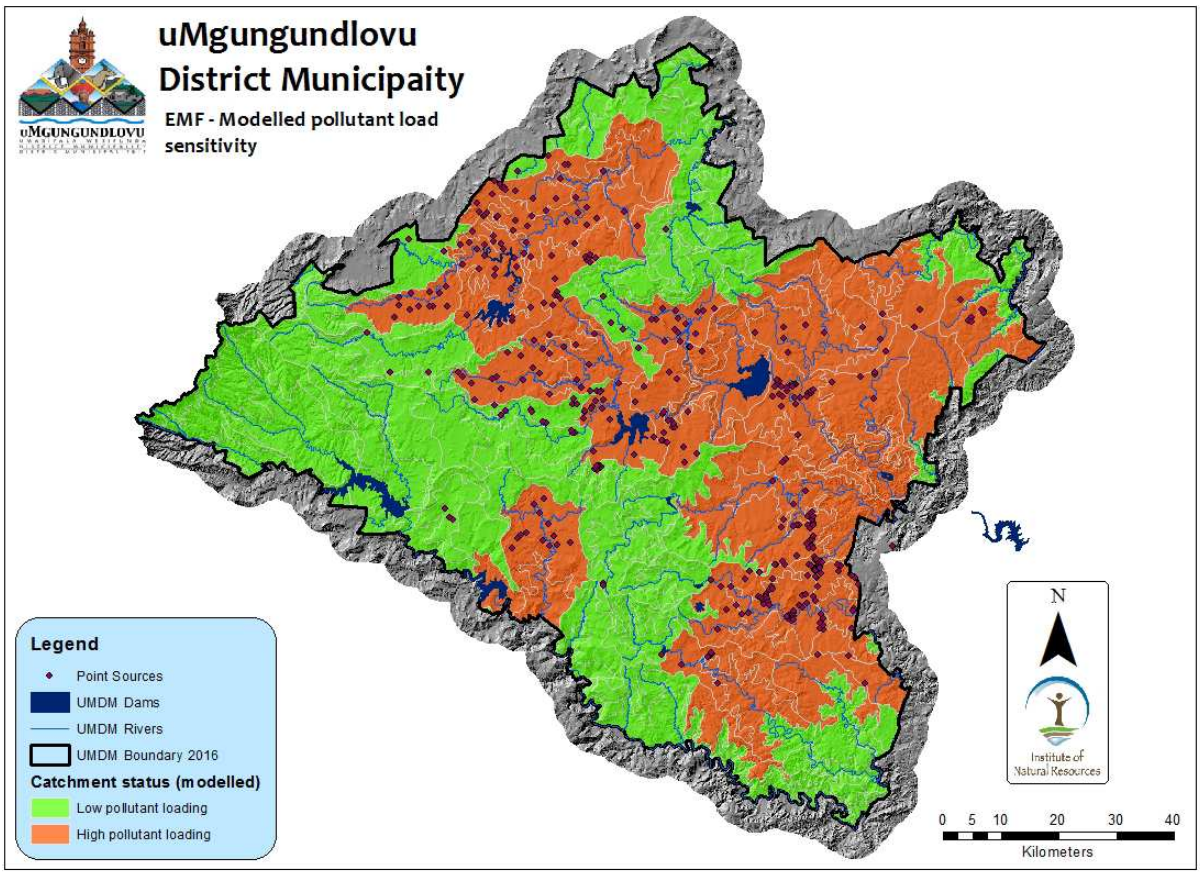

Figure 4: Catchment status with respect to modelled sources of pollution

3. WATER QUALITY ZONE DELINEATION RESULTS

Water quality zones have been established based on the assessment of the various input layers. These are listed and shown in Table 3 and Figure 5. Development objectives with respect to water quality have been developed for each of these zones. These are presented in Table 4.

Table 3: Description of water quality zones and their sensitivity rating

Catchment Features	Sub-features (catchment WQ status)	Zone	Sensitivity
Catchments containing key water supply features	All such catchments	WQ_1	4
Proximal catchments influencing key supply features	with measured elevated pollutant concentrations	WQ_2	4
	with high potential for elevated pollutant concentrations	WQ_3	4
	with low pollutant concentrations	WQ_4	3
Distal catchments influencing key supply features	with measured elevated pollutant concentrations	WQ_5	3
	with high potential for elevated pollutant concentrations	WQ_6	3
	with low pollutant concentrations	WQ_7	2
Catchments not influencing key supply features	with measured elevated pollutant concentrations	WQ_8	2
	with high potential for elevated pollutant concentrations	WQ_9	2
	with low pollutant concentrations	WQ_10	1

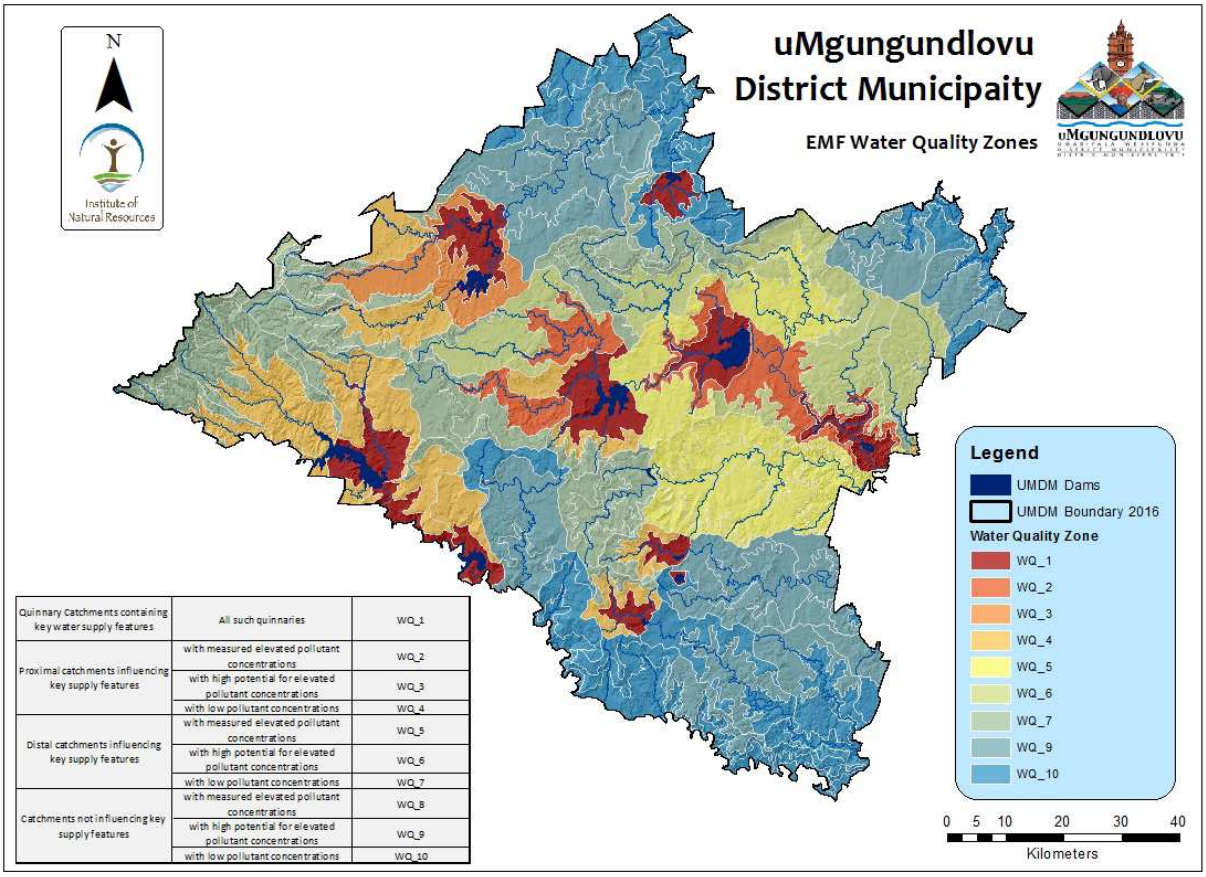

Figure 5: Spatial representation of water quality zones

Table 4: Development objectives and EIA guidelines for water quality zones.

SENSITIVITY	FEATURE	DEVELOPMENT PLANNING OBJECTIVES	EIA GUIDELINES
Very High Sensitivity	**WQ Zone 1** Quinnary Catchments containing key water supply features	No increase in loading of pollutants, particularly nutrients, sediments and microbiological contaminants. Any waste generated in these areas must be treated and discharged outside of WQ_1 areas. Only activities which have a negligible impact on water quality should be permitted in these areas. These are typically activities that: 1. do not generate large volumes of waste i.e. activities associated with low numbers of people, and, 2. activities that do not carry a significant spill pollution risk (fuel and hazardous substance storage and manufacture) and, 3. activities with limited landscape disturbance (where sediment generation can be meaningfully controlled).	A water quality impact study must be undertaken, to determine the proposed development's impact on the key water resources in this catchment and immediately downstream of it. This should assess the impacts broadly, but specifically take into account: 1. The impact of waste generated in and by the development and its proposed disposal 2. Cumulative impacts of existing activities located in the critical and proximal catchments particularly with respect to nutrient loading and bacteria contamination, 3. The potential contribution of the development to eutrophication of the water resource, and 4. The potential sedimentation impacts associated with construction projects. The impact study must also assess the impact of the proposed activity on the sensitive aquatic ecology of the catchment. Any proposed activity must abide by the requirements of the Resource Quality Objectives for the catchment and by requirements of any water use licence issued in respect of the activity.
Very High Sensitivity	**WQ Zone 2** Proximal catchments influencing key supply features with **measured** elevated pollutant concentrations	These areas have no capacity to absorb further contamination. Activities undertaken here should be limited to activities which have a negligible impact on water quality. 1. Where discharge of waste is unavoidable, effluent should be environmentally neutral (nutrient and microbiological concentrations should be the same as or lower than receiving environment concentration to increase dilution) 2. Only activities which will impose no discernible change from present nutrient and microbiological concentrations via diffuse sources should be permissible.	
Very High Sensitivity	**WQ Zone 3** Proximal catchments influencing key supply features with **high potential** for elevated pollutant concentrations	WQ status in these areas should be confirmed through monitoring before decisions are made regarding development. If monitoring indicates contamination to be low, activities should follow guidelines for WQ4 areas. Subject to confirmation of elevated pollutant loads (particularly nutrients and bacteria), activities undertaken here should be limited to activities with a negligible impact on water quality. 1. Where discharge of waste is unavoidable, effluent should be environmentally neutral (nutrient and microbiological concentrations should be the same as or lower than receiving environment concentration to increase dilution) 2. Only activities which will impose no discernible change from present nutrient and microbiological concentrations via diffuse sources should be permissible.	
High Sensitivity	**WQ Zone 4** Proximal catchments influencing key supply features with low pollutant concentrations	The good water quality in these areas should be confirmed through monitoring (if required) and preserved. Developments in these areas should exclude activities with the requirement to discharge large quantities of liquid waste to the environment (i.e. point source discharges) or activites with a high potential for spills and stormwater contamination. Mitigation of risks can	

High Sensitivity	**WQ Zone 5** Distal catchments influencing key supply features with **measured** elevated pollutant concentrations	Amelioration of pollution by the river downstream of these areas means that they are less sensitive than proximal areas. Existing high pollutant loads however means that this service is already being heavily utilised. Activities undertaken in these areas should be limited to those with a low to moderate impact on water quality.	A water quality impact study must be undertaken, to determine the proposed development's impact on the sensitive aquatic ecology of the catchment and on the water resources located downstream of this catchment. This should assess the impacts broadly, but specifically take into account: 1. The impact of waste generated in and by the development and its proposed disposal 2. Cumulative impacts of the proposed development together with existing activities located in the downstream catchments particularly with respect to nutrient loading Any proposed activity must abide by the requirements of the Resource Quality Objectives for the catchment and by requirements of any water use licence issued in respect of the activity.
High Sensitivity	**WQ Zone 6** Distal catchments influencing key supply features with **high potential** for elevated pollutant concentrations	Modelling suggests that these areas show high pollutant loading. Amelioration of pollution by the river downstream of these areas means that they are less sensitive than proximal areas. Existing high pollutant loads means that the amelioration ecosystem service is already being heavily utilised. Activities undertaken in these areas should be limited to those with a low to moderate impact on water quality.	
Medium Sensitivity	**WQ Zone 7** Distal catchments influencing key supply features with low pollutant concentrations	All catchments in the study area are considered important and sensitive from an ecological perspective (see ecological importance and sensitivity map). This means that catchments with lower pollutant loads are still important from a water quality perspective as they provide dilution capacity and support important and sensitive ecosystems. Activities in these catchments should ensure any waste generated is treated to standards reflecting the ecological sensitivity of the receiving environment.	
Medium Sensitivity	**WQ Zone 8** Catchments not influencing key supply features with **measured** elevated pollutant concentrations	All catchments in the study area are considered important and sensitive from an ecological perspective (see ecological importance and sensitivity map). This means that catchments not influencing key supply features are still important from a water quality perspective. Catchments with high pollutant loads should thus be treated carefully. Activities in these catchments should ensure any waste generated is treated to standards reflecting the ecological sensitivity of the receiving environment. All development activities should take the Resource Quality objectives into account and abide by required water quality standards contained therein. All requirements of any water use licence issued must be abided by.	A water quality impact study must be undertaken, to determine the proposed development's impact on the sensitive aquatic ecology of the catchment. This should assess the impacts broadly, but specifically take into account: 1. The impact of waste generated by the development and its proposed disposal 2. Cumulative impacts of the proposed development together with existing activities located in the downstream catchments particularly with respect to nutrient loading
Medium Sensitivity	**WQ Zone 9** Catchments not influencing key supply features with **high potential** for elevated pollutant concentrations	All catchments in the study area are considered important and sensitive from an ecological perspective (see ecological importance and sensitivity map). This means that catchments not influencing key supply features are still important from a water quality perspective. Catchments with high pollutant loads should thus be treated carefully. Activities in these catchments should ensure waste is treated to All development activities should take the Resource Quality objectives into account and abide by required water quality standards contained therein. All requirements of any water use licence issued must be abided by.	

Low Sensitivity	**<u>WQ Zone 10</u>** Catchments not influencing key supply features with low pollutant concentrations	All catchments in the study area are considered important and sensitive from an ecological perspective (see ecological importance and sensitivity map). This means that catchments not influencing key supply features are still important from a water quality perspective. Catchments with high pollutant loads should thus be treated carefully. Activities in these catchments should ensure waste is treated to All development activities should take the Resource Quality objectives into account and abide by required water quality standards contained therein. All requirements of any water use licence issued must be abided by.	Any proposed activity must abide by the requirements of the Resource Quality Objectives for the catchment and by requirements of any water use licence issued in respect of the activity.

CLASSIFICATION OF WATER QUALITY IMPACTS BY LAND USE ACTIVITIES

The typical impacts of the listed land use activities on water quality zones were scored from one – four, with one being low or no perceptible impact and four being an obvious and significant negative impact. The sensitivity of the water quality zone to each particular land use activity is represented by the same score which thus then also represents the level of constraint imposed by water quality sensitivity on each specific land use activity. These scores are shown in Table 3.

Table 5: Impact scores of the listed land use activites on the water quality zones

Land use	WQ_1	WQ_2	WQ_3	WQ_4	WQ_5	WQ_6	WQ_7	WQ_8	WQ_9	WQ_10
Extensive Crop Production	2	2	2	1	2	2	1	1	1	1
Intensive Crop Production	2	2	2	1	2	2	1	1	1	1
Agri-Industry	4	4	4	3	2	2	1	2	2	1
Intensive Animal Production	4	4	4	4	3	3	3	2	2	2
Extensive Animal Production	1	1	1	1	1	1	1	1	1	1
Forestry	4	2	2	1	2	2	1	1	1	1
Civic and Social	3	2	2	2	2	2	1	2	2	1
Cemetery	3	1	1	1	1	1	1	1	1	1
Intense Mixed Use	4	3	3	3	2	2	1	2	2	1
Medium Mixed Use	3	2	2	2	1	1	1	1	1	1
Residential Only Detached	3	1	1	1	1	1	1	1	1	1
Residential Medium Density	4	3	3	2	2	2	1	2	2	1
Smallholdings	2	1	1	1	1	1	1	1	1	1
Small Tourism	2	1	1	1	1	1	1	1	1	1
Medium Tourism	3	2	2	1	1	1	1	1	1	1
Large Tourism	4	3	3	2	2	2	1	2	2	1
Airport	4	3	3	3	2	2	2	2	2	1
Railways and Roads	3	1	1	1	1	1	1	1	1	1
Transport Focus Points	3	1	1	1	1	1	1	1	1	1
Solid Waste Site	4	4	4	4	3	3	2	2	2	1
Waste Water Treatment	4	4	4	4	3	3	2	2	2	1
Bulk Linear Infrastructure	2	1	1	1	1	1	1	1	1	1
Environmental Services / Conservation	1	1	1	1	1	1	1	1	1	1
Active Open Space	2	1	1	1	2	1	1	1	1	1
Passive Open Space	2	1	1	1	1	1	1	1	1	1
Nature Reserve	1	1	1	1	1	1	1	1	1	1
Dam	1	1	1	1	1	1	1	1	1	1
Nature and Culture Based Tourism	1	1	1	1	1	1	1	1	1	1
Extractive Industry / Quarrying / Mining	4	4	4	4	3	3	2	3	3	2
Noxious Industry	4	4	4	4	3	3	3	2	2	2
Logistics Hub	3	2	2	2	1	1	1	1	1	1
Light Industry	3	3	3	3	2	2	1	2	2	1